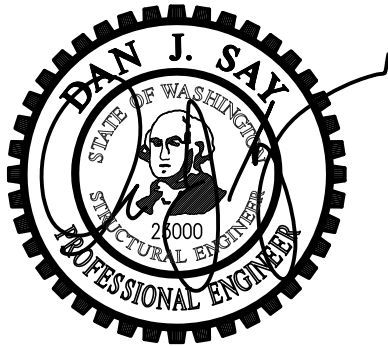Supplemental Structural Calculations for:

# Huber Residence

9611 SE 72nd St

Mercer Island, WA 98040

Prepared for: Brandt Design Group

Job #: 01519-2021-06

Date: April 19, 2022

# Cantilevered Retaining Wall

Project File: Typical Detail Co-04-06.EC6

LIC# : KW-06014947, Build:20.22.3.31     SWENSON SAY FAGET     (c) ENERCALC INC 1983-2022

**DESCRIPTION:** Retaining Wall Schedule 12'-0" Retaining Wall
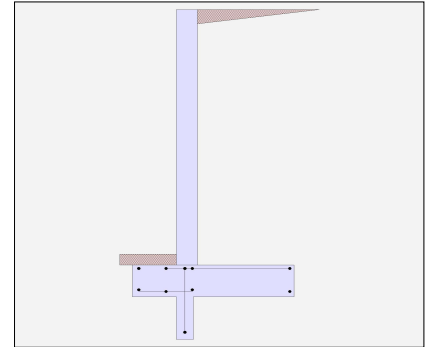
## Code References

Calculations per IBC 2018 1807.3, CBC 2019, ASCE 7-16

## Criteria

| | | |
|---|---|---|
| Retained Height | = | 12.00 ft |
| Wall height above soil | = | 0.00 ft |
| Slope Behind Wall | = | 0.00 |
| Height of Soil over Toe | = | 6.00 in |
| Water height over heel | = | 0.0 ft |

## Soil Data

| | | |
|---|---|---|
| Allow Soil Bearing | = | 3,000.0 psf |
| Equivalent Fluid Pressure Method | | |
| Active Heel Pressure | = | 35.0 psf/ft |
| | = | |
| Passive Pressure | = | 300.0 psf/ft |
| Soil Density, Heel | = | 125.00 pcf |
| Soil Density, Toe | = | 0.00 pcf |
| Footing||Soil Friction | = | 0.300 |
| Soil height to ignore for passive pressure | = | 12.00 in |

## Surcharge Loads

| | | |
|---|---|---|
| Surcharge Over Heel | = | 0.0 psf |
| Used To Resist Sliding & Overturning | | |
| Surcharge Over Toe | = | 0.0 |
| 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 |

## Lateral Load Applied to Stem

| | | |
|---|---|---|
| Lateral Load | = | 0.0 #/ft |
| ...Height to Top | = | 0.00 ft |
| ...Height to Bottom | = | 0.00 ft |
| Load Type | = | Wind (W) |
| | | (Service Level) |
| Wind on Exposed Stem (Strength Level) | = | 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 | | Spread Footing |
| Base Above/Below Soil at Back of Wall | = | 0.0 ft |
| Poisson's Ratio | = | 0.300 |

# Cantilevered Retaining Wall

Project File: Typical Detail Co-04-06.EC6

LIC# : KW-06014947, Build:20.22.3.31     SWENSON SAY FAGET     (c) ENERCALC INC 1983-2022

**DESCRIPTION:** Retaining Wall Schedule 12'-0" Retaining Wall

## Design Summary

**Wall Stability Ratios**

| | | | |
|---|---|---|---|
| Overturning | = | 2.38 | OK |
| Sliding | = | 1.54 | OK |
| Global Stability | = | 1.87 | |

| | | | |
|---|---|---|---|
| Total Bearing Load | = | 8,893 | lbs |
| ...resultant ecc. | = | 11.76 | in |

| | | | |
|---|---|---|---|
| Soil Pressure @ Toe | = | 2,656 psf | OK |
| Soil Pressure @ Heel | = | 116 psf | OK |
| Allowable | = | 3,000 psf | |

Soil Pressure Less Than Allowable

| | | | |
|---|---|---|---|
| ACI Factored @ Toe | = | 3,718 psf | |
| ACI Factored @ Heel | = | 162 psf | |
| Footing Shear @ Toe | = | 10.0 psi | OK |
| Footing Shear @ Heel | = | 17.4 psi | OK |
| Allowable | = | 75.0 psi | |

**Sliding Calcs**

| | | | |
|---|---|---|---|
| Lateral Sliding Force | = | 3,189.4 lbs | |
| less 100% Passive Force | - | 2,250.0 lbs | |
| less 100% Friction Force | ≅ - | 2,667.8 lbs | |
| Added Force Req'd | = | 0.0 lbs | OK |
| ....for 1.5 Stability | = | 0.0 lbs | OK |

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

**Load Factors**

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

## Stem Construction

| | | Bottom | | | | |
|---|---|---|---|---|---|---|
| | | Stem OK | | | | |
| **Design Height Above Ftg** ft = | | 0.00 | | | | |
| Wall Material Above "Ht" | = | Concrete | | | | |
| Design Method | = | SD | SD | SD | SD | SD |
| Thickness | = | 10.00 | | | | |
| Rebar Size | = | # 7 | | | | |
| Rebar Spacing | = | 9.00 | | | | |
| Rebar Placed at | = | Edge | | | | |

**Design Data**

| | | |
|---|---|---|
| fb/FB + fa/Fa | = | **0.676** |

**Total Force @ Section**

| | | |
|---|---|---|
| Service Level | lbs = | |
| Strength Level | lbs = | 4,032.0 |

**Moment....Actual**

| | | |
|---|---|---|
| Service Level | ft-# = | |
| Strength Level | ft-# = | 16,128.0 |
| Moment.....Allowable | = | 23,826.6 |

**Shear.....Actual**

| | | |
|---|---|---|
| Service Level | psi = | |
| Strength Level | psi = | 44.4 |
| Shear.....Allowable | psi = | 75.0 |
| Anet (Masonry) | in2 = | |
| Wall Weight | psf = | 125.0 |
| Rebar Depth 'd' | in = | 7.56 |

**Masonry Data**

| | | |
|---|---|---|
| f'm | psi = | |
| Fs | psi = | |
| Solid Grouting | = | |
| Modular Ratio 'n' | = | |
| Equiv. Solid Thick. | = | |
| Masonry Block Type | = | |
| Masonry Design Method | = | ASD |

**Concrete Data**

| | | |
|---|---|---|
| f'c | psi = | 2,500.0 |
| Fy | psi = | 60,000.0 |

## Cantilevered Retaining Wall

**DESCRIPTION:** Retaining Wall Schedule 12'-0" Retaining Wall

### Concrete Stem Rebar Area Details

| Bottom Stem | Vertical Reinforcing | Horizontal Reinforcing |
|---|---|---|
| As (based on applied moment) : | 0.4948 in2/ft | |
| (4/3) * As : | 0.6597 in2/ft | Min Stem T&S Reinf Area 2.880 in2 |
| 200bd/fy : 200(12)(7.5625)/60000 : | 0.3025 in2/ft | Min Stem T&S Reinf Area per ft of stem Height : 0.240 in2/ft |
| 0.0018bh : 0.0018(12)(10) : | 0.216 in2/ft | Horizontal Reinforcing Options : |
| | ============ | One layer of :     Two layers of : |
| Required Area : | 0.4948 in2/ft | #4@ 10.00 in     #4@ 20.00 in |
| Provided Area : | 0.8 in2/ft | #5@ 15.50 in     #5@ 31.00 in |
| Maximum Area : | 1.0245 in2/ft | #6@ 22.00 in     #6@ 44.00 in |

### Footing Data

| | | |
|---|---|---|
| Toe Width | = | 1.75 ft |
| Heel Width | = | 4.67 |
| Total Footing Width | = | 6.42 |
| Footing Thickness | = | 18.00 in |
| Key Width | = | 8.00 in |
| Key Depth | = | 24.00 in |
| Key Distance from Toe | = | 1.75 ft |

| | | | |
|---|---|---|---|
| f'c = 2,500 psi | Fy = | 60,000 psi | |
| Footing Concrete Density | = | 150.00 pcf | |
| Min. As % | = | 0.0018 | |
| Cover @ Top | 2.00 | @ Btm = 3.00 in | |

### Footing Design Results

| | | Toe | Heel |
|---|---|---|---|
| Factored Pressure | = | 3,718 | 162 psf |
| Mu' : Upward | = | 5,199 | 6,393 ft-# |
| Mu' : Downward | = | 528 | 15,203 ft-# |
| Mu: Design | = | 4,670 | 8,810 ft-# |
| phiMn | = | 37,413 | 29,913 ft-# |
| Actual 1-Way Shear | = | 9.96 | 17.42 psi |
| Allow 1-Way Shear | = | 75.00 | 75.00 psi |
| Toe Reinforcing | = # 7 @ 12.00 in | | |
| Heel Reinforcing | = # 6 @ 12.00 in | | |
| Key Reinforcing | = # 4 @ 10.55 in | | |
| Footing Torsion, Tu | = | 0.00 ft-lbs | |
| Footing Allow. Torsion, phi Tu | = | 0.00 ft-lbs | |

**If torsion exceeds allowable, provide**
**supplemental design for footing torsion.**

Other Acceptable Sizes & Spacings

   Toe:
   Heel:
   Key:

| | | |
|---|---|---|
| Min footing T&S reinf Area | 2.49 | in2 |
| Min footing T&S reinf Area per foot | 0.39 | in2 /ft |

If one layer of horizontal bars:     If two layers of horizontal bars:

   #4@ 6.17 in               #4@ 12.35 in
   #5@ 9.57 in               #5@ 19.14 in
   #6@ 13.58 in              #6@ 27.16 in

## Cantilevered Retaining Wall

**DESCRIPTION:**  Retaining Wall Schedule 12'-0" Retaining Wall

### Summary of Overturning & Resisting Forces & Moments

| Item | .....OVERTURNING..... | | | | .....RESISTING..... | | |
|---|---|---|---|---|---|---|---|
| | Force lbs | Distance ft | Moment ft-# | | Force lbs | Distance ft | Moment ft-# |
| HL Act Pres (ab water tbl) | 3,189.4 | 4.50 | 14,352.2 | Soil Over HL  (ab. water tbl) | 5,749.0 | 4.50 | 25,868.6 |
| HL Act Pres (be water tbl) | | | | Soil Over HL  (bel. water tbl) | | 4.50 | 25,868.6 |
| Hydrostatic Force | | | | Watre Table | | | |
| Buoyant Force | = | | | Sloped Soil Over Heel      = | | | |
| Surcharge over Heel | = | | | Surcharge Over Heel        = | | | |
| Surcharge Over Toe | = | | | Adjacent Footing Load     = | | | |
| Adjacent Footing Load | = | | | Axial Dead Load on Stem = | | | |
| Added Lateral Load | = | | | * Axial Live Load on Stem  = | | | |
| Load @ Stem Above Soil | = | | | Soil Over Toe                  = | | 0.88 | |
| | = | | | Surcharge Over Toe        = | | | |
| | | | | Stem Weight(s)              = | 1,500.0 | 2.17 | 3,250.0 |
| | | | | Earth @ Stem Transitions = | | | |
| **Total** | = | 3,189.4 | O.T.M. = | 14,352.2 | Footing Weight             = | 1,443.6 | 3.21 | 4,631.1 |
| | | | | Key Weight                   = | 200.0 | 2.08 | 416.7 |
| | | | | Vert. Component             = | | | |

**O.T.M.  =  14,352.2**

**Resisting/Overturning Ratio          =      2.38**
  Vertical Loads used for Soil Pressure =     8,892.6  lbs

**Total =    8,892.6  lbs   R.M.=        34,166.3**

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

Vertical component of active lateral soil pressure IS NOT considered in
the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in
the calculation of Overturning Resistance.

### Tilt

#### Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

| | | |
|---|---|---|
| Soil Spring Reaction Modulus | 250.0 | pci |
| Horizontal Defl @ Top of Wall (approximate only) | 0.138 | in |

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe,

because the wall would then tend to rotate into the retained soil.

## Cantilevered Retaining Wall

**DESCRIPTION:** Retaining Wall Schedule 12'-0" Retaining Wall

### Rebar Lap & Embedment Lengths Information

Stem Design Segment: Bottom
Stem Design Height:     0.00 ft above top of footing

| | |
|---|---:|
| Lap Splice length for #7 bar specified in this stem design segment = | 40.95 in |
| Development length for #7 bar specified in this stem design segment = | 31.50 in |
| | |
| Hooked embedment length into footing for #7 bar specified in this stem design segment = | 9.09 in |
| As Provided = | 0.8000 in2/ft |
| As Required = | 0.4948 in2/ft |

## Cantilevered Retaining Wall

**DESCRIPTION:** Retaining Wall Schedule 12'-0" Retaining Wall



10" w/ #7 @ 9"

12'-0"

6"

#7@12in
@ Toe

#4@10.55in
@ Center On Key

#6@12"
@ Heel

2

1'-6"

3"

2'-0"

1'-9"  8"  4'-0"

1'-9"  4'-8"

6'-5"
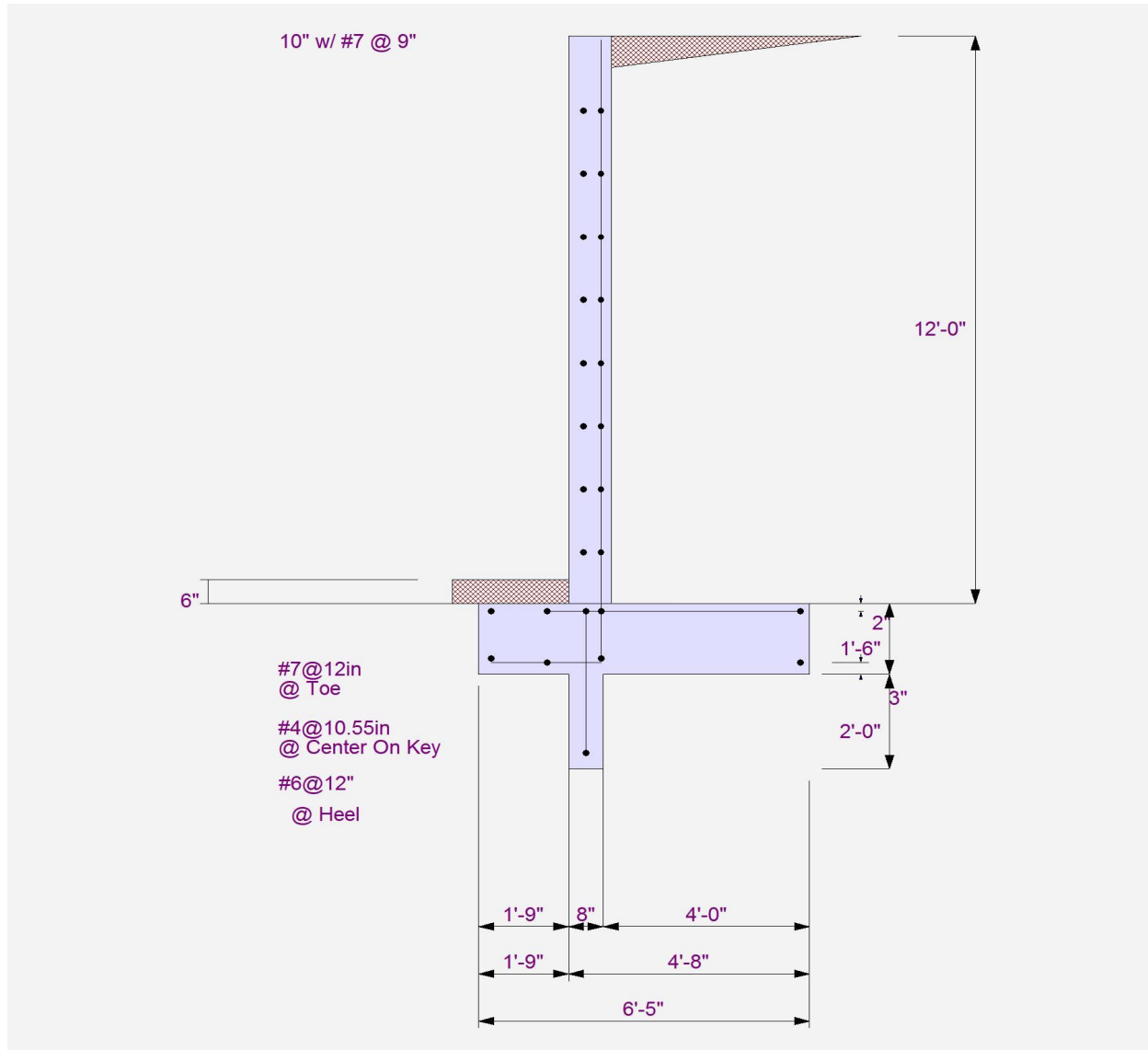
## Cantilevered Retaining Wall
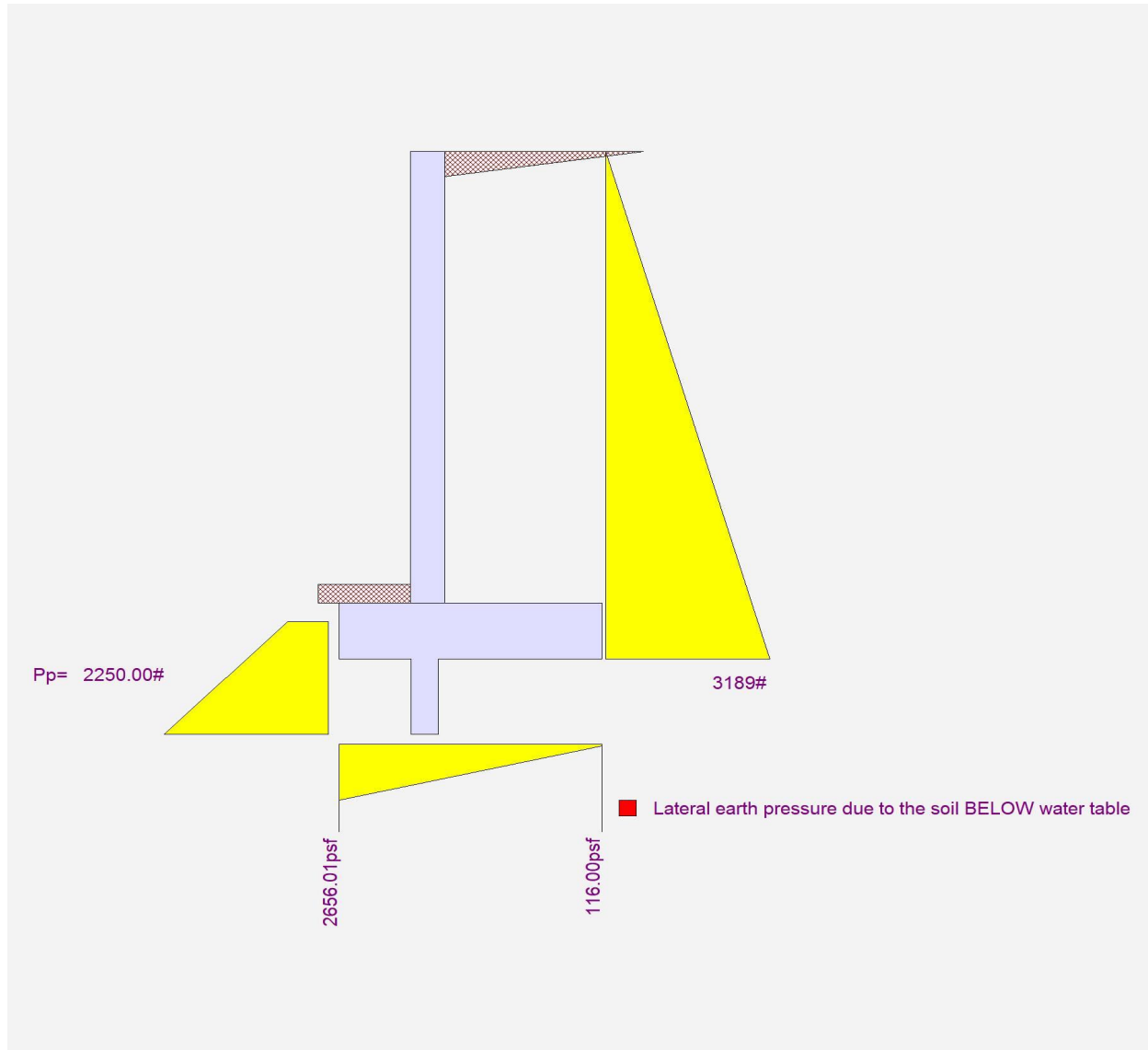
Project File: Typical Detail Co-04-06.EC6

LIC# : KW-06014947, Build:20.22.3.31          SWENSON SAY FAGET          (c) ENERCALC INC 1983-2022

**DESCRIPTION:**  Retaining Wall Schedule 12'-0" Retaining Wall

Pp=  2250.00#

3189#

■ Lateral earth pressure due to the soil BELOW water table

2656.01psf

116.00psf

# Cantilevered Retaining Wall

Project File: Typical Detail Co-04-06.EC6

LIC# : KW-06014947, Build:20.22.3.31    SWENSON SAY FAGET    (c) ENERCALC INC 1983-2022

**DESCRIPTION:** Retaining Wall Schedule 12'-0" Retaining Wall W/ Seismic
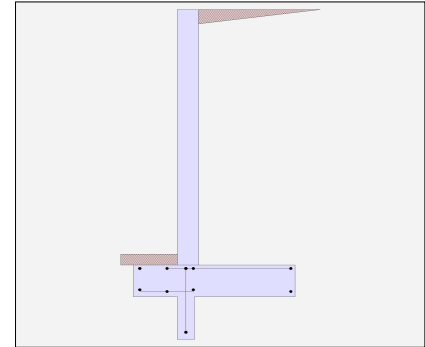
## Code References

Calculations per IBC 2018 1807.3, CBC 2019, ASCE 7-16

### Criteria

| | | |
|---|---|---|
| Retained Height | = | 12.00 ft |
| Wall height above soil | = | 0.00 ft |
| Slope Behind Wall | = | 0.00 |
| Height of Soil over Toe | = | 6.00 in |
| Water height over heel | = | 0.0 ft |

### Soil Data

| | | |
|---|---|---|
| Allow Soil Bearing | = | 4,000.0 psf |
| Equivalent Fluid Pressure Method | | |
| Active Heel Pressure | = | 35.0 psf/ft |
| | = | |
| Passive Pressure | = | 300.0 psf/ft |
| Soil Density, Heel | = | 125.00 pcf |
| Soil Density, Toe | = | 0.00 pcf |
| Footing||Soil Friction | = | 0.300 |
| Soil height to ignore for passive pressure | = | 12.00 in |



### Surcharge Loads

| | | |
|---|---|---|
| Surcharge Over Heel | = | 0.0 psf |
| Used To Resist Sliding & Overturning | | |
| Surcharge Over Toe | = | 0.0 |
| 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 |

### Earth Pressure Seismic Load

Method : Uniform
Multiplier Used    =    6.000
(Multiplier used on soil density)

### Lateral Load Applied to Stem

| | | |
|---|---|---|
| Lateral Load | = | 0.0 #/ft |
| ...Height to Top | = | 0.00 ft |
| ...Height to Bottom | = | 0.00 ft |
| Load Type | = | Wind (W) |
| | | (Service Level) |
| Wind on Exposed Stem | = | 0.0 psf |
| (Strength Level) | | |

| | | |
|---|---|---|
| Uniform Seismic Force | = | 81.000 |
| Total Seismic Force | = | 1,093.500 |

### 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 | | Spread Footing |
| Base Above/Below Soil at Back of Wall | = | 0.0 ft |
| Poisson's Ratio | = | 0.300 |

## Cantilevered Retaining Wall

Project File: Typical Detail Co-04-06.EC6

LIC# : KW-06014947, Build:20.22.3.31    SWENSON SAY FAGET    (c) ENERCALC INC 1983-2022

**DESCRIPTION:** Retaining Wall Schedule 12'-0" Retaining Wall W/ Seismic

### Design Summary

**Wall Stability Ratios**

| | | | |
|---|---|---|---|
| Overturning | = | 1.75 | OK |
| Sliding | = | 1.24 | Ratio < 1.5! |
| Global Stability | = | 1.87 | |

| | | | |
|---|---|---|---|
| Total Bearing Load | = | 8,893 | lbs |
| ...resultant ecc. | = | 18.73 | in |

| | | | |
|---|---|---|---|
| Soil Pressure @ Toe | = | 3,599 psf | OK |
| Soil Pressure @ Heel | = | 0 psf | OK |
| Allowable | = | 4,000 psf | |

Soil Pressure Less Than Allowable

| | | | |
|---|---|---|---|
| ACI Factored @ Toe | = | 5,039 psf | |
| ACI Factored @ Heel | = | 0 psf | |
| Footing Shear @ Toe | = | 13.7 psi | OK |
| Footing Shear @ Heel | = | 27.4 psi | OK |
| Allowable | = | 75.0 psi | |

**Sliding Calcs**

| | | | |
|---|---|---|---|
| Lateral Sliding Force | = | 3,954.8 lbs | |
| less 100% Passive Force | - | 2,250.0 lbs | |
| less 100% Friction Force | - | 2,667.8 lbs | |
| Added Force Req'd | = | 0.0 lbs | OK |
| ....for 1.5 Stability | = | 1,014.5 lbs | NG |

Vertical component of active lateral soil pressure IS
NOT considered in the calculation of soil bearing

**Load Factors**

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

### Stem Construction

| | | Bottom | | | | |
|---|---|---|---|---|---|---|
| | | Stem OK | | | | |
| Design Height Above Ftg | ft = | 0.00 | | | | |
| Wall Material Above "Ht" | = | Concrete | | | | |
| Design Method | = | SD | SD | SD | SD | SD |
| Thickness | = | 10.00 | | | | |
| Rebar Size | = | # 7 | | | | |
| Rebar Spacing | = | 9.00 | | | | |
| Rebar Placed at | = | Edge | | | | |

**Design Data**

| | | | |
|---|---|---|---|
| fb/FB + fa/Fa | = | **0.921** | |
| **Total Force @ Section** | | | |
| Service Level | lbs = | | |
| Strength Level | lbs = | 5,004.0 | |
| **Moment....Actual** | | | |
| Service Level | ft-# = | | |
| Strength Level | ft-# = | 21,960.0 | |
| Moment.....Allowable | = | 23,826.6 | |
| **Shear.....Actual** | | | |
| Service Level | psi = | | |
| Strength Level | psi = | 55.1 | |
| Shear.....Allowable | psi = | 75.0 | |
| Anet (Masonry) | in2 = | | |
| Wall Weight | psf = | 125.0 | |
| Rebar Depth 'd' | in = | 7.56 | |

**Masonry Data**

| | | |
|---|---|---|
| f'm | psi = | |
| Fs | psi = | |
| Solid Grouting | = | |
| Modular Ratio 'n' | = | |
| Equiv. Solid Thick. | = | |
| Masonry Block Type | = | |
| Masonry Design Method | = | ASD |

**Concrete Data**

| | | |
|---|---|---|
| f'c | psi = | 2,500.0 |
| Fy | psi = | 60,000.0 |

# Cantilevered Retaining Wall

Project File: Typical Detail Co-04-06.EC6

LIC# : KW-06014947, Build:20.22.3.31     SWENSON SAY FAGET     (c) ENERCALC INC 1983-2022

**DESCRIPTION:**  Retaining Wall Schedule 12'-0" Retaining Wall W/ Seismic

## Concrete Stem Rebar Area Details

| Bottom Stem | Vertical Reinforcing | Horizontal Reinforcing |
|---|---|---|
| As (based on applied moment) : | 0.6737 in2/ft | |
| (4/3) * As : | 0.8982 in2/ft | Min Stem T&S Reinf Area 2.880 in2 |
| 200bd/fy : 200(12)(7.5625)/60000 : | 0.3025 in2/ft | Min Stem T&S Reinf Area per ft of stem Height : 0.240 in2/ft |
| 0.0018bh : 0.0018(12)(10) : | 0.216 in2/ft | Horizontal Reinforcing Options : |
| | ============ | One layer of :        Two layers of : |
| Required Area : | 0.6737 in2/ft | #4@ 10.00 in        #4@ 20.00 in |
| Provided Area : | 0.8 in2/ft | #5@ 15.50 in        #5@ 31.00 in |
| Maximum Area : | 1.0245 in2/ft | #6@ 22.00 in        #6@ 44.00 in |

### Footing Data

| Toe Width | = | 1.75 ft |
|---|---|---|
| Heel Width | = | 4.67 |
| Total Footing Width | = | 6.42 |
| Footing Thickness | = | 18.00 in |
| Key Width | = | 8.00 in |
| Key Depth | = | 24.00 in |
| Key Distance from Toe | = | 1.75 ft |

f'c =     2,500 psi     Fy =     60,000 psi
Footing Concrete Density  =     150.00 pcf
Min. As %                 =     0.0018
Cover @ Top     2.00     @ Btm.=   3.00 in

### Footing Design Results

| | | Toe | Heel | |
|---|---|---|---|---|
| Factored Pressure | = | 5,039 | 0 | psf |
| Mu' : Upward | = | 6,805 | 2,228 | ft-# |
| Mu' : Downward | = | 528 | 15,203 | ft-# |
| Mu: Design | = | 6,277 | 12,975 | ft-# |
| phiMn | = | 37,413 | 29,913 | ft-# |
| Actual 1-Way Shear | = | 13.67 | 27.41 | psi |
| Allow 1-Way Shear | = | 75.00 | 75.00 | psi |
| Toe Reinforcing | = | # 7 @ 12.00 in | | |
| Heel Reinforcing | = | # 6 @ 12.00 in | | |
| Key Reinforcing | = | # 4 @ 9.12 in | | |
| Footing Torsion, Tu | = | | 0.00 | ft-lbs |
| Footing Allow. Torsion, phi Tu | = | | 0.00 | ft-lbs |

**If torsion exceeds allowable, provide
supplemental design for footing torsion.**

Other Acceptable Sizes & Spacings

Toe:
Heel:
Key:

| Min footing T&S reinf Area | 2.49 | in2 |
|---|---|---|
| Min footing T&S reinf Area per foot | 0.39 | in2 /ft |

If one layer of horizontal bars:          If two layers of horizontal bars:

| #4@  6.17 in | #4@ 12.35 in |
|---|---|
| #5@  9.57 in | #5@ 19.14 in |
| #6@ 13.58 in | #6@ 27.16 in |

# Cantilevered Retaining Wall

Project File: Typical Detail Co-04-06.EC6

LIC# : KW-06014947, Build:20.22.3.31          SWENSON SAY FAGET          (c) ENERCALC INC 1983-2022

**DESCRIPTION:**  Retaining Wall Schedule 12'-0" Retaining Wall W/ Seismic

## Summary of Overturning & Resisting Forces & Moments

| Item | | .....OVERTURNING..... Force lbs | Distance ft | Moment ft-# | | .....RESISTING..... Force lbs | Distance ft | Moment ft-# |
|---|---|---|---|---|---|---|---|---|
| HL Act Pres (ab water tbl) | | 3,189.4 | 4.50 | 14,352.2 | Soil Over HL (ab. water tbl) | 5,749.0 | 4.50 | 25,868.6 |
| HL Act Pres (be water tbl) | | | | | Soil Over HL (bel. water tbl) | | 4.50 | 25,868.6 |
| Hydrostatic Force | | | | | Watre Table | | | |
| Buoyant Force | = | | | | Sloped Soil Over Heel = | | | |
| Surcharge over Heel | = | | | | Surcharge Over Heel = | | | |
| Surcharge Over Toe | = | | | | Adjacent Footing Load = | | | |
| Adjacent Footing Load | = | | | | Axial Dead Load on Stem = | | | |
| Added Lateral Load | = | | | | * Axial Live Load on Stem = | | | |
| Load @ Stem Above Soil | = | | | | Soil Over Toe = | | 0.88 | |
| Seismic Earth Load | = | 765.5 | 6.75 | 5,166.8 | Surcharge Over Toe = | | | |
| | = | | | | Stem Weight(s) = | 1,500.0 | 2.17 | 3,250.0 |
| | | | | | Earth @ Stem Transitions = | | | |
| **Total** | = | 3,954.8 | **O.T.M.** = | 19,519.0 | Footing Weight = | 1,443.6 | 3.21 | 4,631.1 |
| | | | | | Key Weight = | 200.0 | 2.08 | 416.7 |
| | | | | | Vert. Component = | | | |

**Resisting/Overturning Ratio**   =   **1.75**
  Vertical Loads used for Soil Pressure =   8,892.6  lbs

**Total =**   8,892.6  lbs  **R.M.=**   34,166.3

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

If seismic is included, the OTM and sliding ratios
may be 1.1 per section 1807.2.3 of IBC.

Vertical component of active lateral soil pressure IS NOT considered in
the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in
the calculation of Overturning Resistance.

## Tilt

### Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus                250.0  pci
Horizontal Defl @ Top of Wall (approximate only)        0.187  in
The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe,
because the wall would then tend to rotate into the retained soil.

## Cantilevered Retaining Wall

Project File: Typical Detail Co-04-06.EC6

**DESCRIPTION:**  Retaining Wall Schedule 12'-0" Retaining Wall W/ Seismic

---

### Rebar Lap & Embedment Lengths Information

Stem Design Segment: Bottom
Stem Design Height:      0.00 ft above top of footing

| | |
|---|---:|
| Lap Splice length for #7 bar specified in this stem design segment = | 40.95 in |
| Development length for #7 bar specified in this stem design segment = | 31.50 in |
| | |
| Hooked embedment length into footing for #7 bar specified in this stem design segment = | 12.38 in |
| As Provided = | 0.8000 in2/ft |
| As Required = | 0.6737 in2/ft |

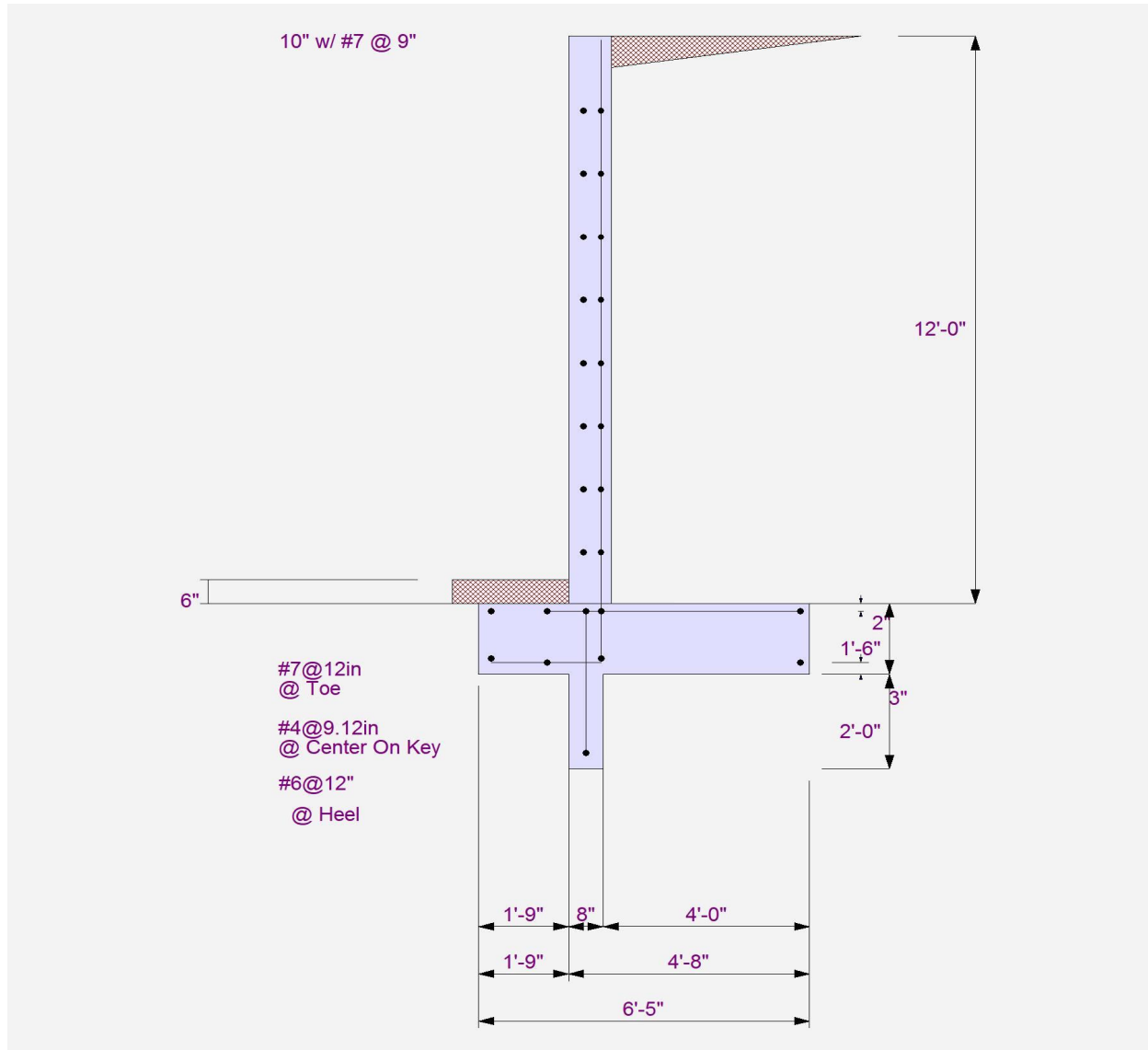## Cantilevered Retaining Wall

Project File: Typical Detail Co-04-06.EC6

LIC# : KW-06014947, Build:20.22.3.31          SWENSON SAY FAGET          (c) ENERCALC INC 1983-2022

**DESCRIPTION:**  Retaining Wall Schedule 12'-0" Retaining Wall W/ Seismic



10" w/ #7 @ 9"

12'-0"

6"

#7@12in
@ Toe

#4@9.12in
@ Center On Key

#6@12"
  @ Heel

2
1'-6"
3"
2'-0"

1'-9"   8"   4'-0"

1'-9"   4'-8"

6'-5"

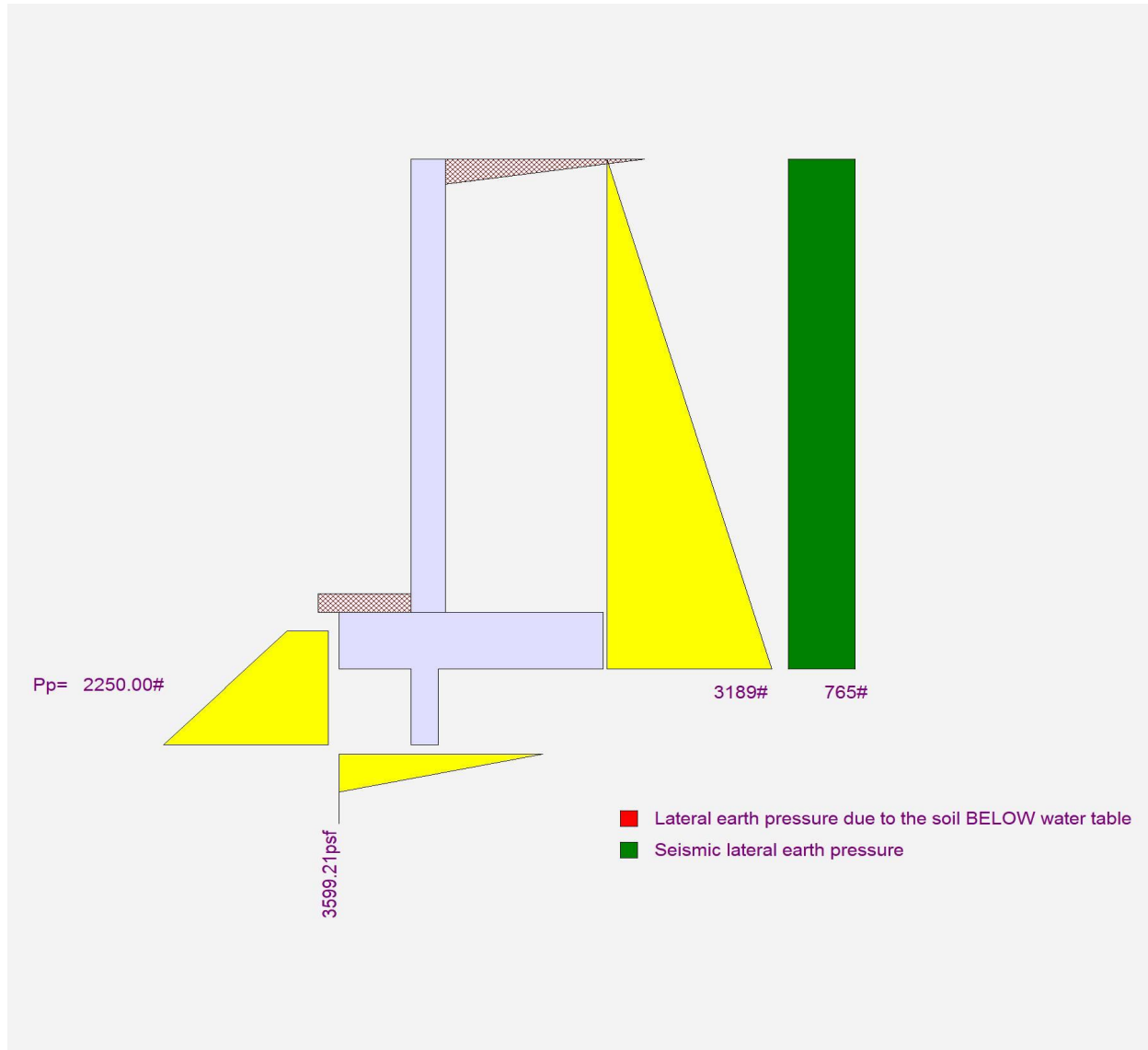## Cantilevered Retaining Wall

Project File: Typical Detail Co-04-06.EC6

LIC# : KW-06014947, Build:20.22.3.31          SWENSON SAY FAGET          (c) ENERCALC INC 1983-2022

**DESCRIPTION:**  Retaining Wall Schedule 12'-0" Retaining Wall W/ Seismic



Pp=  2250.00#

3189#          765#

3599.21psf

■ Lateral earth pressure due to the soil BELOW water table

■ Seismic lateral earth pressure

## Cantilevered Retaining Wall

Project File: Typical Detail Co-04-06.EC6

LIC# : KW-06014947, Build:20.22.3.31     SWENSON SAY FAGET     (c) ENERCALC INC 1983-2022

**DESCRIPTION:** Retaining Wall Schedule 10'-0" Retaining Wall
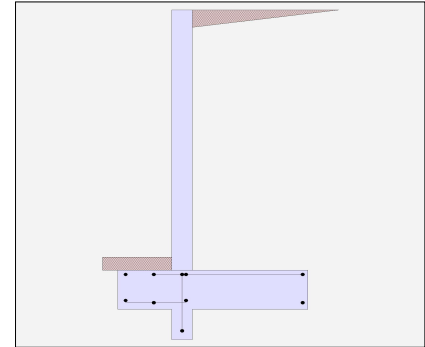
### Code References

Calculations per IBC 2018 1807.3, CBC 2019, ASCE 7-16

### Criteria

| | | |
|---|---|---|
| Retained Height | = | 10.00 ft |
| Wall height above soil | = | 0.00 ft |
| Slope Behind Wall | = | 0.00 |
| Height of Soil over Toe | = | 6.00 in |
| Water height over heel | = | 0.0 ft |

### Soil Data

| | | |
|---|---|---|
| Allow Soil Bearing | = | 3,000.0 psf |
| Equivalent Fluid Pressure Method | | |
| Active Heel Pressure | = | 35.0 psf/ft |
| | = | |
| Passive Pressure | = | 300.0 psf/ft |
| Soil Density, Heel | = | 125.00 pcf |
| Soil Density, Toe | = | 0.00 pcf |
| Footing||Soil Friction | = | 0.300 |
| Soil height to ignore for passive pressure | = | 12.00 in |



### Surcharge Loads

| | | |
|---|---|---|
| Surcharge Over Heel | = | 0.0 psf |
| Used To Resist Sliding & Overturning | | |
| Surcharge Over Toe | = | 0.0 |
| 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 |

### Lateral Load Applied to Stem

| | | |
|---|---|---|
| Lateral Load | = | 0.0 #/ft |
| ...Height to Top | = | 0.00 ft |
| ...Height to Bottom | = | 0.00 ft |
| Load Type | = | Wind (W) |
| | | (Service Level) |
| Wind on Exposed Stem | = | 0.0 psf |
| (Service Level) | | |

### 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 | | Spread Footing |
| Base Above/Below Soil at Back of Wall | = | 0.0 ft |
| Poisson's Ratio | = | 0.300 |

## Cantilevered Retaining Wall

Project File: Typical Detail Co-04-06.EC6

**DESCRIPTION:** Retaining Wall Schedule 10'-0" Retaining Wall

### Design Summary

**Wall Stability Ratios**

| | | | |
|---|---|---|---|
| Overturning | = | 3.01 | OK |
| Sliding | = | 1.52 | OK |
| Global Stability | = | 2.07 | |

| | | | |
|---|---|---|---|
| Total Bearing Load | = | 7,191 | lbs |
| ...resultant ecc. | = | 7.22 | in |

| | | | |
|---|---|---|---|
| Soil Pressure @ Toe | = | 1,849 psf | OK |
| Soil Pressure @ Heel | = | 484 psf | OK |
| Allowable | = | 3,000 psf | |

Soil Pressure Less Than Allowable

| | | | |
|---|---|---|---|
| ACI Factored @ Toe | = | 2,588 psf | |
| ACI Factored @ Heel | = | 677 psf | |
| Footing Shear @ Toe | = | 6.6 psi | OK |
| Footing Shear @ Heel | = | 10.3 psi | OK |
| Allowable | = | 75.0 psi | |

**Sliding Calcs**

| | | | |
|---|---|---|---|
| Lateral Sliding Force | = | 2,314.4 lbs | |
| less 100% Passive Force | - | 1,354.2 lbs | |
| less 100% Friction Force | ≡ - | 2,157.2 lbs | |
| Added Force Req'd | = | 0.0 lbs | OK |
| ....for 1.5 Stability | = | 0.0 lbs | OK |

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

**Load Factors**

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

### Stem Construction

**Bottom**

Stem OK

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Design Height Above Ftg** | ft = | 0.00 | | | | | |
| Wall Material Above "Ht" | = | Concrete | | | | | |
| Design Method | = | SD | SD | SD | SD | SD |
| Thickness | = | 8.00 | | | | | |
| Rebar Size | = | # 7 | | | | | |
| Rebar Spacing | = | 12.00 | | | | | |
| Rebar Placed at | = | Edge | | | | | |

**Design Data**

| | | |
|---|---|---|
| fb/FB + fa/Fa | = | **0.712** |

**Total Force @ Section**

| | | |
|---|---|---|
| Service Level | lbs = | |
| Strength Level | lbs = | 2,800.0 |

**Moment....Actual**

| | | |
|---|---|---|
| Service Level | ft-# = | |
| Strength Level | ft-# = | 9,333.3 |
| Moment.....Allowable | = | 13,107.2 |

**Shear.....Actual**

| | | |
|---|---|---|
| Service Level | psi = | |
| Strength Level | psi = | 41.9 |
| Shear.....Allowable | psi = | 75.0 |
| Anet (Masonry) | in2 = | |
| Wall Weight | psf = | 100.0 |
| Rebar Depth 'd' | in = | 5.56 |

**Masonry Data**

| | | |
|---|---|---|
| f'm | psi = | |
| Fs | psi = | |
| Solid Grouting | = | |
| Modular Ratio 'n' | = | |
| Equiv. Solid Thick. | = | |
| Masonry Block Type | = | |
| Masonry Design Method | = | ASD |

**Concrete Data**

| | | |
|---|---|---|
| f'c | psi = | 2,500.0 |
| Fy | psi = | 60,000.0 |

# Cantilevered Retaining Wall

Project File: Typical Detail Co-04-06.EC6

**DESCRIPTION:** Retaining Wall Schedule 10'-0" Retaining Wall

## Concrete Stem Rebar Area Details

| Bottom Stem | Vertical Reinforcing | Horizontal Reinforcing |
|---|---|---|
| As (based on applied moment) : | 0.3955 in2/ft | |
| (4/3) * As : | 0.5274 in2/ft | Min Stem T&S Reinf Area 1.920 in2 |
| 200bd/fy : 200(12)(5.5625)/60000 : | 0.2225 in2/ft | Min Stem T&S Reinf Area per ft of stem Height : 0.192 in2/ft |
| 0.0018bh : 0.0018(12)(8) : | 0.1728 in2/ft | Horizontal Reinforcing Options : |
| | ============ | One layer of :      Two layers of : |
| Required Area : | 0.3955 in2/ft | #4@ 12.50 in        #4@ 25.00 in |
| Provided Area : | 0.6 in2/ft | #5@ 19.38 in        #5@ 38.75 in |
| Maximum Area : | 0.7535 in2/ft | #6@ 27.50 in        #6@ 55.00 in |

### Footing Data

| Toe Width | = | 1.75 ft |
|---|---|---|
| Heel Width | = | 4.42 |
| Total Footing Width | = | 6.17 |
| Footing Thickness | = | 18.00 in |
| Key Width | = | 8.00 in |
| Key Depth | = | 14.00 in |
| Key Distance from Toe | = | 1.75 ft |

| f'c = 2,500 psi | Fy = | 60,000 psi |
|---|---|---|
| Footing Concrete Density | = | 150.00 pcf |
| Min. As % | = | 0.0018 |
| Cover @ Top    2.00 | @ Btm.= | 3.00 in |

### Footing Design Results

| | | **Toe** | **Heel** |
|---|---|---|---|
| Factored Pressure | = | 2,588 | 677 psf |
| Mu' : Upward | = | 3,686 | 7,482 ft-# |
| Mu' : Downward | = | 528 | 12,441 ft-# |
| Mu: Design | = | 3,158 | 4,959 ft-# |
| phiMn | = | 37,413 | 29,913 ft-# |
| Actual 1-Way Shear | = | 6.64 | 10.32 psi |
| Allow 1-Way Shear | = | 75.00 | 75.00 psi |
| Toe Reinforcing | = # 7 @ 12.00 in | | |
| Heel Reinforcing | = # 6 @ 12.00 in | | |
| Key Reinforcing | = # 4 @ 13.89 in | | |
| Footing Torsion, Tu | = | | 0.00 ft-lbs |
| Footing Allow. Torsion, phi Tu | = | | 0.00 ft-lbs |

**If torsion exceeds allowable, provide
supplemental design for footing torsion.**

Other Acceptable Sizes & Spacings

Toe:
Heel:
Key:

| Min footing T&S reinf Area | 2.40 | in2 |
|---|---|---|
| Min footing T&S reinf Area per foot | 0.39 | in2 /ft |

| If one layer of horizontal bars: | If two layers of horizontal bars: |
|---|---|
| #4@  6.17 in | #4@ 12.35 in |
| #5@  9.57 in | #5@ 19.14 in |
| #6@ 13.58 in | #6@ 27.16 in |

## Cantilevered Retaining Wall

**DESCRIPTION:**  Retaining Wall Schedule 10'-0" Retaining Wall

### Summary of Overturning & Resisting Forces & Moments

| Item | .....OVERTURNING..... Force lbs | Distance ft | Moment ft-# | | .....RESISTING..... Force lbs | Distance ft | Moment ft-# |
|---|---|---|---|---|---|---|---|
| HL Act Pres (ab water tbl) | 2,314.4 | 3.83 | 8,871.8 | Soil Over HL  (ab. water tbl) | 4,686.7 | 4.29 | 20,112.0 |
| HL Act Pres (be water tbl) | | | | Soil Over HL  (bel. water tbl) | | 4.29 | 20,112.0 |
| Hydrostatic Force | | | | Watre Table | | | |
| Buoyant Force = | | | | Sloped Soil Over Heel = | | | |
| Surcharge over Heel = | | | | Surcharge Over Heel = | | | |
| Surcharge Over Toe = | | | | Adjacent Footing Load = | | | |
| Adjacent Footing Load = | | | | Axial Dead Load on Stem = | | | |
| Added Lateral Load = | | | | * Axial Live Load on Stem = | | | |
| Load @ Stem Above Soil = | | | | Soil Over Toe = | | 0.88 | |
| = | | | | Surcharge Over Toe = | | | |
| | | | | Stem Weight(s) = | 1,000.0 | 2.08 | 2,083.3 |
| | | | | Earth @ Stem Transitions = | | | |
| **Total** = | 2,314.4 | **O.T.M.** = | 8,871.8 | Footing Weight = | 1,387.4 | 3.08 | 4,277.2 |
| | | | | Key Weight = | 116.7 | 2.08 | 243.1 |
| **Resisting/Overturning Ratio** = | | **3.01** | | Vert. Component = | | | |
| Vertical Loads used for Soil Pressure = | 7,190.7 | lbs | | **Total =** | 7,190.7 lbs | **R.M.=** | 26,715.6 |

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

Vertical component of active lateral soil pressure IS NOT considered in
the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in
the calculation of Overturning Resistance.

### Tilt

#### Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

| | | |
|---|---|---|
| Soil Spring Reaction Modulus | 250.0 | pci |
| Horizontal Defl @ Top of Wall (approximate only) | 0.083 | in |

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe,

because the wall would then tend to rotate into the retained soil.

## Cantilevered Retaining Wall

**DESCRIPTION:**  Retaining Wall Schedule 10'-0" Retaining Wall

### Rebar Lap & Embedment Lengths Information

Stem Design Segment: Bottom
Stem Design Height:     0.00 ft above top of footing

| | |
|---|---:|
| Lap Splice length for #7 bar specified in this stem design segment = | 40.95 in |
| Development length for #7 bar specified in this stem design segment = | 31.50 in |
| Hooked embedment length into footing for #7 bar specified in this stem design segment = | 9.69 in |
| As Provided = | 0.6000 in2/ft |
| As Required = | 0.3955 in2/ft |

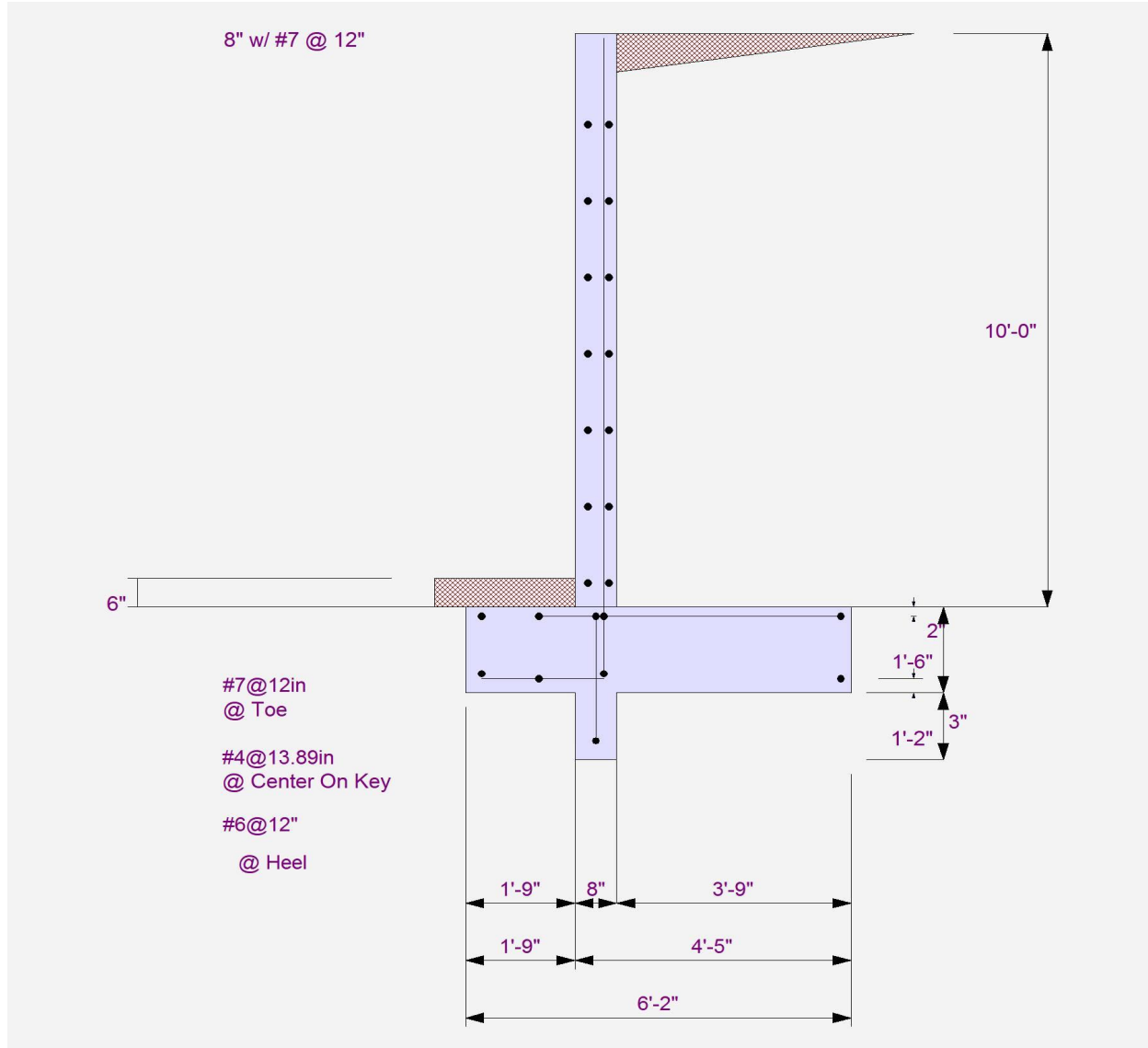**Cantilevered Retaining Wall**

Project File: Typical Detail Co-04-06.EC6

LIC# : KW-06014947, Build:20.22.3.31          SWENSON SAY FAGET          (c) ENERCALC INC 1983-2022

**DESCRIPTION:**  Retaining Wall Schedule 10'-0" Retaining Wall



8" w/ #7 @ 12"

10'-0"

6"

2"

1'-6"

3"

1'-2"

#7@12in
@ Toe

#4@13.89in
@ Center On Key

#6@12"

@ Heel

1'-9"   8"   3'-9"

1'-9"   4'-5"

6'-2"

# Cantilevered Retaining Wall
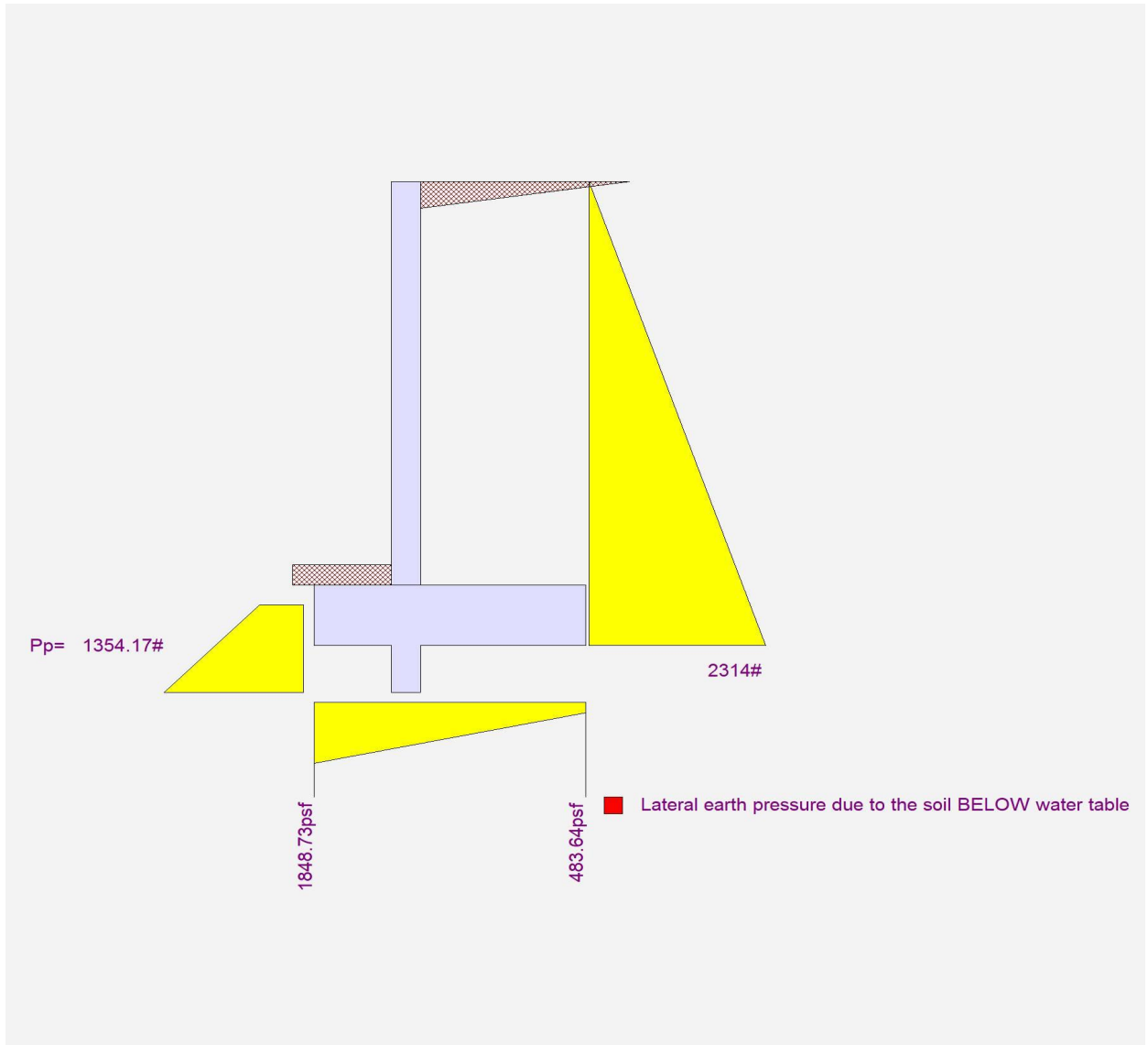
Project File: Typical Detail Co-04-06.EC6

LIC# : KW-06014947, Build:20.22.3.31                         SWENSON SAY FAGET                         (c) ENERCALC INC 1983-2022

**DESCRIPTION:**  Retaining Wall Schedule 10'-0" Retaining Wall
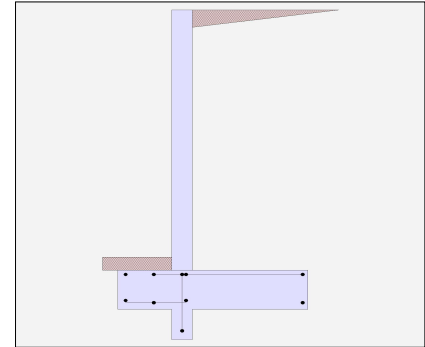
Pp=   1354.17#

2314#

1848.73psf

483.64psf

■ Lateral earth pressure due to the soil BELOW water table

## Cantilevered Retaining Wall

Project File: Typical Detail Co-04-06.EC6

**DESCRIPTION:**  Retaining Wall Schedule 10'-0" Retaining Wall W/ Seismic

### Code References

Calculations per IBC 2018 1807.3, CBC 2019, ASCE 7-16

### Criteria

| | | |
|---|---|---|
| Retained Height | = | 10.00 ft |
| Wall height above soil | = | 0.00 ft |
| Slope Behind Wall | = | 0.00 |
| Height of Soil over Toe | = | 6.00 in |
| Water height over heel | = | 0.0 ft |

### Soil Data

| | | |
|---|---|---|
| Allow Soil Bearing | = | 4,000.0 psf |
| Equivalent Fluid Pressure Method | | |
| Active Heel Pressure | = | 35.0 psf/ft |
| | = | |
| Passive Pressure | = | 300.0 psf/ft |
| Soil Density, Heel | = | 125.00 pcf |
| Soil Density, Toe | = | 0.00 pcf |
| Footing||Soil Friction | = | 0.300 |
| Soil height to ignore for passive pressure | = | 12.00 in |

### Surcharge Loads

| | | |
|---|---|---|
| Surcharge Over Heel | = | 0.0 psf |
| Used To Resist Sliding & Overturning | | |
| Surcharge Over Toe | = | 0.0 |
| 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 |

### Earth Pressure Seismic Load

Method : Uniform

| | | |
|---|---|---|
| Multiplier Used | = | 6.000 |

(Multiplier used on soil density)

### Lateral Load Applied to Stem

| | | |
|---|---|---|
| Lateral Load | = | 0.0 #/ft |
| ...Height to Top | = | 0.00 ft |
| ...Height to Bottom | = | 0.00 ft |
| Load Type | = | Wind (W) |
| | | (Service Level) |
| Wind on Exposed Stem | = | 0.0 psf |
| (Service Level) | | |

| | | |
|---|---|---|
| Uniform Seismic Force | = | 69.000 |
| Total Seismic Force | = | 793.500 |

### 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 | | Spread Footing |
| Base Above/Below Soil at Back of Wall | = | 0.0 ft |
| Poisson's Ratio | = | 0.300 |

## Cantilevered Retaining Wall

**DESCRIPTION:**  Retaining Wall Schedule 10'-0" Retaining Wall W/ Seismic

### Design Summary

### Stem Construction

**Bottom**

| | | | |
|---|---|---|---|
| | | | Stem OK |

#### Wall Stability Ratios

| | | | |
|---|---|---|---|
| Overturning | = | 2.21 | OK |
| Sliding | = | 1.22 | Ratio < 1.5! |
| Global Stability | = | 2.07 | |
| | | | |
| Total Bearing Load | = | 7,191 lbs | |
| ...resultant ecc. | = | 12.55 in | |
| | | | |
| Soil Pressure @ Toe | = | 2,353 psf | OK |
| Soil Pressure @ Heel | = | 0 psf | OK |
| Allowable | = | 4,000 psf | |

Soil Pressure Less Than Allowable

| | | | |
|---|---|---|---|
| ACI Factored @ Toe | = | 3,294 psf | |
| ACI Factored @ Heel | = | 0 psf | |
| Footing Shear @ Toe | = | 8.6 psi | OK |
| Footing Shear @ Heel | = | 15.9 psi | OK |
| Allowable | = | 75.0 psi | |

#### Sliding Calcs

| | | | |
|---|---|---|---|
| Lateral Sliding Force | = | 2,869.8 lbs | |
| less 100% Passive Force | - | 1,354.2 lbs | |
| less 100% Friction Force | - | 2,157.2 lbs | |
| Added Force Req'd | = | 0.0 lbs | OK |
| ....for 1.5 Stability | = | 793.4 lbs | NG |

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

#### Load Factors

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

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Design Height Above Ftg** | ft = | 0.00 | | | | | |
| Wall Material Above "Ht" | = | Concrete | | | | | |
| Design Method | = | SD | SD | SD | SD | SD | |
| Thickness | = | 8.00 | | | | | |
| Rebar Size | = | # 7 | | | | | |
| Rebar Spacing | = | 12.00 | | | | | |
| Rebar Placed at | = | Edge | | | | | |

#### Design Data

| | | | |
|---|---|---|---|
| fb/FB + fa/Fa | = | **0.975** | |
| **Total Force @ Section** | | | |
| Service Level | lbs = | | |
| Strength Level | lbs = | 3,490.0 | |
| **Moment....Actual** | | | |
| Service Level | ft-# = | | |
| Strength Level | ft-# = | 12,783.3 | |
| Moment.....Allowable | = | 13,107.2 | |
| **Shear.....Actual** | | | |
| Service Level | psi = | | |
| Strength Level | psi = | 52.3 | |
| Shear.....Allowable | psi = | 75.0 | |
| Anet (Masonry) | in2 = | | |
| Wall Weight | psf = | 100.0 | |
| Rebar Depth 'd' | in = | 5.56 | |

#### Masonry Data

| | | |
|---|---|---|
| f'm | psi = | |
| Fs | psi = | |
| Solid Grouting | = | |
| Modular Ratio 'n' | = | |
| Equiv. Solid Thick. | = | |
| Masonry Block Type | = | |
| Masonry Design Method | = | ASD |

#### Concrete Data

| | | |
|---|---|---|
| f'c | psi = | 2,500.0 |
| Fy | psi = | 60,000.0 |

# Cantilevered Retaining Wall

LIC# : KW-06014947, Build:20.22.3.31          SWENSON SAY FAGET          (c) ENERCALC INC 1983-2022

**DESCRIPTION:** Retaining Wall Schedule 10'-0" Retaining Wall W/ Seismic

---

## Concrete Stem Rebar Area Details

| Bottom Stem | Vertical Reinforcing | Horizontal Reinforcing |
|---|---|---|
| As (based on applied moment) : | 0.5417 in2/ft | |
| (4/3) * As : | 0.7223 in2/ft | Min Stem T&S Reinf Area 1.920 in2 |
| 200bd/fy : 200(12)(5.5625)/60000 : | 0.2225 in2/ft | Min Stem T&S Reinf Area per ft of stem Height : 0.192 in2/ft |
| 0.0018bh : 0.0018(12)(8) : | 0.1728 in2/ft | Horizontal Reinforcing Options : |
| | ============ | One layer of :        Two layers of : |
| Required Area : | 0.5417 in2/ft | #4@ 12.50 in        #4@ 25.00 in |
| Provided Area : | 0.6 in2/ft | #5@ 19.38 in        #5@ 38.75 in |
| Maximum Area : | 0.7535 in2/ft | #6@ 27.50 in        #6@ 55.00 in |

### Footing Data

| | | |
|---|---|---|
| Toe Width | = | 1.75 ft |
| Heel Width | = | 4.42 |
| Total Footing Width | = | 6.17 |
| Footing Thickness | = | 18.00 in |
| Key Width | = | 8.00 in |
| Key Depth | = | 14.00 in |
| Key Distance from Toe | = | 1.75 ft |

f'c =    2,500 psi    Fy =    60,000 psi
Footing Concrete Density  =    150.00 pcf
Min. As %        =    0.0018
Cover @ Top    2.00    @ Btm.=  3.00 in

### Footing Design Results

| | | Toe | Heel |
|---|---|---|---|
| Factored Pressure | = | 3,294 | 0 psf |
| Mu' : Upward | = | 4,563 | 4,533 ft-# |
| Mu' : Downward | = | 528 | 12,441 ft-# |
| Mu: Design | = | 4,034 | 7,908 ft-# |
| phiMn | = | 37,413 | 29,913 ft-# |
| Actual 1-Way Shear | = | 8.65 | 15.89 psi |
| Allow 1-Way Shear | = | 75.00 | 75.00 psi |
| Toe Reinforcing | = # 7 @ 12.00 in | | |
| Heel Reinforcing | = # 6 @ 12.00 in | | |
| Key Reinforcing | = # 4 @ 13.89 in | | |
| Footing Torsion, Tu | = | | 0.00 ft-lbs |
| Footing Allow. Torsion, phi Tu | = | | 0.00 ft-lbs |

**If torsion exceeds allowable, provide**
**supplemental design for footing torsion.**

Other Acceptable Sizes & Spacings
   Toe:
   Heel:
   Key:

Min footing T&S reinf Area          2.40    in2
Min footing T&S reinf Area per foot    0.39    in2 /ft
If one layer of horizontal bars:        If two layers of horizontal bars:
   #4@  6.17 in                             #4@ 12.35 in
   #5@  9.57 in                             #5@ 19.14 in
   #6@ 13.58 in                             #6@ 27.16 in

| Cantilevered Retaining Wall | Project File: Typical Detail Co-04-06.EC6 |
|---|---|
| LIC# : KW-06014947, Build:20.22.3.31 | SWENSON SAY FAGET | (c) ENERCALC INC 1983-2022 |

**DESCRIPTION:** Retaining Wall Schedule 10'-0" Retaining Wall W/ Seismic

## Summary of Overturning & Resisting Forces & Moments

| Item | | .....OVERTURNING..... Force lbs | Distance ft | Moment ft-# | | .....RESISTING..... Force lbs | Distance ft | Moment ft-# |
|---|---|---|---|---|---|---|---|---|
| HL Act Pres (ab water tbl) | | 2,314.4 | 3.83 | 8,871.8 | Soil Over HL (ab. water tbl) | 4,686.7 | 4.29 | 20,112.0 |
| HL Act Pres (be water tbl) | | | | | Soil Over HL (bel. water tbl) | | 4.29 | 20,112.0 |
| Hydrostatic Force | | | | | Watre Table | | | |
| Buoyant Force | = | | | | Sloped Soil Over Heel = | | | |
| Surcharge over Heel | = | | | | Surcharge Over Heel = | | | |
| Surcharge Over Toe | = | | | | Adjacent Footing Load = | | | |
| Adjacent Footing Load | = | | | | Axial Dead Load on Stem = | | | |
| Added Lateral Load | = | | | | * Axial Live Load on Stem = | | | |
| Load @ Stem Above Soil | = | | | | Soil Over Toe = | | 0.88 | |
| Seismic Earth Load | = | 555.5 | 5.75 | 3,193.8 | Surcharge Over Toe = | | | |
| | = | | | | Stem Weight(s) = | 1,000.0 | 2.08 | 2,083.3 |
| | | | | | Earth @ Stem Transitions = | | | |
| **Total** | = | 2,869.8 | **O.T.M.** = | 12,065.6 | Footing Weight = | 1,387.4 | 3.08 | 4,277.2 |
| | | | | | Key Weight = | 116.7 | 2.08 | 243.1 |
| | | | | | Vert. Component = | | | |
| | | | | | **Total =** | 7,190.7 lbs | **R.M.=** | 26,715.6 |

**Resisting/Overturning Ratio** = **2.21**
Vertical Loads used for Soil Pressure = 7,190.7 lbs

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

If seismic is included, the OTM and sliding ratios may be 1.1 per section 1807.2.3 of IBC.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

## Tilt

### Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

| Soil Spring Reaction Modulus | 250.0 | pci |
|---|---|---|
| Horizontal Defl @ Top of Wall (approximate only) | 0.106 | in |

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe, because the wall would then tend to rotate into the retained soil.

## Cantilevered Retaining Wall

Project File: Typical Detail Co-04-06.EC6

**DESCRIPTION:**  Retaining Wall Schedule 10'-0" Retaining Wall W/ Seismic

---

### Rebar Lap & Embedment Lengths Information

Stem Design Segment: Bottom
Stem Design Height:      0.00 ft above top of footing

| | |
|---|---:|
| Lap Splice length for #7 bar specified in this stem design segment = | 40.95 in |
| Development length for #7 bar specified in this stem design segment = | 31.50 in |
| | |
| Hooked embedment length into footing for #7 bar specified in this stem design segment = | 13.27 in |
| As Provided = | 0.6000 in2/ft |
| As Required = | 0.5417 in2/ft |

## Cantilevered Retaining Wall

LIC# : KW-06014947, Build:20.22.3.31        SWENSON SAY FAGET        (c) ENERCALC INC 1983-2022

**DESCRIPTION:**  Retaining Wall Schedule 10'-0" Retaining Wall W/ Seismic

8" w/ #7 @ 12"

10'-0"

6"

#7@12in
@ Toe

#4@13.89in
@ Center On Key

#6@12"

  @ Heel

2"

1'-6"

3"

1'-2"

1'-9"    8"    3'-9"

1'-9"    4'-5"

6'-2"

## Cantilevered Retaining Wall
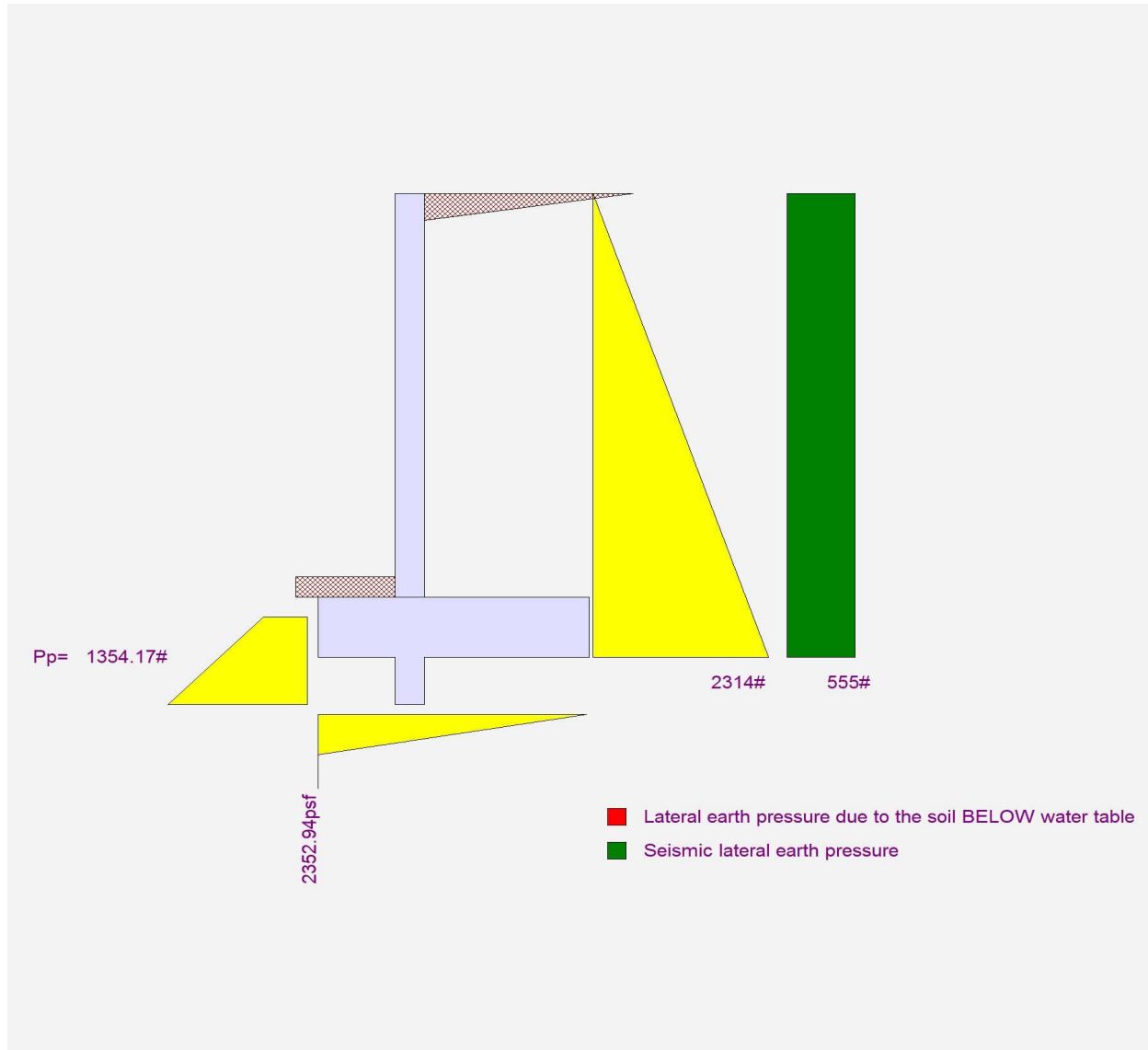
Project File: Typical Detail Co-04-06.EC6

LIC# : KW-06014947, Build:20.22.3.31          SWENSON SAY FAGET          (c) ENERCALC INC 1983-2022

**DESCRIPTION:**  Retaining Wall Schedule 10'-0" Retaining Wall W/ Seismic

Pp=   1354.17#

2314#          555#

2352.94psf

■ Lateral earth pressure due to the soil BELOW water table

■ Seismic lateral earth pressure

# Cantilevered Retaining Wall

Project File: Typical Detail Co-04-06.EC6

LIC# : KW-06014947, Build:20.22.3.31 | SWENSON SAY FAGET | (c) ENERCALC INC 1983-2022

**DESCRIPTION:** Retaining Wall Schedule 8'-0" Retaining Wall
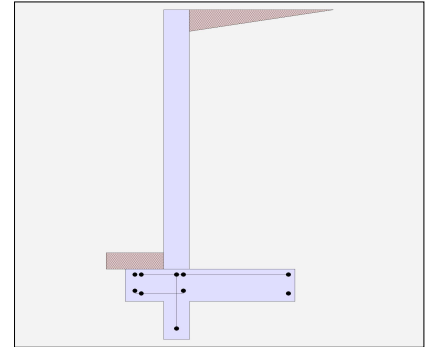
## Code References

Calculations per IBC 2018 1807.3, CBC 2019, ASCE 7-16

## Criteria

| | | |
|---|---|---|
| Retained Height | = | 8.00 ft |
| Wall height above soil | = | 0.00 ft |
| Slope Behind Wall | = | 0.00 |
| Height of Soil over Toe | = | 6.00 in |
| Water height over heel | = | 0.0 ft |

## Soil Data

| | | |
|---|---|---|
| Allow Soil Bearing | = | 3,000.0 psf |
| Equivalent Fluid Pressure Method | | |
| Active Heel Pressure | = | 35.0 psf/ft |
| | = | |
| Passive Pressure | = | 300.0 psf/ft |
| Soil Density, Heel | = | 125.00 pcf |
| Soil Density, Toe | = | 0.00 pcf |
| Footing||Soil Friction | = | 0.300 |
| Soil height to ignore for passive pressure | = | 12.00 in |



## Surcharge Loads

| | | |
|---|---|---|
| Surcharge Over Heel | = | 0.0 psf |
| Used To Resist Sliding & Overturning | | |
| Surcharge Over Toe | = | 0.0 |
| 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 |

## Lateral Load Applied to Stem

| | | |
|---|---|---|
| Lateral Load | = | 0.0 #/ft |
| ...Height to Top | = | 0.00 ft |
| ...Height to Bottom | = | 0.00 ft |
| Load Type | = | Wind (W) |
| | | (Service Level) |
| Wind on Exposed Stem (Service Level) | = | 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 | | Spread Footing |
| Base Above/Below Soil at Back of Wall | = | 0.0 ft |
| Poisson's Ratio | = | 0.300 |

# Cantilevered Retaining Wall

Project File: Typical Detail Co-04-06.EC6

**DESCRIPTION:** Retaining Wall Schedule 8'-0" Retaining Wall

## Design Summary

**Stem Construction**

| | | | Bottom |
|---|---|---|---|
| | | | Stem OK |

### Wall Stability Ratios

| | | | |
|---|---|---|---|
| Overturning | = | 2.60 | OK |
| Sliding | = | 1.56 | OK |
| Global Stability | = | 2.00 | |

| | | | |
|---|---|---|---|
| Total Bearing Load | = | 4,328 lbs | |
| ...resultant ecc. | = | 7.66 in | |

| | | | |
|---|---|---|---|
| Soil Pressure @ Toe | = | 1,830 psf | OK |
| Soil Pressure @ Heel | = | 130 psf | OK |
| Allowable | = | 3,000 psf | |

Soil Pressure Less Than Allowable

| | | | |
|---|---|---|---|
| ACI Factored @ Toe | = | 2,562 psf | |
| ACI Factored @ Heel | = | 182 psf | |
| Footing Shear @ Toe | = | 6.3 psi | OK |
| Footing Shear @ Heel | = | 11.0 psi | OK |
| Allowable | = | 75.0 psi | |

### Sliding Calcs

| | | | |
|---|---|---|---|
| Lateral Sliding Force | = | 1,417.5 lbs | |
| less 100% Passive Force | - | 916.7 lbs | |
| less 100% Friction Force | ≅ - | 1,298.5 lbs | |
| Added Force Req'd | = | 0.0 lbs | OK |
| ....for 1.5 Stability | = | 0.0 lbs | OK |

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

### Load Factors

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

### Stem Construction (details)

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Design Height Above Ftg** | ft = | 0.00 | | | | | |
| Wall Material Above "Ht" | = | Concrete | | | | | |
| Design Method | = | SD | SD | SD | SD | SD | |
| Thickness | = | 8.00 | | | | | |
| Rebar Size | = | # 5 | | | | | |
| Rebar Spacing | = | 12.00 | | | | | |
| Rebar Placed at | = | Edge | | | | | |

**Design Data**

| | | |
|---|---|---|
| fb/FB + fa/Fa | = | **0.588** |

**Total Force @ Section**

| | | |
|---|---|---|
| Service Level | lbs = | |
| Strength Level | lbs = | 1,792.0 |

**Moment....Actual**

| | | |
|---|---|---|
| Service Level | ft-# = | |
| Strength Level | ft-# = | 4,778.7 |
| Moment.....Allowable | = | 8,121.3 |

**Shear.....Actual**

| | | |
|---|---|---|
| Service Level | psi = | |
| Strength Level | psi = | 24.1 |
| Shear.....Allowable | psi = | 75.0 |
| Anet (Masonry) | in2 = | |
| Wall Weight | psf = | 100.0 |
| Rebar Depth 'd' | in = | 6.19 |

**Masonry Data**

| | | |
|---|---|---|
| f'm | psi = | |
| Fs | psi = | |
| Solid Grouting | = | |
| Modular Ratio 'n' | = | |
| Equiv. Solid Thick. | = | |
| Masonry Block Type | = | |
| Masonry Design Method | = | ASD |

**Concrete Data**

| | | |
|---|---|---|
| f'c | psi = | 2,500.0 |
| Fy | psi = | 60,000.0 |

## Cantilevered Retaining Wall

**DESCRIPTION:** Retaining Wall Schedule 8'-0" Retaining Wall

### Concrete Stem Rebar Area Details

| Bottom Stem | Vertical Reinforcing | Horizontal Reinforcing |
|---|---|---|
| As (based on applied moment) : | 0.1809 in2/ft | |
| (4/3) * As : | 0.2413 in2/ft | Min Stem T&S Reinf Area 1.536 in2 |
| 200bd/fy : 200(12)(6.1875)/60000 : | 0.2475 in2/ft | Min Stem T&S Reinf Area per ft of stem Height : 0.192 in2/ft |
| 0.0018bh : 0.0018(12)(8) : | 0.1728 in2/ft | Horizontal Reinforcing Options : |
| | ============ | One layer of :     Two layers of : |
| Required Area : | 0.2413 in2/ft | #4@ 12.50 in     #4@ 25.00 in |
| Provided Area : | 0.31 in2/ft | #5@ 19.38 in     #5@ 38.75 in |
| Maximum Area : | 0.8382 in2/ft | #6@ 27.50 in     #6@ 55.00 in |

### Footing Data

| | | |
|---|---|---|
| Toe Width | = | 1.00 ft |
| Heel Width | = | 3.42 |
| Total Footing Width | = | 4.42 |
| Footing Thickness | = | 12.00 in |
| Key Width | = | 8.00 in |
| Key Depth | = | 14.00 in |
| Key Distance from Toe | = | 1.00 ft |

f'c = 2,500 psi    Fy = 60,000 psi
Footing Concrete Density = 150.00 pcf
Min. As % = 0.0018
Cover @ Top 2.00   @ Btm = 3.00 in

### Footing Design Results

| | | Toe | Heel | |
|---|---|---|---|---|
| Factored Pressure | = | 2,562 | 182 | psf |
| Mu' : Upward | = | 1,191 | 2,555 | ft-# |
| Mu' : Downward | = | 128 | 5,216 | ft-# |
| Mu: Design | = | 1,064 | 2,661 | ft-# |
| phiMn | = | 11,610 | 13,005 | ft-# |
| Actual 1-Way Shear | = | 6.30 | 11.02 | psi |
| Allow 1-Way Shear | = | 75.00 | 75.00 | psi |
| Toe Reinforcing | = | # 5 @ 12.00 in | | |
| Heel Reinforcing | = | # 5 @ 12.00 in | | |
| Key Reinforcing | = | # 4 @ 13.89 in | | |
| Footing Torsion, Tu | = | | 0.00 | ft-lbs |
| Footing Allow. Torsion, phi Tu | = | | 0.00 | ft-lbs |

**If torsion exceeds allowable, provide supplemental design for footing torsion.**

Other Acceptable Sizes & Spacings
   Toe:
   Heel:
   Key:

| | | |
|---|---|---|
| Min footing T&S reinf Area | 1.14 | in2 |
| Min footing T&S reinf Area per foot | 0.26 | in2 /ft |

If one layer of horizontal bars:    If two layers of horizontal bars:

   #4@ 9.26 in            #4@ 18.52 in
   #5@ 14.35 in          #5@ 28.70 in
   #6@ 20.37 in          #6@ 40.74 in

## Cantilevered Retaining Wall

Project File: Typical Detail Co-04-06.EC6

**DESCRIPTION:** Retaining Wall Schedule 8'-0" Retaining Wall

### Summary of Overturning & Resisting Forces & Moments

| Item | .....OVERTURNING..... Force lbs | Distance ft | Moment ft-# | | .....RESISTING..... Force lbs | Distance ft | Moment ft-# |
|---|---|---|---|---|---|---|---|
| HL Act Pres (ab water tbl) | 1,417.5 | 3.00 | 4,252.5 | Soil Over HL (ab. water tbl) | 2,749.3 | 3.04 | 8,361.6 |
| HL Act Pres (be water tbl) | | | | Soil Over HL (bel. water tbl) | | 3.04 | 8,361.6 |
| Hydrostatic Force | | | | Watre Table | | | |
| Buoyant Force = | | | | Sloped Soil Over Heel = | | | |
| Surcharge over Heel = | | | | Surcharge Over Heel = | | | |
| Surcharge Over Toe = | | | | Adjacent Footing Load = | | | |
| Adjacent Footing Load = | | | | Axial Dead Load on Stem = | | | |
| Added Lateral Load = | | | | * Axial Live Load on Stem = | | | |
| Load @ Stem Above Soil = | | | | Soil Over Toe = | | 0.50 | |
| = | | | | Surcharge Over Toe = | | | |
| | | | | Stem Weight(s) = | 800.0 | 1.33 | 1,066.7 |
| | | | | Earth @ Stem Transitions = | | | |
| **Total** = | 1,417.5 | **O.T.M.** = | 4,252.5 | Footing Weight = | 662.4 | 2.21 | 1,462.6 |
| | | | | Key Weight = | 116.7 | 1.33 | 155.6 |
| **Resisting/Overturning Ratio** = | **2.60** | | | Vert. Component = | | | |
| Vertical Loads used for Soil Pressure = | 4,328.4 lbs | | | **Total =** | 4,328.4 lbs | **R.M.=** | 11,046.4 |

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

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

### Tilt

#### Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

| | | |
|---|---|---|
| Soil Spring Reaction Modulus | 250.0 | pci |
| Horizontal Defl @ Top of Wall (approximate only) | 0.092 | in |

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe, because the wall would then tend to rotate into the retained soil.

## Cantilevered Retaining Wall
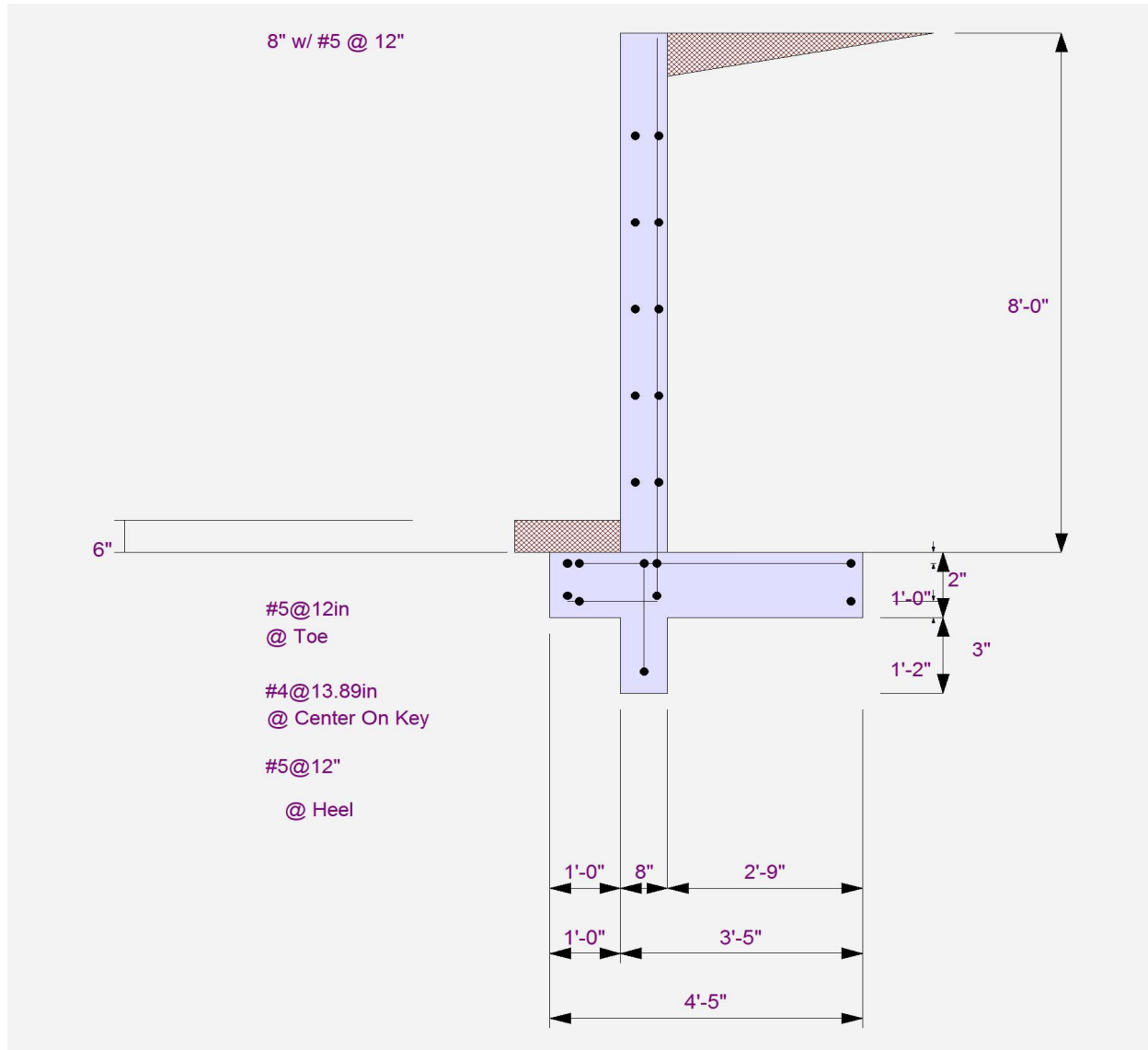
Project File: Typical Detail Co-04-06.EC6

LIC# : KW-06014947, Build:20.22.3.31                    SWENSON SAY FAGET                    (c) ENERCALC INC 1983-2022

**DESCRIPTION:**  Retaining Wall Schedule 8'-0" Retaining Wall

---

### Rebar Lap & Embedment Lengths Information

Stem Design Segment: Bottom
Stem Design Height:      0.00 ft above top of footing


| | |
|---|---:|
| Lap Splice length for #5 bar specified in this stem design segment = | 23.40 in |
| Development length for #5 bar specified in this stem design segment = | 18.00 in |
| | |
| Hooked embedment length into footing for #5 bar specified in this stem design segment = | 8.17 in |
| As Provided = | 0.3100 in2/ft |
| As Required = | 0.2413 in2/ft |

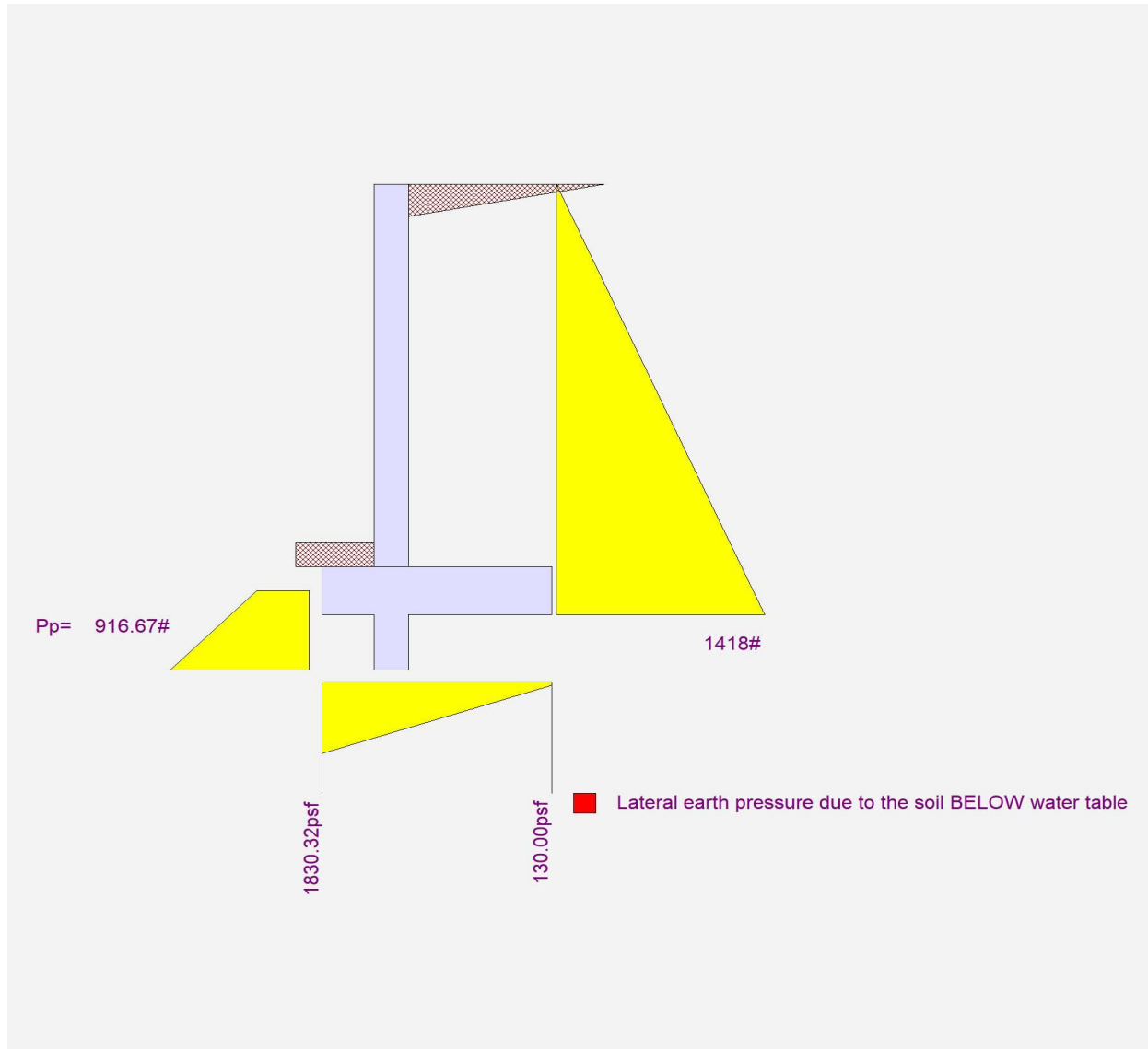## Cantilevered Retaining Wall

Project File: Typical Detail Co-04-06.EC6

LIC# : KW-06014947, Build:20.22.3.31     SWENSON SAY FAGET     (c) ENERCALC INC 1983-2022

**DESCRIPTION:** Retaining Wall Schedule 8'-0" Retaining Wall



8" w/ #5 @ 12"

8'-0"

6"

#5@12in
@ Toe

#4@13.89in
@ Center On Key

#5@12"

@ Heel

2"
1'-0"
3"
1'-2"

1'-0"    8"    2'-9"

1'-0"    3'-5"

4'-5"

**Cantilevered Retaining Wall**

LIC# : KW-06014947, Build:20.22.3.31     SWENSON SAY FAGET     (c) ENERCALC INC 1983-2022

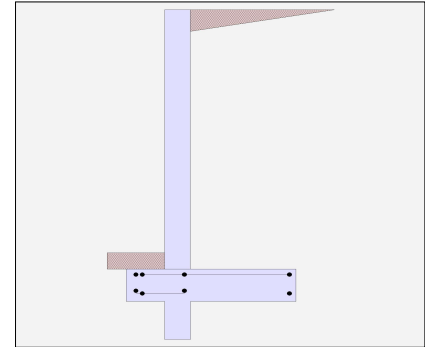**DESCRIPTION:** Retaining Wall Schedule 8'-0" Retaining Wall

Pp=   916.67#

1418#

1830.32psf

130.00psf

Lateral earth pressure due to the soil BELOW water table

# Cantilevered Retaining Wall

Project File: Typical Detail Co-04-06.EC6

**DESCRIPTION:** Retaining Wall Schedule 8'-0" Retaining Wall W/ Seismic

## Code References

Calculations per IBC 2018 1807.3, CBC 2019, ASCE 7-16

## Criteria

| | | |
|---|---|---|
| Retained Height | = | 8.00 ft |
| Wall height above soil | = | 0.00 ft |
| Slope Behind Wall | = | 0.00 |
| Height of Soil over Toe | = | 6.00 in |
| Water height over heel | = | 0.0 ft |

## Soil Data

| | | |
|---|---|---|
| Allow Soil Bearing | = | 4,000.0 psf |
| Equivalent Fluid Pressure Method | | |
| Active Heel Pressure | = | 35.0 psf/ft |
| | = | |
| Passive Pressure | = | 300.0 psf/ft |
| Soil Density, Heel | = | 125.00 pcf |
| Soil Density, Toe | = | 0.00 pcf |
| Footing||Soil Friction | = | 0.300 |
| Soil height to ignore for passive pressure | = | 12.00 in |

## Surcharge Loads

| | | |
|---|---|---|
| Surcharge Over Heel | = | 0.0 psf |
| Used To Resist Sliding & Overturning | | |
| Surcharge Over Toe | = | 0.0 |
| 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 |

## Earth Pressure Seismic Load

Method : Uniform
Multiplier Used        =        6.000
(Multiplier used on soil density)

## Lateral Load Applied to Stem

| | | |
|---|---|---|
| Lateral Load | = | 0.0 #/ft |
| ...Height to Top | = | 0.00 ft |
| ...Height to Bottom | = | 0.00 ft |
| Load Type | = | Wind (W) |
| | | (Service Level) |
| Wind on Exposed Stem (Strength Level) | = | 0.0 psf |

| | | |
|---|---|---|
| Uniform Seismic Force | = | 54.000 |
| Total Seismic Force | = | 486.000 |

## 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 | | Spread Footing |
| Base Above/Below Soil at Back of Wall | = | 0.0 ft |
| Poisson's Ratio | = | 0.300 |

# Cantilevered Retaining Wall

Project File: Typical Detail Co-04-06.EC6

**DESCRIPTION:** Retaining Wall Schedule 8'-0" Retaining Wall W/ Seismic

## Design Summary

### Wall Stability Ratios

| | | | |
|---|---|---|---|
| Overturning | = | 1.91 | OK |
| Sliding | = | 1.26 | Ratio < 1.5! |
| Global Stability | = | 2.00 | |
| | | | |
| Total Bearing Load | = | 4,328 lbs | |
| ...resultant ecc. | = | 11.90 in | |
| | | | |
| Soil Pressure @ Toe | = | 2,373 psf | OK |
| Soil Pressure @ Heel | = | 0 psf | OK |
| Allowable | = | 4,000 psf | |

Soil Pressure Less Than Allowable

| | | | |
|---|---|---|---|
| ACI Factored @ Toe | = | 3,322 psf | |
| ACI Factored @ Heel | = | 0 psf | |
| Footing Shear @ Toe | = | 8.3 psi | OK |
| Footing Shear @ Heel | = | 17.6 psi | OK |
| Allowable | = | 75.0 psi | |

### Sliding Calcs

| | | | |
|---|---|---|---|
| Lateral Sliding Force | = | 1,757.7 lbs | |
| less 100% Passive Force | - | 916.7 lbs | |
| less 100% Friction Force | ≡ - | 1,298.5 lbs | |
| Added Force Req'd | = | 0.0 lbs | OK |
| ....for 1.5 Stability | = | 421.4 lbs | NG |

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

### Load Factors

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

## Stem Construction

| | | **Bottom** | | | | |
|---|---|---|---|---|---|---|
| | | Stem OK | | | | |
| **Design Height Above Ftg** | ft = | 0.00 | | | | |
| Wall Material Above "Ht" | = | Concrete | | | | |
| Design Method | = | SD | SD | SD | SD | SD |
| Thickness | = | 8.00 | | | | |
| Rebar Size | = | # 5 | | | | |
| Rebar Spacing | = | 12.00 | | | | |
| Rebar Placed at | = | Edge | | | | |

### Design Data

| | | |
|---|---|---|
| fb/FB + fa/Fa | = | **0.801** |
| **Total Force @ Section** | | |
| Service Level | lbs = | |
| Strength Level | lbs = | 2,224.0 |
| **Moment....Actual** | | |
| Service Level | ft-# = | |
| Strength Level | ft-# = | 6,506.7 |
| Moment.....Allowable | = | 8,121.3 |
| **Shear.....Actual** | | |
| Service Level | psi = | |
| Strength Level | psi = | 30.0 |
| Shear.....Allowable | psi = | 75.0 |
| Anet (Masonry) | in2 = | |
| Wall Weight | psf = | 100.0 |
| Rebar Depth 'd' | in = | 6.19 |

### Masonry Data

| | | |
|---|---|---|
| f'm | psi = | |
| Fs | psi = | |
| Solid Grouting | = | |
| Modular Ratio 'n' | = | |
| Equiv. Solid Thick. | = | |
| Masonry Block Type | = | |
| Masonry Design Method | = | ASD |

### Concrete Data

| | | |
|---|---|---|
| f'c | psi = | 2,500.0 |
| Fy | psi = | 60,000.0 |

## Cantilevered Retaining Wall

Project File: Typical Detail Co-04-06.EC6

**DESCRIPTION:** Retaining Wall Schedule 8'-0" Retaining Wall W/ Seismic

---

### Concrete Stem Rebar Area Details

| Bottom Stem | Vertical Reinforcing | Horizontal Reinforcing |
|---|---|---|
| As (based on applied moment) : | 0.2464 in2/ft | |
| (4/3) * As : | 0.3285 in2/ft | Min Stem T&S Reinf Area 1.536 in2 |
| 200bd/fy : 200(12)(6.1875)/60000 : | 0.2475 in2/ft | Min Stem T&S Reinf Area per ft of stem Height : 0.192 in2/ft |
| 0.0018bh : 0.0018(12)(8) : | 0.1728 in2/ft | Horizontal Reinforcing Options : |
| | ============ | One layer of :    Two layers of : |
| Required Area : | 0.2475 in2/ft | #4@ 12.50 in    #4@ 25.00 in |
| Provided Area : | 0.31 in2/ft | #5@ 19.38 in    #5@ 38.75 in |
| Maximum Area : | 0.8382 in2/ft | #6@ 27.50 in    #6@ 55.00 in |

### Footing Data

| | | |
|---|---|---|
| Toe Width | = | 1.00 ft |
| Heel Width | = | 3.42 |
| Total Footing Width | = | 4.42 |
| Footing Thickness | = | 12.00 in |
| Key Width | = | 8.00 in |
| Key Depth | = | 14.00 in |
| Key Distance from Toe | = | 1.00 ft |

f'c = 2,500 psi    Fy = 60,000 psi
Footing Concrete Density = 150.00 pcf
Min. As % = 0.0018
Cover @ Top 2.00 @ Btm = 3.00 in

### Footing Design Results

| | | Toe | Heel |
|---|---|---|---|
| Factored Pressure | = | 3,322 | 0 psf |
| Mu' : Upward | = | 1,509 | 1,180 ft-# |
| Mu' : Downward | = | 128 | 5,216 ft-# |
| Mu: Design | = | 1,382 | 4,035 ft-# |
| phiMn | = | 11,610 | 13,005 ft-# |
| Actual 1-Way Shear | = | 8.32 | 17.60 psi |
| Allow 1-Way Shear | = | 75.00 | 75.00 psi |
| Toe Reinforcing | = | # 5 @ 12.00 in | |
| Heel Reinforcing | = | # 5 @ 12.00 in | |
| Key Reinforcing | = | None Spec'd | |
| Footing Torsion, Tu | = | | 0.00 ft-lbs |
| Footing Allow. Torsion, phi Tu | = | | 0.00 ft-lbs |

**If torsion exceeds allowable, provide
supplemental design for footing torsion.**

Other Acceptable Sizes & Spacings

    Toe:
    Heel:
    Key:

| Min footing T&S reinf Area | 1.14 | in2 |
|---|---|---|
| Min footing T&S reinf Area per foot | 0.26 | in2 /ft |

If one layer of horizontal bars:     If two layers of horizontal bars:

   #4@ 9.26 in        #4@ 18.52 in
   #5@ 14.35 in       #5@ 28.70 in
   #6@ 20.37 in       #6@ 40.74 in

## Cantilevered Retaining Wall

Project File: Typical Detail Co-04-06.EC6

**DESCRIPTION:**  Retaining Wall Schedule 8'-0" Retaining Wall W/ Seismic

### Summary of Overturning & Resisting Forces & Moments

| Item | .....OVERTURNING..... | | | | .....RESISTING..... | | |
| | Force lbs | Distance ft | Moment ft-# | | Force lbs | Distance ft | Moment ft-# |
|---|---|---|---|---|---|---|---|
| HL Act Pres (ab water tbl) | 1,417.5 | 3.00 | 4,252.5 | Soil Over HL  (ab. water tbl) | 2,749.3 | 3.04 | 8,361.6 |
| HL Act Pres (be water tbl) | | | | Soil Over HL  (bel. water tbl) | | 3.04 | 8,361.6 |
| Hydrostatic Force | | | | Watre Table | | | |
| Buoyant Force = | | | | Sloped Soil Over Heel  = | | | |
| Surcharge over Heel = | | | | Surcharge Over Heel  = | | | |
| Surcharge Over Toe = | | | | Adjacent Footing Load  = | | | |
| Adjacent Footing Load = | | | | Axial Dead Load on Stem = | | | |
| Added Lateral Load = | | | | * Axial Live Load on Stem  = | | | |
| Load @ Stem Above Soil = | | | | Soil Over Toe  = | | 0.50 | |
| Seismic Earth Load = | 340.2 | 4.50 | 1,530.9 | Surcharge Over Toe  = | | | |
| = | | | | Stem Weight(s)  = | 800.0 | 1.33 | 1,066.7 |
| | | | | Earth @ Stem Transitions = | | | |
| **Total** = | 1,757.7 | O.T.M. = | 5,783.4 | Footing Weight  = | 662.4 | 2.21 | 1,462.6 |
| | | | | Key Weight  = | 116.7 | 1.33 | 155.6 |
| | | | | Vert. Component  = | | | |
| **Resisting/Overturning Ratio** = **1.91** | | | | Total = | 4,328.4 | lbs  R.M.= | 11,046.4 |

Vertical Loads used for Soil Pressure =     4,328.4  lbs

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

If seismic is included, the OTM and sliding ratios
may be 1.1 per section 1807.2.3 of IBC.

Vertical component of active lateral soil pressure IS NOT considered in
the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in
the calculation of Overturning Resistance.

### Tilt

#### Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

| | | |
|---|---|---|
| Soil Spring Reaction Modulus | 250.0 | pci |
| Horizontal Defl @ Top of Wall (approximate only) | 0.119 | in |

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe,

because the wall would then tend to rotate into the retained soil.
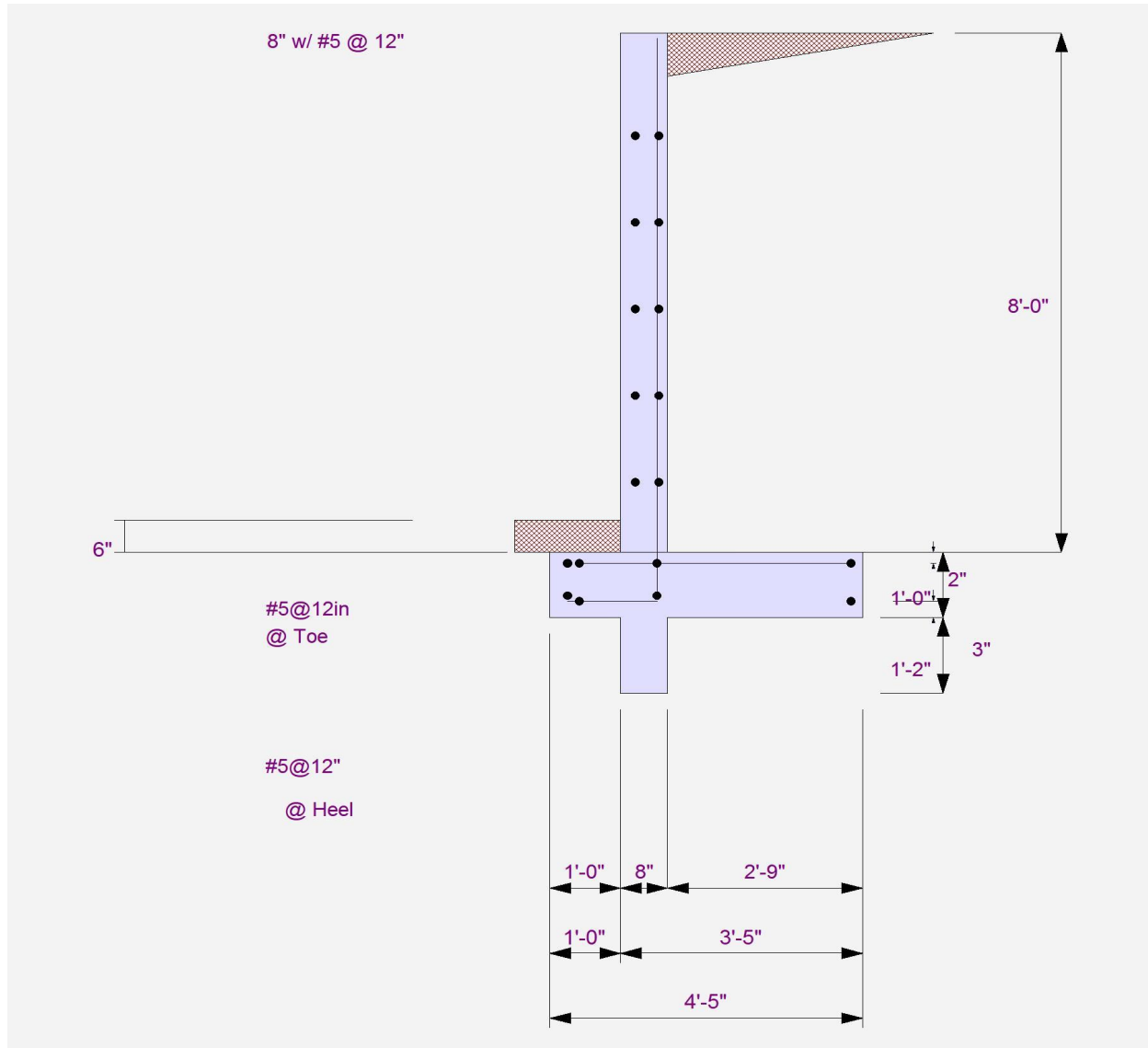
## Cantilevered Retaining Wall

Project File: Typical Detail Co-04-06.EC6

LIC# : KW-06014947, Build:20.22.3.31      SWENSON SAY FAGET      (c) ENERCALC INC 1983-2022

**DESCRIPTION:** Retaining Wall Schedule 8'-0" Retaining Wall W/ Seismic

### Rebar Lap & Embedment Lengths Information

Stem Design Segment: Bottom
Stem Design Height:      0.00 ft above top of footing

| | |
|---|---|
| Lap Splice length for #5 bar specified in this stem design segment = | 23.40 in |
| Development length for #5 bar specified in this stem design segment = | 18.00 in |
| Hooked embedment length into footing for #5 bar specified in this stem design segment = | 8.38 in |
| As Provided = | 0.3100 in2/ft |
| As Required = | 0.2475 in2/ft |

## Cantilevered Retaining Wall

**DESCRIPTION:**  Retaining Wall Schedule 8'-0" Retaining Wall W/ Seismic

8" w/ #5 @ 12"

8'-0"

6"

#5@12in
@ Toe

2"

1'-0"

3"

1'-2"

#5@12"

@ Heel

1'-0"   8"   2'-9"

1'-0"   3'-5"

4'-5"

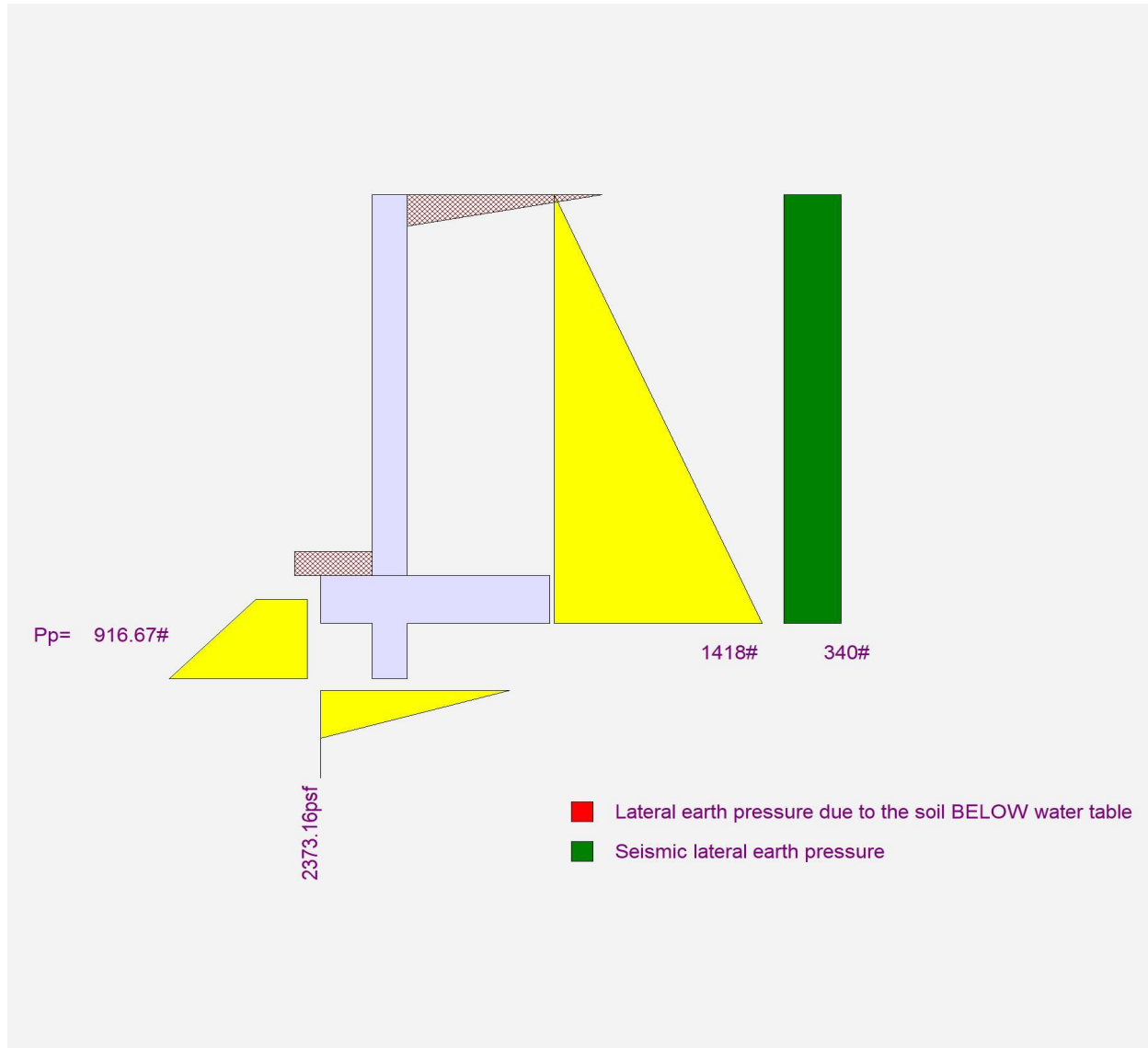# Cantilevered Retaining Wall

Project File: Typical Detail Co-04-06.EC6

LIC# : KW-06014947, Build:20.22.3.31     SWENSON SAY FAGET     (c) ENERCALC INC 1983-2022

**DESCRIPTION:**  Retaining Wall Schedule 8'-0" Retaining Wall W/ Seismic



Pp=   916.67#

1418#     340#

2373.16psf

🟥 Lateral earth pressure due to the soil BELOW water table

🟩 Seismic lateral earth pressure

## Cantilevered Retaining Wall

Project File: Typical Detail Co-04-06.EC6

LIC# : KW-06014947, Build:20.22.3.31          SWENSON SAY FAGET          (c) ENERCALC INC 1983-2022

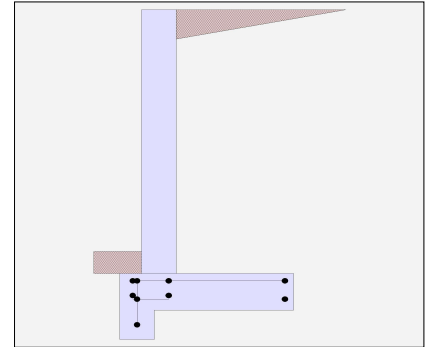**DESCRIPTION:**  Retaining Wall Schedule 6'-0" Retaining Wall

### Code References

Calculations per IBC 2018 1807.3, CBC 2019, ASCE 7-16

### Criteria

| | | |
|---|---|---|
| Retained Height | = | 6.00 ft |
| Wall height above soil | = | 0.00 ft |
| Slope Behind Wall | = | 0.00 |
| Height of Soil over Toe | = | 6.00 in |
| Water height over heel | = | 0.0 ft |

### Soil Data

| | | |
|---|---|---|
| Allow Soil Bearing | = | 3,000.0 psf |
| Equivalent Fluid Pressure Method | | |
| Active Heel Pressure | = | 35.0 psf/ft |
| | = | |
| Passive Pressure | = | 300.0 psf/ft |
| Soil Density, Heel | = | 125.00 pcf |
| Soil Density, Toe | = | 0.00 pcf |
| Footing||Soil Friction | = | 0.300 |
| Soil height to ignore for passive pressure | = | 12.00 in |



### Surcharge Loads

| | | |
|---|---|---|
| Surcharge Over Heel | = | 0.0 psf |
| Used To Resist Sliding & Overturning | | |
| Surcharge Over Toe | = | 0.0 |
| Used for Sliding & Overturning | | |

### Lateral Load Applied to Stem

| | | |
|---|---|---|
| Lateral Load | = | 0.0 #/ft |
| ...Height to Top | = | 0.00 ft |
| ...Height to Bottom | = | 0.00 ft |
| Load Type | = | Wind (W) |
| | | (Service Level) |
| Wind on Exposed Stem | = | 0.0 psf |
| (Strength Level) | | |

### 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 | | Spread Footing |
| Base Above/Below Soil at Back of Wall | = | 0.0 ft |
| Poisson's Ratio | = | 0.300 |

### Axial Load Applied to Stem

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

# Cantilevered Retaining Wall

LIC# : KW-06014947, Build:20.22.3.31      SWENSON SAY FAGET      (c) ENERCALC INC 1983-2022

**DESCRIPTION:** Retaining Wall Schedule 6'-0" Retaining Wall

## Design Summary

### Wall Stability Ratios
| | | | |
|---|---|---|---|
| Overturning | = | 2.64 | OK |
| Sliding | = | 1.57 | OK |
| Global Stability | = | 2.22 | |
| | | | |
| Total Bearing Load | = | 2,774 lbs | |
| ...resultant ecc. | = | 6.84 in | |
| | | | |
| Soil Pressure @ Toe | = | 1,682 psf | OK |
| Soil Pressure @ Heel | = | 0 psf | OK |
| Allowable | = | 3,000 psf | |

Soil Pressure Less Than Allowable

| | | | |
|---|---|---|---|
| ACI Factored @ Toe | = | 2,355 psf | |
| ACI Factored @ Heel | = | 0 psf | |
| Footing Shear @ Toe | = | 0.4 psi | OK |
| Footing Shear @ Heel | = | 6.9 psi | OK |
| Allowable | = | 94.9 psi | |

### Sliding Calcs
| | | | |
|---|---|---|---|
| Lateral Sliding Force | = | 817.2 lbs | |
| less 100% Passive Force | - | 450.0 lbs | |
| less 100% Friction Force | - | 832.3 lbs | |
| Added Force Req'd | = | 0.0 lbs | OK |
| ....for 1.5 Stability | = | 0.0 lbs | OK |

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

### Load Factors
| | |
|---|---|
| Building Code | |
| Dead Load | 1.200 |
| Live Load | 1.600 |
| Earth, H | 1.600 |
| Wind, W | 1.600 |
| Seismic, E | 1.000 |

## Stem Construction

| | | Bottom | | | | |
|---|---|---|---|---|---|---|
| | | Stem OK | | | | |
| **Design Height Above Ftg** ft = | | 0.00 | | | | |
| Wall Material Above "Ht" | = | Concrete | | | | |
| Design Method | = | SD | SD | SD | SD | SD |
| Thickness | = | 8.00 | | | | |
| Rebar Size | = | # 4 | | | | |
| Rebar Spacing | = | 12.00 | | | | |
| Rebar Placed at | = | Edge | | | | |

**Design Data**
| | | |
|---|---|---|
| fb/FB + fa/Fa | = | **0.367** |

**Total Force @ Section**
| | | |
|---|---|---|
| Service Level | lbs = | |
| Strength Level | lbs = | 1,008.0 |

**Moment....Actual**
| | | |
|---|---|---|
| Service Level | ft-# = | |
| Strength Level | ft-# = | 2,016.0 |
| Moment.....Allowable | = | 5,492.3 |

**Shear.....Actual**
| | | |
|---|---|---|
| Service Level | psi = | |
| Strength Level | psi = | 13.4 |
| Shear.....Allowable | psi = | 94.9 |
| Anet (Masonry) | in2 = | |
| Wall Weight | psf = | 100.0 |
| Rebar Depth  'd' | in = | 6.25 |

**Masonry Data**
| | | |
|---|---|---|
| f'm | psi = | |
| Fs | psi = | |
| Solid Grouting | = | |
| Modular Ratio 'n' | = | |
| Equiv. Solid Thick. | = | |
| Masonry Block Type | = | |
| Masonry Design Method | = | ASD |

**Concrete Data**
| | | |
|---|---|---|
| f'c | psi = | 4,000.0 |
| Fy | psi = | 60,000.0 |

## Cantilevered Retaining Wall

Project File: Typical Detail Co-04-06.EC6

LIC# : KW-06014947, Build:20.22.3.31       SWENSON SAY FAGET       (c) ENERCALC INC 1983-2022

**DESCRIPTION:** Retaining Wall Schedule 6'-0" Retaining Wall

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### Concrete Stem Rebar Area Details

Bottom Stem      Vertical Reinforcing      Horizontal Reinforcing

As (based on applied moment) :      0.0755 in2/ft

(4/3) * As :      0.1007 in2/ft      Min Stem T&S Reinf Area 1.152 in2

200bd/fy : 200(12)(6.25)/60000 :      0.25 in2/ft      Min Stem T&S Reinf Area per ft of stem Height : 0.192 in2/ft

0.0018bh : 0.0018(12)(8) :      0.1728 in2/ft      Horizontal Reinforcing Options :

     ============      One layer of :      Two layers of :

Required Area :      0.1728 in2/ft      #4@ 12.50 in      #4@ 25.00 in

Provided Area :      0.2 in2/ft      #5@ 19.38 in      #5@ 38.75 in

Maximum Area :      1.3547 in2/ft      #6@ 27.50 in      #6@ 55.00 in

### Footing Data

| | | |
|---|---|---|
| Toe Width | = | 0.42 ft |
| Heel Width | = | 2.92 |
| Total Footing Width | = | 3.34 |
| Footing Thickness | = | 10.00 in |
| Key Width | = | 8.00 in |
| Key Depth | = | 8.00 in |
| Key Distance from Toe | = | 0.00 ft |

f'c = 4,000 psi    Fy = 60,000 psi
Footing Concrete Density = 150.00 pcf
Min. As % = 0.0018
Cover @ Top 2.00 @ Btm.= 3.00 in

### Footing Design Results

| | | Toe | Heel | |
|---|---|---|---|---|
| Factored Pressure | = | 2,355 | 0 | psf |
| Mu' : Upward | = | 199 | 1,288 | ft-# |
| Mu' : Downward | = | 20 | 2,666 | ft-# |
| Mu: Design | = | 179 | 1,378 | ft-# |
| phiMn | = | 5,943 | 6,843 | ft-# |
| Actual 1-Way Shear | = | 0.39 | 6.88 | psi |
| Allow 1-Way Shear | = | 94.87 | 94.87 | psi |
| Toe Reinforcing | = | # 4 @ 12.00 in | | |
| Heel Reinforcing | = | # 4 @ 12.00 in | | |
| Key Reinforcing | = | # 4 @ 13.89 in | | |
| Footing Torsion, Tu | = | | 0.00 | ft-lbs |
| Footing Allow. Torsion, phi Tu | = | | 0.00 | ft-lbs |

**If torsion exceeds allowable, provide supplemental design for footing torsion.**

Other Acceptable Sizes & Spacings

   Toe:
   Heel:
   Key:

| | | |
|---|---|---|
| Min footing T&S reinf Area | 0.72 | in2 |
| Min footing T&S reinf Area per foot | 0.22 | in2 /ft |

If one layer of horizontal bars:      If two layers of horizontal bars:

   #4@ 11.11 in          #4@ 22.22 in

   #5@ 17.22 in          #5@ 34.44 in

   #6@ 24.44 in          #6@ 48.89 in

## Cantilevered Retaining Wall

Project File: Typical Detail Co-04-06.EC6

LIC# : KW-06014947, Build:20.22.3.31       SWENSON SAY FAGET       (c) ENERCALC INC 1983-2022

**DESCRIPTION:** Retaining Wall Schedule 6'-0" Retaining Wall

### Summary of Overturning & Resisting Forces & Moments

| Item | .....OVERTURNING..... Force lbs | Distance ft | Moment ft-# | | .....RESISTING..... Force lbs | Distance ft | Moment ft-# |
|---|---|---|---|---|---|---|---|
| HL Act Pres (ab water tbl) | 817.2 | 2.28 | 1,861.3 | Soil Over HL  (ab. water tbl) | 1,690.0 | 2.21 | 3,740.5 |
| HL Act Pres (be water tbl) | | | | Soil Over HL  (bel. water tbl) | | 2.21 | 3,740.5 |
| Hydrostatic Force | | | | Watre Table | | | |
| Buoyant Force | = | | | Sloped Soil Over Heel      = | | | |
| Surcharge over Heel | = | | | Surcharge Over Heel      = | | | |
| Surcharge Over Toe | = | | | Adjacent Footing Load      = | | | |
| Adjacent Footing Load | = | | | Axial Dead Load on Stem = | | | |
| Added Lateral Load | = | | | * Axial Live Load on Stem  = | | | |
| Load @ Stem Above Soil | = | | | Soil Over Toe      = | | 0.21 | |
| | = | | | Surcharge Over Toe      = | | | |
| | | | | Stem Weight(s)      = | 600.0 | 0.75 | 452.0 |
| | | | | Earth @ Stem Transitions = | | | |
| **Total** | = 817.2 | **O.T.M.** = | 1,861.3 | Footing Weight      = | 417.5 | 1.67 | 697.2 |
| | | | | Key Weight      = | 66.7 | 0.33 | 22.2 |
| **Resisting/Overturning Ratio** | = | **2.64** | | Vert. Component      = | | | |
| Vertical Loads used for Soil Pressure = | | 2,774.2 lbs | | **Total =** | 2,774.2 lbs | **R.M.=** | 4,912.0 |

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

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

### Tilt

#### Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

| | | |
|---|---|---|
| Soil Spring Reaction Modulus | 250.0 | pci |
| Horizontal Defl @ Top of Wall (approximate only) | 0.084 | in |

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe, because the wall would then tend to rotate into the retained soil.

## Cantilevered Retaining Wall

Project File: Typical Detail Co-04-06.EC6

**DESCRIPTION:**  Retaining Wall Schedule 6'-0" Retaining Wall

## Rebar Lap & Embedment Lengths Information

Stem Design Segment: Bottom
Stem Design Height:      0.00 ft above top of footing

| | |
|---|---:|
| Lap Splice length for #4 bar specified in this stem design segment = | 15.60 in |
| Development length for #4 bar specified in this stem design segment = | 12.00 in |
| Hooked embedment length into footing for #4 bar specified in this stem design segment = | 6.00 in |
| As Provided = | 0.2000 in2/ft |
| As Required = | 0.1728 in2/ft |

## Cantilevered Retaining Wall

Project File: Typical Detail Co-04-06.EC6

**DESCRIPTION:**  Retaining Wall Schedule 6'-0" Retaining Wall



8" w/ #4 @ 12"

6'-0"

6"

#4@12in
@ Toe

#4@13.89in
@ Center On Key

#4@12"
@ Heel

2"
10"
8"
3"

8"    2'-8"

5"    2'-11"
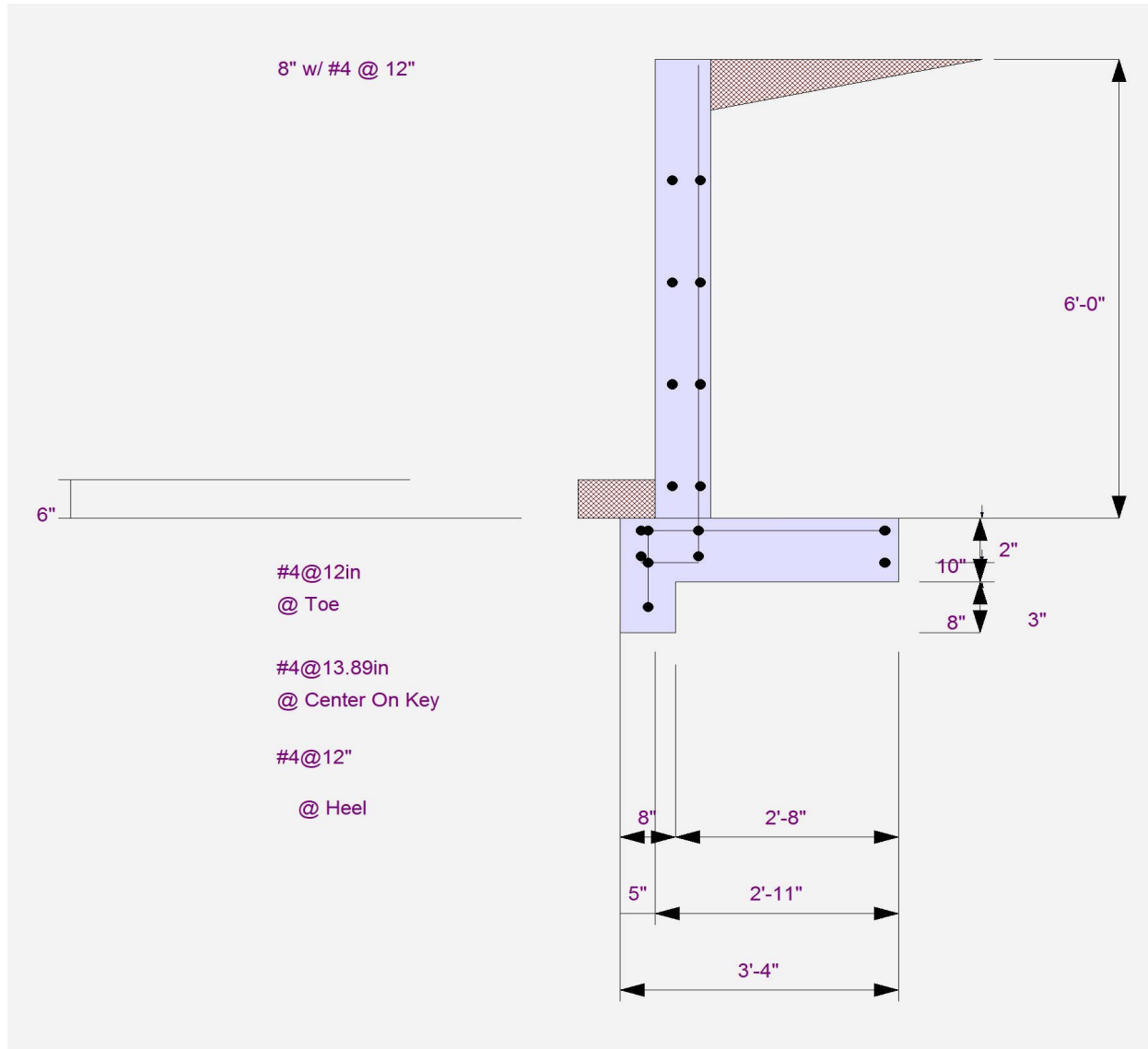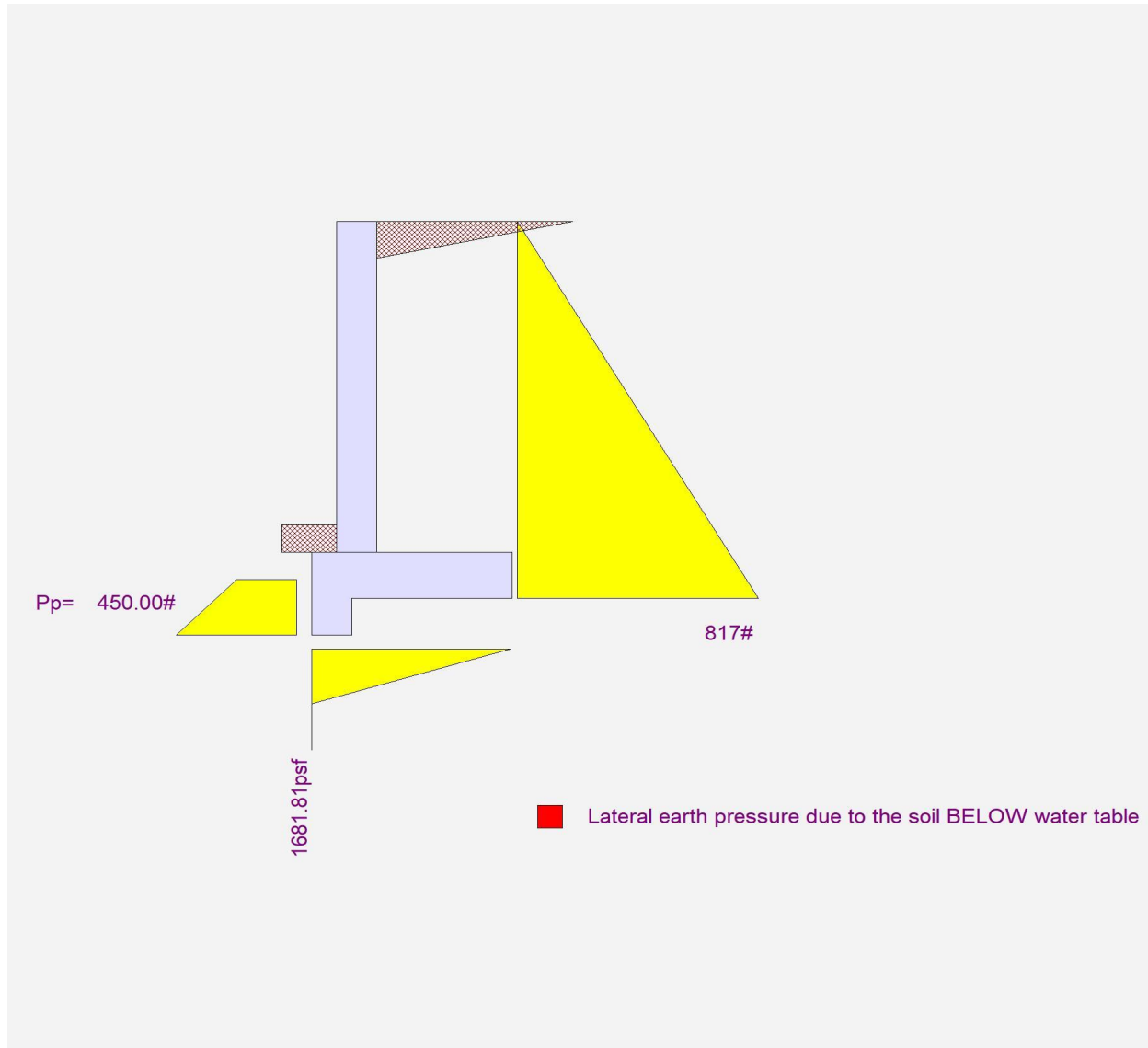
3'-4"

## Cantilevered Retaining Wall

Project File: Typical Detail Co-04-06.EC6

LIC# : KW-06014947, Build:20.22.3.31                SWENSON SAY FAGET                (c) ENERCALC INC 1983-2022

**DESCRIPTION:**  Retaining Wall Schedule 6'-0" Retaining Wall

Pp=    450.00#

817#

1681.81psf

■  Lateral earth pressure due to the soil BELOW water table

## Cantilevered Retaining Wall

Project File: Typical Detail Co-04-06.EC6

LIC# : KW-06014947, Build:20.22.3.31              SWENSON SAY FAGET                    (c) ENERCALC INC 1983-2022

**DESCRIPTION:**  Retaining Wall Schedule 6'-0" Retaining Wall W/ Seismic
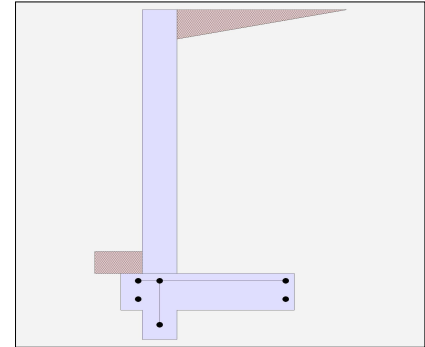
### Code References

Calculations per IBC 2018 1807.3, CBC 2019, ASCE 7-16

### Criteria

| | | |
|---|---|---|
| Retained Height | = | 6.00 ft |
| Wall height above soil | = | 0.00 ft |
| Slope Behind Wall | = | 0.00 |
| Height of Soil over Toe | = | 6.00 in |
| Water height over heel | = | 0.0 ft |

### Soil Data

| | | |
|---|---|---|
| Allow Soil Bearing | = | 4,000.0 psf |
| Equivalent Fluid Pressure Method | | |
| Active Heel Pressure | = | 35.0 psf/ft |
| | = | |
| Passive Pressure | = | 300.0 psf/ft |
| Soil Density, Heel | = | 125.00 pcf |
| Soil Density, Toe | = | 0.00 pcf |
| Footing||Soil Friction | = | 0.300 |
| Soil height to ignore for passive pressure | = | 12.00 in |



### Surcharge Loads

| | | |
|---|---|---|
| Surcharge Over Heel | = | 0.0 psf |
| Used To Resist Sliding & Overturning | | |
| Surcharge Over Toe | = | 0.0 |
| 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 |

### Earth Pressure Seismic Load

Method  : Uniform
Multiplier Used         =       6.000
(Multiplier used on soil density)

### Lateral Load Applied to Stem

| | | |
|---|---|---|
| Lateral Load | = | 0.0 #/ft |
| ...Height to Top | = | 0.00 ft |
| ...Height to Bottom | = | 0.00 ft |
| Load Type | = | Wind (W) |
| | | (Service Level) |
| Wind on Exposed Stem | = | 0.0 psf |
| (Strength Level) | | |

| | | |
|---|---|---|
| Uniform Seismic Force | = | 41.000 |
| Total Seismic Force | = | 280.167 |

### 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 | | Spread Footing |
| Base Above/Below Soil at Back of Wall | = | 0.0 ft |
| Poisson's Ratio | = | 0.300 |

# Cantilevered Retaining Wall

Project File: Typical Detail Co-04-06.EC6

LIC# : KW-06014947, Build:20.22.3.31     SWENSON SAY FAGET     (c) ENERCALC INC 1983-2022

**DESCRIPTION:** Retaining Wall Schedule 6'-0" Retaining Wall W/ Seismic

## Design Summary

**Wall Stability Ratios**

| | | | |
|---|---|---|---|
| Overturning | = | 1.95 | OK |
| Sliding | = | 1.27 | Ratio < 1.5! |
| Global Stability | = | 2.22 | |
| | | | |
| Total Bearing Load | = | 2,774 lbs | |
| ...resultant ecc. | = | 9.64 in | |
| | | | |
| Soil Pressure @ Toe | = | 2,139 psf | OK |
| Soil Pressure @ Heel | = | 0 psf | OK |
| Allowable | = | 4,000 psf | |

Soil Pressure Less Than Allowable

| | | | |
|---|---|---|---|
| ACI Factored @ Toe | = | 2,995 psf | |
| ACI Factored @ Heel | = | 0 psf | |
| Footing Shear @ Toe | = | 0.4 psi | OK |
| Footing Shear @ Heel | = | 11.6 psi | OK |
| Allowable | = | 75.0 psi | |

**Sliding Calcs**

| | | | |
|---|---|---|---|
| Lateral Sliding Force | = | 1,013.3 lbs | |
| less 100% Passive Force | - | 450.0 lbs | |
| less 100% Friction Force | - | 832.1 lbs | |
| Added Force Req'd | = | 0.0 lbs | OK |
| ....for 1.5 Stability | = | 237.8 lbs | NG |

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

**Load Factors**

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

## Stem Construction

| | | Bottom | | | | |
|---|---|---|---|---|---|---|
| | | Stem OK | | | | |
| **Design Height Above Ftg** ft = | | 0.00 | | | | |
| Wall Material Above "Ht" | = | Concrete | | | | |
| Design Method | = | SD | SD | SD | SD | SD |
| Thickness | = | 8.00 | | | | |
| Rebar Size | = | # 4 | | | | |
| Rebar Spacing | = | 12.00 | | | | |
| Rebar Placed at | = | Edge | | | | |

**Design Data**

| | | | |
|---|---|---|---|
| fb/FB + fa/Fa | = | **0.508** | |
| **Total Force @ Section** | | | |
| Service Level | lbs = | | |
| Strength Level | lbs = | 1,254.0 | |
| **Moment....Actual** | | | |
| Service Level | ft-# = | | |
| Strength Level | ft-# = | 2,754.0 | |
| Moment.....Allowable | = | 5,412.6 | |
| **Shear.....Actual** | | | |
| Service Level | psi = | | |
| Strength Level | psi = | 16.7 | |
| Shear.....Allowable | psi = | 75.0 | |
| Anet (Masonry) | in2 = | | |
| Wall Weight | psf = | 100.0 | |
| Rebar Depth 'd' | in = | 6.25 | |

**Masonry Data**

| | | |
|---|---|---|
| f'm | psi = | |
| Fs | psi = | |
| Solid Grouting | = | |
| Modular Ratio 'n' | = | |
| Equiv. Solid Thick. | = | |
| Masonry Block Type | = | |
| Masonry Design Method | = | ASD |

**Concrete Data**

| | | |
|---|---|---|
| f'c | psi = | 2,500.0 |
| Fy | psi = | 60,000.0 |

## Cantilevered Retaining Wall

Project File: Typical Detail Co-04-06.EC6

LIC# : KW-06014947, Build:20.22.3.31          SWENSON SAY FAGET          (c) ENERCALC INC 1983-2022

**DESCRIPTION:**  Retaining Wall Schedule 6'-0" Retaining Wall W/ Seismic

### Concrete Stem Rebar Area Details

| Bottom Stem | Vertical Reinforcing | Horizontal Reinforcing |
|---|---|---|
| As (based on applied moment) : | 0.1032 in2/ft | |
| (4/3) * As : | 0.1376 in2/ft | Min Stem T&S Reinf Area 1.152 in2 |
| 200bd/fy : 200(12)(6.25)/60000 : | 0.25 in2/ft | Min Stem T&S Reinf Area per ft of stem Height : 0.192 in2/ft |
| 0.0018bh : 0.0018(12)(8) : | 0.1728 in2/ft | Horizontal Reinforcing Options : |
| | ============ | One layer of :      Two layers of : |
| Required Area : | 0.1728 in2/ft | #4@ 12.50 in      #4@ 25.00 in |
| Provided Area : | 0.2 in2/ft | #5@ 19.38 in      #5@ 38.75 in |
| Maximum Area : | 0.8467 in2/ft | #6@ 27.50 in      #6@ 55.00 in |

### Footing Data

| | | |
|---|---|---|
| Toe Width | = | 0.42 ft |
| Heel Width | = | 2.92 |
| Total Footing Width | = | 3.34 |
| Footing Thickness | = | 10.00 in |
| Key Width | = | 8.00 in |
| Key Depth | = | 8.00 in |
| Key Distance from Toe | = | 0.42 ft |

f'c =      2,500 psi      Fy =      60,000 psi
Footing Concrete Density  =      150.00 pcf
Min. As %          =      0.0018
Cover @ Top      2.00      @ Btm.=      3.00 in

### Footing Design Results

| | | **Toe** | **Heel** |
|---|---|---|---|
| Factored Pressure | = | 2,995 | 0 psf |
| Mu' : Upward | = | 245 | 663 ft-# |
| Mu' : Downward | = | 19 | 2,666 ft-# |
| Mu:  Design | = | 226 | 2,002 ft-# |
| phiMn | = | 5,863 | 6,763 ft-# |
| Actual 1-Way Shear | = | 0.40 | 11.65 psi |
| Allow 1-Way Shear | = | 75.00 | 75.00 psi |
| Toe Reinforcing | = # 4 @ 12.00 in | | |
| Heel Reinforcing | = # 4 @ 12.00 in | | |
| Key Reinforcing | = # 4 @ 13.89 in | | |
| Footing Torsion, Tu | = | | 0.00 ft-lbs |
| Footing Allow. Torsion, phi Tu | = | | 0.00 ft-lbs |

**If torsion exceeds allowable, provide
supplemental design for footing torsion.**

Other Acceptable Sizes & Spacings

Toe:
Heel:
Key:

Min footing T&S reinf Area          0.72      in2
Min footing T&S reinf Area per foot      0.22      in2 /ft
If one layer of horizontal bars:          If two layers of horizontal bars:
#4@ 11.11 in                          #4@ 22.22 in
#5@ 17.22 in                          #5@ 34.44 in
#6@ 24.44 in                          #6@ 48.89 in

| **Cantilevered Retaining Wall** | Project File: Typical Detail Co-04-06.EC6 |
|---|---|

**DESCRIPTION:** Retaining Wall Schedule 6'-0" Retaining Wall W/ Seismic

## Summary of Overturning & Resisting Forces & Moments

| | .....OVERTURNING..... | | | | | .....RESISTING..... | | |
|---|---|---|---|---|---|---|---|---|
| **Item** | **Force** lbs | **Distance** ft | **Moment** ft-# | | | **Force** lbs | **Distance** ft | **Moment** ft-# |
| HL Act Pres (ab water tbl) | 817.2 | 2.28 | 1,861.3 | | Soil Over HL  (ab. water tbl) | 1,690.0 | 2.21 | 3,733.8 |
| HL Act Pres (be water tbl) | | | | | Soil Over HL  (bel. water tbl) | | 2.21 | 3,733.8 |
| Hydrostatic Force | | | | | Watre Table | | | |
| Buoyant Force | = | | | | Sloped Soil Over Heel | = | | |
| Surcharge over Heel | = | | | | Surcharge Over Heel | = | | |
| Surcharge Over Toe | = | | | | Adjacent Footing Load | = | | |
| Adjacent Footing Load | = | | | | Axial Dead Load on Stem | = | | |
| Added Lateral Load | = | | | | * Axial Live Load on Stem | = | | |
| Load @ Stem Above Soil | = | | | | Soil Over Toe | = | 0.21 | |
| Seismic Earth Load | = 196.1 | 3.42 | 670.1 | | Surcharge Over Toe | = | | |
| | = | | | | Stem Weight(s) | = 600.0 | 0.75 | 449.6 |
| | | | | | Earth @ Stem Transitions | = | | |
| **Total** | = 1,013.3 | **O.T.M.** = | 2,531.4 | | Footing Weight | = 417.0 | 1.67 | 695.6 |
| | | | | | Key Weight | = 66.7 | 0.75 | 50.0 |
| | | | | | Vert. Component | = | | |

**Resisting/Overturning Ratio**     =    **1.95**
   Vertical Loads used for Soil Pressure =    2,773.7   lbs

           **Total =**   2,773.7   lbs   **R.M.=**    4,928.9
* Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

If seismic is included, the OTM and sliding ratios
may be 1.1 per section 1807.2.3 of IBC.

Vertical component of active lateral soil pressure IS NOT considered in
the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in
the calculation of Overturning Resistance.

## Tilt

### Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

| | | |
|---|---|---|
| Soil Spring Reaction Modulus | 250.0 | pci |
| Horizontal Defl @ Top of Wall (approximate only) | 0.107 | in |

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe,

because the wall would then tend to rotate into the retained soil.

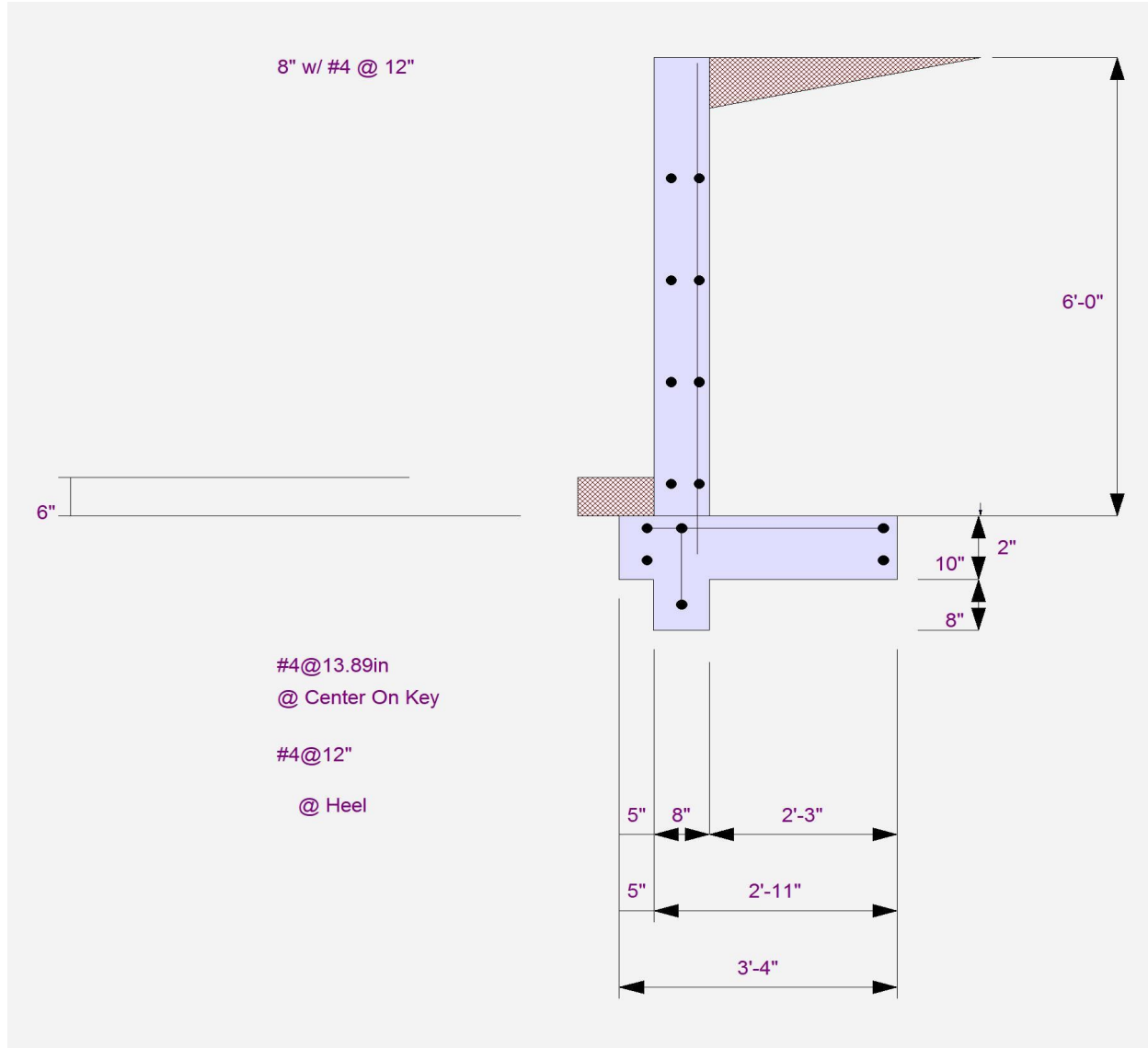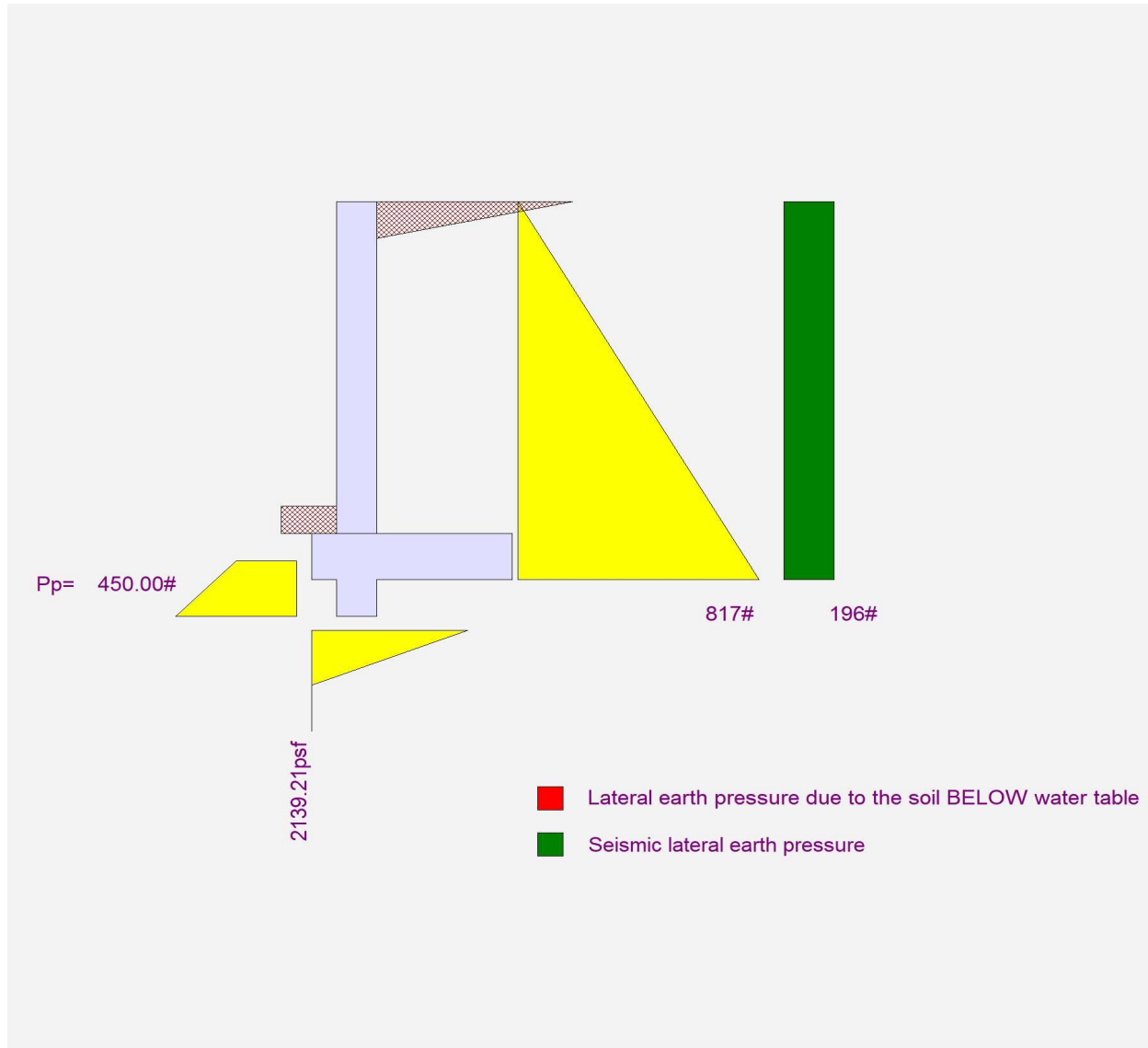## Cantilevered Retaining Wall

| | | |
|---|---|---|
| | | Project File: Typical Detail Co-04-06.EC6 |
| LIC# : KW-06014947, Build:20.22.3.31 | SWENSON SAY FAGET | (c) ENERCALC INC 1983-2022 |

**DESCRIPTION:**  Retaining Wall Schedule 6'-0" Retaining Wall W/ Seismic

---

### Rebar Lap & Embedment Lengths Information

Stem Design Segment: Bottom
Stem Design Height:     0.00 ft above top of footing

| | |
|---|---|
| Lap Splice length for #4 bar specified in this stem design segment = | 18.72 in |
| Development length for #4 bar specified in this stem design segment = | 14.40 in |
| | |
| Hooked embedment length into footing for #4 bar specified in this stem design segment = | 7.26 in |
| As Provided = | 0.2000 in2/ft |
| As Required = | 0.1728 in2/ft |

# Cantilevered Retaining Wall

Project File: Typical Detail Co-04-06.EC6

**DESCRIPTION:** Retaining Wall Schedule 6'-0" Retaining Wall W/ Seismic



8" w/ #4 @ 12"

6'-0"

6"

2"
10"
8"

#4@13.89in
@ Center On Key

#4@12"

@ Heel

5"   8"   2'-3"

5"   2'-11"

3'-4"

## Cantilevered Retaining Wall

Project File: Typical Detail Co-04-06.EC6

LIC# : KW-06014947, Build:20.22.3.31        SWENSON SAY FAGET        (c) ENERCALC INC 1983-2022

**DESCRIPTION:**  Retaining Wall Schedule 6'-0" Retaining Wall W/ Seismic
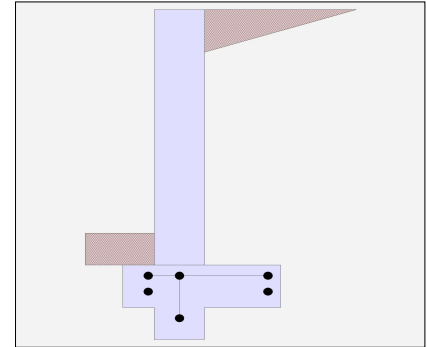
Pp=    450.00#

817#          196#

2139.21psf

■ Lateral earth pressure due to the soil BELOW water table

■ Seismic lateral earth pressure

## Cantilevered Retaining Wall

Project File: Typical Detail Co-04-06.EC6

LIC# : KW-06014947, Build:20.22.3.31        SWENSON SAY FAGET        (c) ENERCALC INC 1983-2022

**DESCRIPTION:**  Retaining Wall Schedule 4'-0" Retaining Wall

### Code References

Calculations per IBC 2018 1807.3, CBC 2019, ASCE 7-16

### Criteria

| | | |
|---|---|---|
| Retained Height | = | 4.00 ft |
| Wall height above soil | = | 0.00 ft |
| Slope Behind Wall | = | 0.00 |
| Height of Soil over Toe | = | 6.00 in |
| Water height over heel | = | 0.0 ft |

### Soil Data

| | | |
|---|---|---|
| Allow Soil Bearing | = | 3,000.0 psf |
| Equivalent Fluid Pressure Method | | |
| Active Heel Pressure | = | 35.0 psf/ft |
| | = | |
| Passive Pressure | = | 350.0 psf/ft |
| Soil Density, Heel | = | 125.00 pcf |
| Soil Density, Toe | = | 0.00 pcf |
| Footing‖Soil Friction | = | 0.300 |
| Soil height to ignore for passive pressure | = | 12.00 in |

### Surcharge Loads

| | | |
|---|---|---|
| Surcharge Over Heel | = | 0.0 psf |
| Used To Resist Sliding & Overturning | | |
| Surcharge Over Toe | = | 0.0 |
| 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 |

### Lateral Load Applied to Stem

| | | |
|---|---|---|
| Lateral Load | = | 0.0 #/ft |
| ...Height to Top | = | 0.00 ft |
| ...Height to Bottom | = | 0.00 ft |
| Load Type | = | Wind (W) |
| | | (Service Level) |
| Wind on Exposed Stem (Strength Level) | = | 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 | | Spread Footing |
| Base Above/Below Soil at Back of Wall | = | 0.0 ft |
| Poisson's Ratio | = | 0.300 |

## Cantilevered Retaining Wall

Project File: Typical Detail Co-04-06.EC6

**DESCRIPTION:** Retaining Wall Schedule 4'-0" Retaining Wall

### Design Summary

**Wall Stability Ratios**

| | | |
|---|---|---|
| Overturning | = | 2.28 OK |
| Sliding | = | 1.73 OK |
| Global Stability | = | 2.36 |
| | | |
| Total Bearing Load | = | 1,160 lbs |
| ...resultant ecc. | = | 4.69 in |
| | | |
| Soil Pressure @ Toe | = | 1,186 psf OK |
| Soil Pressure @ Heel | = | 0 psf OK |
| Allowable | = | 3,000 psf |

Soil Pressure Less Than Allowable

| | | |
|---|---|---|
| ACI Factored @ Toe | = | 1,660 psf |
| ACI Factored @ Heel | = | 0 psf |
| Footing Shear @ Toe | = | 1.1 psi OK |
| Footing Shear @ Heel | = | 6.0 psi OK |
| Allowable | = | 75.0 psi |

**Sliding Calcs**

| | | | |
|---|---|---|---|
| Lateral Sliding Force | = | | 381.1 lbs |
| less 100% Passive Force | - | | 311.1 lbs |
| less 100% Friction Force | ≅ - | | 348.1 lbs |
| Added Force Req'd | = | | 0.0 lbs OK |
| ....for 1.5 Stability | = | | 0.0 lbs OK |

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

**Load Factors**

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

### Stem Construction

**Bottom**

Stem OK

| | | | | | | |
|---|---|---|---|---|---|---|
| **Design Height Above Ftg** | ft = | 0.00 | | | | |
| Wall Material Above "Ht" | = | Concrete | | | | |
| Design Method | = | SD | SD | SD | SD | SD |
| Thickness | = | 8.00 | | | | |
| Rebar Size | = | # 4 | | | | |
| Rebar Spacing | = | 18.00 | | | | |
| Rebar Placed at | = | Edge | | | | |

**Design Data**

| | | |
|---|---|---|
| fb/FB + fa/Fa | = | **0.163** |

**Total Force @ Section**

| | | |
|---|---|---|
| Service Level | lbs = | |
| Strength Level | lbs = | 448.0 |

**Moment....Actual**

| | | |
|---|---|---|
| Service Level | ft-# = | |
| Strength Level | ft-# = | 597.3 |
| Moment.....Allowable | = | 3,655.6 |

**Shear.....Actual**

| | | |
|---|---|---|
| Service Level | psi = | |
| Strength Level | psi = | 6.0 |
| Shear.....Allowable | psi = | 75.0 |
| Anet (Masonry) | in2 = | |
| Wall Weight | psf = | 100.0 |
| Rebar Depth 'd' | in = | 6.25 |

**Masonry Data**

| | | |
|---|---|---|
| f'm | psi = | |
| Fs | psi = | |
| Solid Grouting | = | |
| Modular Ratio 'n' | = | |
| Equiv. Solid Thick. | = | |
| Masonry Block Type | = | |
| Masonry Design Method | = | ASD |

**Concrete Data**

| | | |
|---|---|---|
| f'c | psi = | 2,500.0 |
| Fy | psi = | 60,000.0 |

## Cantilevered Retaining Wall

Project File: Typical Detail Co-04-06.EC6

**DESCRIPTION:** Retaining Wall Schedule 4'-0" Retaining Wall

### Concrete Stem Rebar Area Details

| Bottom Stem | Vertical Reinforcing | Horizontal Reinforcing |
|---|---|---|
| As (based on applied moment) : | 0.0224 in2/ft | |
| (4/3) * As : | 0.0298 in2/ft | Min Stem T&S Reinf Area 0.768 in2 |
| 200bd/fy : 200(12)(6.25)/60000 : | 0.25 in2/ft | Min Stem T&S Reinf Area per ft of stem Height : 0.192 in2/ft |
| 0.0012bh : 0.0012(12)(8) : | 0.1152 in2/ft | Horizontal Reinforcing Options : |
| | ============ | One layer of :     Two layers of : |
| Required Area : | 0.1152 in2/ft | #4@ 12.50 in     #4@ 25.00 in |
| Provided Area : | 0.1333 in2/ft | #5@ 19.38 in     #5@ 38.75 in |
| Maximum Area : | 0.8467 in2/ft | #6@ 27.50 in     #6@ 55.00 in |

### Footing Data

| | | |
|---|---|---|
| Toe Width | = | 0.42 ft |
| Heel Width | = | 1.67 |
| Total Footing Width | = | 2.09 |
| Footing Thickness | = | 8.00 in |
| Key Width | = | 8.00 in |
| Key Depth | = | 6.00 in |
| Key Distance from Toe | = | 0.42 ft |

f'c =     2,500 psi     Fy =     60,000 psi
Footing Concrete Density  =     150.00 pcf
Min. As %          =     0.0018
Cover @ Top     2.00     @ Btm.=  3.00 in

### Footing Design Results

| | | Toe | Heel |
|---|---|---|---|
| Factored Pressure | = | 1,660 | 0 psf |
| Mu' : Upward | = | 133 | 94 ft-# |
| Mu' : Downward | = | 17 | 362 ft-# |
| Mu:  Design | = | 117 | 268 ft-# |
| phiMn | = | 4,063 | 4,963 ft-# |
| Actual 1-Way Shear | = | 1.08 | 6.04 psi |
| Allow 1-Way Shear | = | 75.00 | 75.00 psi |
| Toe Reinforcing | = # 4 @ 12.00 in | | |
| Heel Reinforcing | = # 4 @ 12.00 in | | |
| Key Reinforcing | = # 4 @ 13.89 in | | |
| Footing Torsion, Tu | = | | 0.00 ft-lbs |
| Footing Allow. Torsion, phi Tu | = | | 0.00 ft-lbs |

**If torsion exceeds allowable, provide
supplemental design for footing torsion.**

Other Acceptable Sizes & Spacings

   Toe:
   Heel:
   Key:

| | | |
|---|---|---|
| Min footing T&S reinf Area | 0.36 | in2 |
| Min footing T&S reinf Area per foot | 0.17 | in2 /ft |

If one layer of horizontal bars:          If two layers of horizontal bars:

   #4@ 13.89 in                               #4@ 27.78 in
   #5@ 21.53 in                               #5@ 43.06 in
   #6@ 30.56 in                               #6@ 61.11 in

## Cantilevered Retaining Wall

Project File: Typical Detail Co-04-06.EC6

**DESCRIPTION:** Retaining Wall Schedule 4'-0" Retaining Wall

### Summary of Overturning & Resisting Forces & Moments

| Item | .....OVERTURNING..... Force lbs | Distance ft | Moment ft-# | | .....RESISTING..... Force lbs | Distance ft | Moment ft-# |
|---|---|---|---|---|---|---|---|
| HL Act Pres (ab water tbl) | 381.1 | 1.56 | 592.8 | Soil Over HL (ab. water tbl) | 501.7 | 1.58 | 794.8 |
| HL Act Pres (be water tbl) | | | | Soil Over HL (bel. water tbl) | | 1.58 | 794.8 |
| Hydrostatic Force | | | | Watre Table | | | |
| Buoyant Force = | | | | Sloped Soil Over Heel = | | | |
| Surcharge over Heel = | | | | Surcharge Over Heel = | | | |
| Surcharge Over Toe = | | | | Adjacent Footing Load = | | | |
| Adjacent Footing Load = | | | | Axial Dead Load on Stem = | | | |
| Added Lateral Load = | | | | * Axial Live Load on Stem = | | | |
| Load @ Stem Above Soil = | | | | Soil Over Toe = | | 0.21 | |
| = | | | | Surcharge Over Toe = | | | |
| | | | | Stem Weight(s) = | 400.0 | 0.75 | 299.7 |
| | | | | Earth @ Stem Transitions = | | | |
| **Total** = | 381.1 | **O.T.M.** = | 592.8 | Footing Weight = | 208.6 | 1.04 | 217.6 |
| | | | | Key Weight = | 50.0 | 0.75 | 37.5 |
| | | | | Vert. Component = | | | |

**Resisting/Overturning Ratio** = **2.28**

Vertical Loads used for Soil Pressure = 1,160.3 lbs

**Total =** 1,160.3 lbs **R.M.=** 1,349.6

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

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

### Tilt

#### Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

| | | |
|---|---|---|
| Soil Spring Reaction Modulus | 250.0 | pci |
| Horizontal Defl @ Top of Wall (approximate only) | 0.063 | in |

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe,

because the wall would then tend to rotate into the retained soil.

## Cantilevered Retaining Wall

**DESCRIPTION:**  Retaining Wall Schedule 4'-0" Retaining Wall

### Rebar Lap & Embedment Lengths Information

Stem Design Segment: Bottom
Stem Design Height:      0.00 ft above top of footing

| | |
|---|---:|
| Lap Splice length for #4 bar specified in this stem design segment = | 18.72 in |
| Development length for #4 bar specified in this stem design segment = | 14.40 in |
| | |
| Hooked embedment length into footing for #4 bar specified in this stem design segment = | 7.26 in |
| As Provided = | 0.1333 in2/ft |
| As Required = | 0.1152 in2/ft |

## Cantilevered Retaining Wall

**DESCRIPTION:**  Retaining Wall Schedule 4'-0" Retaining Wall

8" w/ #4 @ 18"

4'-0"

6"

8"

2"

6"

#4@13.89in

@ Center On Key

#4@12"

@ Heel

5"    8"    1'-0"

5"    1'-8"

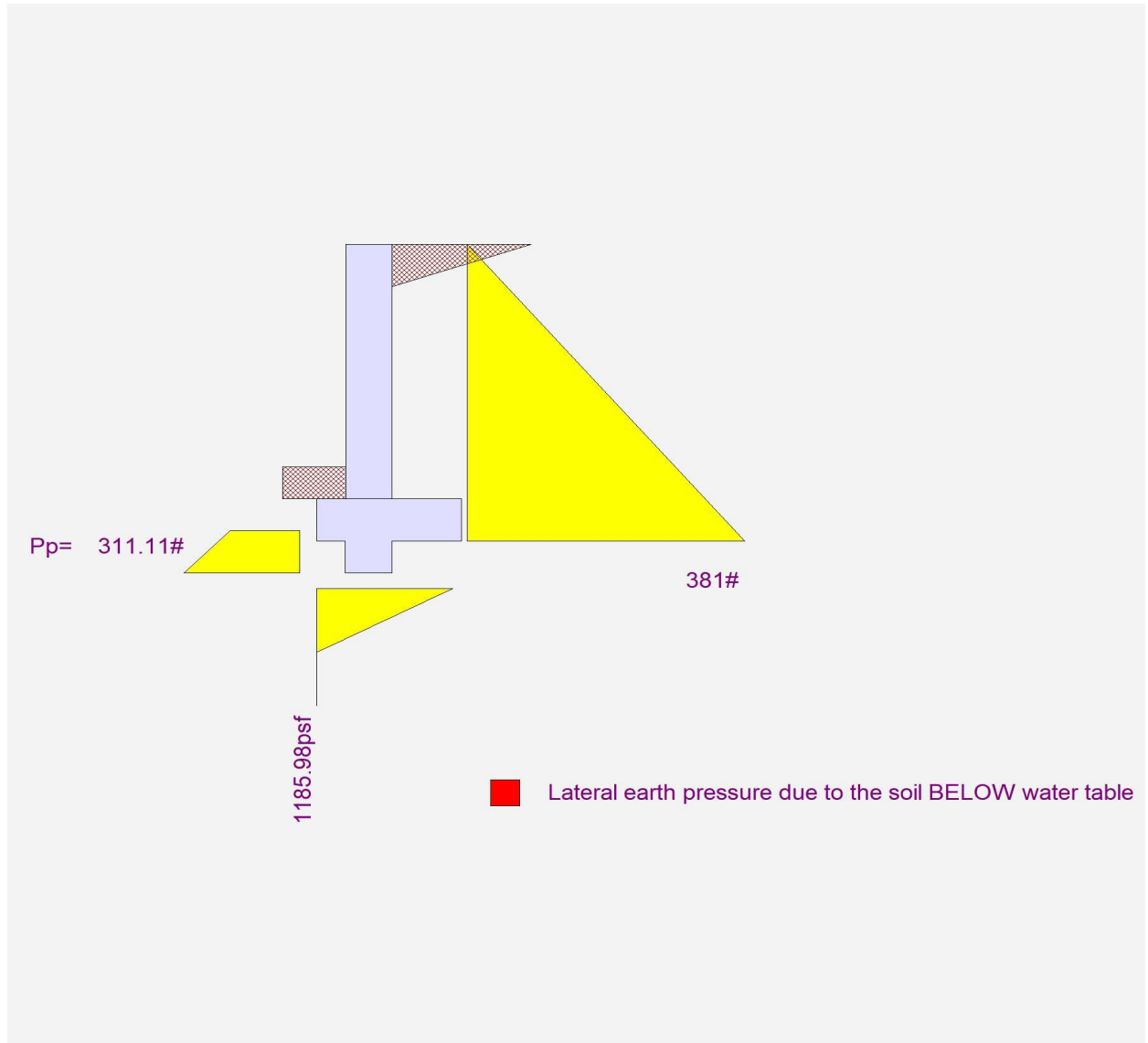2'-1"

## Cantilevered Retaining Wall

Project File: Typical Detail Co-04-06.EC6

LIC# : KW-06014947, Build:20.22.3.31          SWENSON SAY FAGET          (c) ENERCALC INC 1983-2022

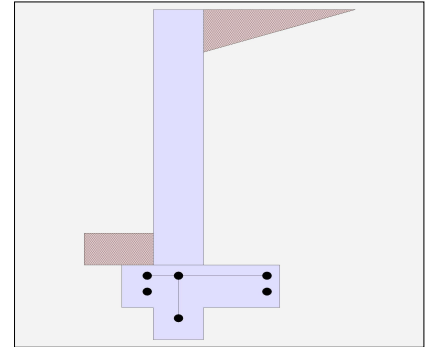**DESCRIPTION:** Retaining Wall Schedule 4'-0" Retaining Wall



Pp=   311.11#

381#

1185.98psf

Lateral earth pressure due to the soil BELOW water table

# Cantilevered Retaining Wall

Project File: Typical Detail Co-04-06.EC6

**DESCRIPTION:** Retaining Wall Schedule 4'-0" Retaining Wall W/ Seismic

## Code References

Calculations per IBC 2018 1807.3, CBC 2019, ASCE 7-16

## Criteria

| | | |
|---|---|---|
| Retained Height | = | 4.00 ft |
| Wall height above soil | = | 0.00 ft |
| Slope Behind Wall | = | 0.00 |
| Height of Soil over Toe | = | 6.00 in |
| Water height over heel | = | 0.0 ft |

## Soil Data

| | | |
|---|---|---|
| Allow Soil Bearing | = | 4,000.0 psf |
| Equivalent Fluid Pressure Method | | |
| Active Heel Pressure | = | 35.0 psf/ft |
| | = | |
| Passive Pressure | = | 300.0 psf/ft |
| Soil Density, Heel | = | 125.00 pcf |
| Soil Density, Toe | = | 0.00 pcf |
| Footing||Soil Friction | = | 0.300 |
| Soil height to ignore for passive pressure | = | 12.00 in |

## Surcharge Loads

| | | |
|---|---|---|
| Surcharge Over Heel | = | 0.0 psf |
| Used To Resist Sliding & Overturning | | |
| Surcharge Over Toe | = | 0.0 |
| 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 |

## Earth Pressure Seismic Load

Method : Uniform

| | | |
|---|---|---|
| Multiplier Used | = | 6.000 |
| (Multiplier used on soil density) | | |

## Lateral Load Applied to Stem

| | | |
|---|---|---|
| Lateral Load | = | 0.0 #/ft |
| ...Height to Top | = | 0.00 ft |
| ...Height to Bottom | = | 0.00 ft |
| Load Type | = | Wind (W) |
| | | (Service Level) |
| Wind on Exposed Stem | = | 0.0 psf |
| (Strength Level) | | |

| | | |
|---|---|---|
| Uniform Seismic Force | = | 28.000 |
| Total Seismic Force | = | 130.667 |

## 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 | | Spread Footing |
| Base Above/Below Soil at Back of Wall | = | 0.0 ft |
| Poisson's Ratio | = | 0.300 |

## Cantilevered Retaining Wall

Project File: Typical Detail Co-04-06.EC6

**DESCRIPTION:** Retaining Wall Schedule 4'-0" Retaining Wall W/ Seismic

### Design Summary

**Wall Stability Ratios**

| | | | |
|---|---|---|---|
| Overturning | = | 1.67 | OK |
| Sliding | = | 1.30 | Ratio < 1.5! |
| Global Stability | = | 2.36 | |

| | | | |
|---|---|---|---|
| Total Bearing Load | = | 1,160 | lbs |
| ...resultant ecc. | = | 6.90 | in |

| | | | | |
|---|---|---|---|---|
| Soil Pressure @ Toe | = | 1,652 | psf | OK |
| Soil Pressure @ Heel | = | 0 | psf | OK |
| Allowable | = | 4,000 | psf | |

Soil Pressure Less Than Allowable

| | | | |
|---|---|---|---|
| ACI Factored @ Toe | = | 2,313 | psf |
| ACI Factored @ Heel | = | 0 | psf |
| Footing Shear @ Toe | = | 1.6 | psi OK |
| Footing Shear @ Heel | = | 9.7 | psi OK |
| Allowable | = | 75.0 | psi |

**Sliding Calcs**

| | | | | |
|---|---|---|---|---|
| Lateral Sliding Force | = | | 472.6 | lbs |
| less 100% Passive Force | - | | 266.7 | lbs |
| less 100% Friction Force | ≡ - | | 348.1 | lbs |
| Added Force Req'd | = | | 0.0 | lbs OK |
| ....for 1.5 Stability | = | | 94.1 | lbs NG |

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

**Load Factors**

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

### Stem Construction

| | | Bottom | | | | |
|---|---|---|---|---|---|---|
| | | Stem OK | | | | |
| **Design Height Above Ftg** | ft = | 0.00 | | | | |
| Wall Material Above "Ht" | = | Concrete | | | | |
| Design Method | = | SD | SD | SD | SD | SD |
| Thickness | = | 8.00 | | | | |
| Rebar Size | = | # 4 | | | | |
| Rebar Spacing | = | 18.00 | | | | |
| Rebar Placed at | = | Edge | | | | |

**Design Data**

| | | | |
|---|---|---|---|
| fb/FB + fa/Fa | = | **0.224** | |
| **Total Force @ Section** | | | |
| Service Level | lbs = | | |
| Strength Level | lbs = | 560.0 | |
| **Moment....Actual** | | | |
| Service Level | ft-# = | | |
| Strength Level | ft-# = | 821.3 | |
| Moment.....Allowable | = | 3,655.6 | |
| **Shear.....Actual** | | | |
| Service Level | psi = | | |
| Strength Level | psi = | 7.5 | |
| Shear.....Allowable | psi = | 75.0 | |
| Anet (Masonry) | in2 = | | |
| Wall Weight | psf = | 100.0 | |
| Rebar Depth 'd' | in = | 6.25 | |

**Masonry Data**

| | | |
|---|---|---|
| f'm | psi = | |
| Fs | psi = | |
| Solid Grouting | = | |
| Modular Ratio 'n' | = | |
| Equiv. Solid Thick. | = | |
| Masonry Block Type | = | |
| Masonry Design Method | = | ASD |

**Concrete Data**

| | | |
|---|---|---|
| f'c | psi = | 2,500.0 |
| Fy | psi = | 60,000.0 |

## Cantilevered Retaining Wall

Project File: Typical Detail Co-04-06.EC6

**DESCRIPTION:**  Retaining Wall Schedule 4'-0" Retaining Wall W/ Seismic

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### Concrete Stem Rebar Area Details

| Bottom Stem | Vertical Reinforcing | Horizontal Reinforcing |
|---|---|---|
| As (based on applied moment) : | 0.0308 in2/ft | |
| (4/3) * As : | 0.041 in2/ft | Min Stem T&S Reinf Area 0.768 in2 |
| 200bd/fy : 200(12)(6.25)/60000 : | 0.25 in2/ft | Min Stem T&S Reinf Area per ft of stem Height : 0.192 in2/ft |
| 0.0012bh : 0.0012(12)(8) : | 0.1152 in2/ft | Horizontal Reinforcing Options : |
| | ============ | One layer of :        Two layers of : |
| Required Area : | 0.1152 in2/ft | #4@ 12.50 in        #4@ 25.00 in |
| Provided Area : | 0.1333 in2/ft | #5@ 19.38 in        #5@ 38.75 in |
| Maximum Area : | 0.8467 in2/ft | #6@ 27.50 in        #6@ 55.00 in |

### Footing Data

| | | |
|---|---|---|
| Toe Width | = | 0.42 ft |
| Heel Width | = | 1.67 |
| Total Footing Width | = | 2.09 |
| Footing Thickness | = | 8.00 in |
| Key Width | = | 8.00 in |
| Key Depth | = | 6.00 in |
| Key Distance from Toe | = | 0.42 ft |

f'c =      2,500 psi    Fy =    60,000 psi
Footing Concrete Density  =    150.00 pcf
Min. As %                 =    0.0018
Cover @ Top      2.00      @ Btm = 3.00 in

### Footing Design Results

| | | **Toe** | **Heel** |
|---|---|---|---|
| Factored Pressure | = | 2,313 | 0 psf |
| Mu' : Upward | = | 180 | 9 ft-# |
| Mu' : Downward | = | 17 | 362 ft-# |
| Mu: Design | = | 163 | 353 ft-# |
| phiMn | = | 4,063 | 4,963 ft-# |
| Actual 1-Way Shear | = | 1.56 | 9.65 psi |
| Allow 1-Way Shear | = | 75.00 | 75.00 psi |
| Toe Reinforcing | = # 4 @ 12.00 in | | |
| Heel Reinforcing | = # 4 @ 12.00 in | | |
| Key Reinforcing | = # 4 @ 13.89 in | | |
| Footing Torsion, Tu | = | | 0.00 ft-lbs |
| Footing Allow. Torsion, phi Tu | = | | 0.00 ft-lbs |

**If torsion exceeds allowable, provide
supplemental design for footing torsion.**

Other Acceptable Sizes & Spacings

Toe:
Heel:
Key:

| Min footing T&S reinf Area | 0.36 | in2 |
|---|---|---|
| Min footing T&S reinf Area per foot | 0.17 | in2 /ft |

If one layer of horizontal bars:          If two layers of horizontal bars:
  #4@ 13.89 in                              #4@ 27.78 in
  #5@ 21.53 in                              #5@ 43.06 in
  #6@ 30.56 in                              #6@ 61.11 in

## Cantilevered Retaining Wall

Project File: Typical Detail Co-04-06.EC6

**DESCRIPTION:** Retaining Wall Schedule 4'-0" Retaining Wall W/ Seismic

### Summary of Overturning & Resisting Forces & Moments

| Item | .....OVERTURNING..... Force lbs | Distance ft | Moment ft-# | | .....RESISTING..... Force lbs | Distance ft | Moment ft-# |
|---|---|---|---|---|---|---|---|
| HL Act Pres (ab water tbl) | 381.1 | 1.56 | 592.8 | Soil Over HL (ab. water tbl) | 501.7 | 1.58 | 794.8 |
| HL Act Pres (be water tbl) | | | | Soil Over HL (bel. water tbl) | | 1.58 | 794.8 |
| Hydrostatic Force | | | | Watre Table | | | |
| Buoyant Force = | | | | Sloped Soil Over Heel = | | | |
| Surcharge over Heel = | | | | Surcharge Over Heel = | | | |
| Surcharge Over Toe = | | | | Adjacent Footing Load = | | | |
| Adjacent Footing Load = | | | | Axial Dead Load on Stem = | | | |
| Added Lateral Load = | | | | * Axial Live Load on Stem = | | | |
| Load @ Stem Above Soil = | | | | Soil Over Toe = | | 0.21 | |
| Seismic Earth Load = | 91.5 | 2.33 | 213.4 | Surcharge Over Toe = | | | |
| = | | | | Stem Weight(s) = | 400.0 | 0.75 | 299.7 |
| | | | | Earth @ Stem Transitions = | | | |
| **Total** = | 472.6 | O.T.M. = | 806.3 | Footing Weight = | 208.6 | 1.04 | 217.6 |
| | | | | Key Weight = | 50.0 | 0.75 | 37.5 |
| | | | | Vert. Component = | | | |

**Resisting/Overturning Ratio** = **1.67**
Vertical Loads used for Soil Pressure = 1,160.3 lbs

**Total =** 1,160.3 lbs **R.M.=** 1,349.6

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

If seismic is included, the OTM and sliding ratios may be 1.1 per section 1807.2.3 of IBC.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

### Tilt

#### Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

| | | |
|---|---|---|
| Soil Spring Reaction Modulus | 250.0 | pci |
| Horizontal Defl @ Top of Wall (approximate only) | 0.088 | in |

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe,

because the wall would then tend to rotate into the retained soil.

## Cantilevered Retaining Wall

LIC# : KW-06014947, Build:20.22.3.31                SWENSON SAY FAGET                (c) ENERCALC INC 1983-2022

**DESCRIPTION:**  Retaining Wall Schedule 4'-0" Retaining Wall W/ Seismic

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### Rebar Lap & Embedment Lengths Information

Stem Design Segment: Bottom
Stem Design Height:      0.00 ft above top of footing

| | |
|---|---|
| Lap Splice length for #4 bar specified in this stem design segment = | 18.72 in |
| Development length for #4 bar specified in this stem design segment = | 14.40 in |
| | |
| Hooked embedment length into footing for #4 bar specified in this stem design segment = | 7.26 in |
| As Provided = | 0.1333 in2/ft |
| As Required = | 0.1152 in2/ft |

## Cantilevered Retaining Wall

LIC# : KW-06014947, Build:20.22.3.31          SWENSON SAY FAGET          (c) ENERCALC INC 1983-2022

**DESCRIPTION:** Retaining Wall Schedule 4'-0" Retaining Wall W/ Seismic



8" w/ #4 @ 18"

6"

4'-0"

8"

2"

6"

#4@13.89in

@ Center On Key

#4@12"

@ Heel

5"   8"   1'-0"

5"   1'-8"

2'-1"

# Cantilevered Retaining Wall

Project File: Typical Detail Co-04-06.EC6

LIC# : KW-06014947, Build:20.22.3.31          SWENSON SAY FAGET          (c) ENERCALC INC 1983-2022

**DESCRIPTION:** Retaining Wall Schedule 4'-0" Retaining Wall W/ Seismic
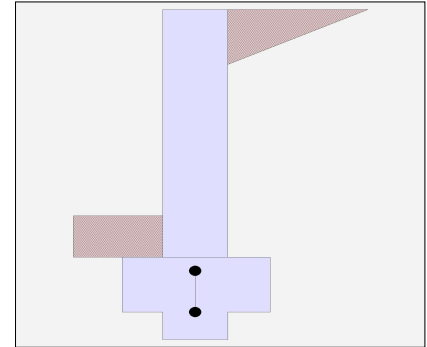
Pp=   266.67#

381#          91#

1651.86psf

■ Lateral earth pressure due to the soil BELOW water table

■ Seismic lateral earth pressure

# Cantilevered Retaining Wall

Project File: Typical Detail Co-04-06.EC6

**DESCRIPTION:**  Retaining Wall Schedule 3'-0" Retaining Wall

## Code References

Calculations per IBC 2018 1807.3, CBC 2019, ASCE 7-16

## Criteria

| | | |
|---|---|---|
| Retained Height | = | 3.00 ft |
| Wall height above soil | = | 0.00 ft |
| Slope Behind Wall | = | 0.00 |
| Height of Soil over Toe | = | 6.00 in |
| Water height over heel | = | 0.0 ft |

## Soil Data

| | | |
|---|---|---|
| Allow Soil Bearing | = | 3,000.0 psf |
| Equivalent Fluid Pressure Method | | |
| Active Heel Pressure | = | 35.0 psf/ft |
| | = | |
| Passive Pressure | = | 300.0 psf/ft |
| Soil Density, Heel | = | 125.00 pcf |
| Soil Density, Toe | = | 0.00 pcf |
| Footing||Soil Friction | = | 0.300 |
| Soil height to ignore for passive pressure | = | 12.00 in |

## Surcharge Loads

| | | |
|---|---|---|
| Surcharge Over Heel | = | 0.0 psf |
| Used To Resist Sliding & Overturning | | |
| Surcharge Over Toe | = | 0.0 |
| 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 |

## Lateral Load Applied to Stem

| | | |
|---|---|---|
| Lateral Load | = | 0.0 #/ft |
| ...Height to Top | = | 0.00 ft |
| ...Height to Bottom | = | 0.00 ft |
| Load Type | = | Wind (W) |
| | | (Service Level) |
| Wind on Exposed Stem (Service Level) | = | 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 | | Spread Footing |
| Base Above/Below Soil at Back of Wall | = | 0.0 ft |
| Poisson's Ratio | = | 0.300 |

## Cantilevered Retaining Wall

Project File: Typical Detail Co-04-06.EC6

**DESCRIPTION:** Retaining Wall Schedule 3'-0" Retaining Wall

### Design Summary

**Wall Stability Ratios**

| | | | |
|---|---|---|---|
| Overturning | = | 2.00 | OK |
| Sliding | = | 1.62 | OK |
| Global Stability | = | 2.66 | |

| | | | |
|---|---|---|---|
| Total Bearing Load | = | 647 lbs | |
| ...resultant ecc. | = | 3.75 in | |

| | | | |
|---|---|---|---|
| Soil Pressure @ Toe | = | 969 psf | OK |
| Soil Pressure @ Heel | = | 0 psf | OK |
| Allowable | = | 3,000 psf | |

Soil Pressure Less Than Allowable

| | | | |
|---|---|---|---|
| ACI Factored @ Toe | = | 1,357 psf | |
| ACI Factored @ Heel | = | 0 psf | |
| Footing Shear @ Toe | = | 0.6 psi | OK |
| Footing Shear @ Heel | = | 3.0 psi | OK |
| Allowable | = | 75.0 psi | |

**Sliding Calcs**

| | | | |
|---|---|---|---|
| Lateral Sliding Force | = | 235.3 lbs | |
| less 100% Passive Force | - | 187.5 lbs | |
| less 100% Friction Force | ≡ - | 194.2 lbs | |
| Added Force Req'd | = | 0.0 lbs | OK |
| ....for 1.5 Stability | = | 0.0 lbs | OK |

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

**Load Factors**

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

### Stem Construction

**Bottom**

| | | Stem OK | | | | |
|---|---|---|---|---|---|---|
| **Design Height Above Ftg** | ft = | 0.00 | | | | |
| Wall Material Above "Ht" | = | Concrete | | | | |
| Design Method | = | SD | SD | SD | SD | SD |
| Thickness | = | 8.00 | | | | |
| Rebar Size | = | # 4 | | | | |
| Rebar Spacing | = | 18.00 | | | | |
| Rebar Placed at | = | Edge | | | | |

**Design Data**

| | | |
|---|---|---|
| fb/FB + fa/Fa | = | **0.068** |

**Total Force @ Section**

| | | |
|---|---|---|
| Service Level | lbs = | |
| Strength Level | lbs = | 252.0 |

**Moment....Actual**

| | | |
|---|---|---|
| Service Level | ft-# = | |
| Strength Level | ft-# = | 252.0 |
| Moment.....Allowable | = | 3,655.6 |

**Shear.....Actual**

| | | |
|---|---|---|
| Service Level | psi = | |
| Strength Level | psi = | 3.4 |
| Shear.....Allowable | psi = | 75.0 |
| Anet (Masonry) | in2 = | |
| Wall Weight | psf = | 100.0 |
| Rebar Depth 'd' | in = | 6.25 |

**Masonry Data**

| | | |
|---|---|---|
| f'm | psi = | |
| Fs | psi = | |
| Solid Grouting | = | |
| Modular Ratio 'n' | = | |
| Equiv. Solid Thick. | = | |
| Masonry Block Type | = | |
| Masonry Design Method | = | ASD |

**Concrete Data**

| | | |
|---|---|---|
| f'c | psi = | 2,500.0 |
| Fy | psi = | 60,000.0 |

## Cantilevered Retaining Wall

Project File: Typical Detail Co-04-06.EC6

**DESCRIPTION:**  Retaining Wall Schedule 3'-0" Retaining Wall

---

### Concrete Stem Rebar Area Details

| Bottom Stem | Vertical Reinforcing | Horizontal Reinforcing |
|---|---|---|
| As (based on applied moment) : | 0.0094 in2/ft | |
| (4/3) * As : | 0.0126 in2/ft | Min Stem T&S Reinf Area 0.576 in2 |
| 200bd/fy : 200(12)(6.25)/60000 : | 0.25 in2/ft | Min Stem T&S Reinf Area per ft of stem Height : 0.192 in2/ft |
| 0.0012bh : 0.0012(12)(8) : | 0.1152 in2/ft | Horizontal Reinforcing Options : |
| | ============ | One layer of :        Two layers of : |
| Required Area : | 0.1152 in2/ft | #4@ 12.50 in        #4@ 25.00 in |
| Provided Area : | 0.1333 in2/ft | #5@ 19.38 in        #5@ 38.75 in |
| Maximum Area : | 0.8467 in2/ft | #6@ 27.50 in        #6@ 55.00 in |

### Footing Data

| | | |
|---|---|---|
| Toe Width | = | 0.42 ft |
| Heel Width | = | 1.10 |
| Total Footing Width | = | 1.52 |
| Footing Thickness | = | 8.00 in |
| Key Width | = | 8.00 in |
| Key Depth | = | 4.00 in |
| Key Distance from Toe | = | 0.42 ft |

f'c =     2,500 psi    Fy =    60,000 psi
Footing Concrete Density  =    150.00 pcf
Min. As %        =      0.0018
Cover @ Top      2.00      @ Btm.=   3.00 in

### Footing Design Results

| | | **Toe** | **Heel** |
|---|---|---|---|
| Factored Pressure | = | 1,357 | 0 psf |
| Mu' : Upward | = | 105 | 3 ft-# |
| Mu' : Downward | = | 17 | 54 ft-# |
| Mu: Design | = | 88 | 51 ft-# |
| phiMn | = | 900 | 900 ft-# |
| Actual 1-Way Shear | = | 0.64 | 2.98 psi |
| Allow 1-Way Shear | = | 40.00 | 40.00 psi |
| Toe Reinforcing | = None Spec'd | | |
| Heel Reinforcing | = None Spec'd | | |
| Key Reinforcing | = # 4 @ 13.89 in | | |
| Footing Torsion, Tu | = | | 0.00 ft-lbs |
| Footing Allow. Torsion, phi Tu | = | | 0.00 ft-lbs |

**If torsion exceeds allowable, provide
supplemental design for footing torsion.**

Other Acceptable Sizes & Spacings
   Toe:
   Heel:
   Key:

| | | |
|---|---|---|
| Min footing T&S reinf Area | 0.26 | in2 |
| Min footing T&S reinf Area per foot | 0.17 | in2 /ft |

If one layer of horizontal bars:        If two layers of horizontal bars:
   #4@ 13.89 in                    #4@ 27.78 in
   #5@ 21.53 in                    #5@ 43.06 in
   #6@ 30.56 in                    #6@ 61.11 in
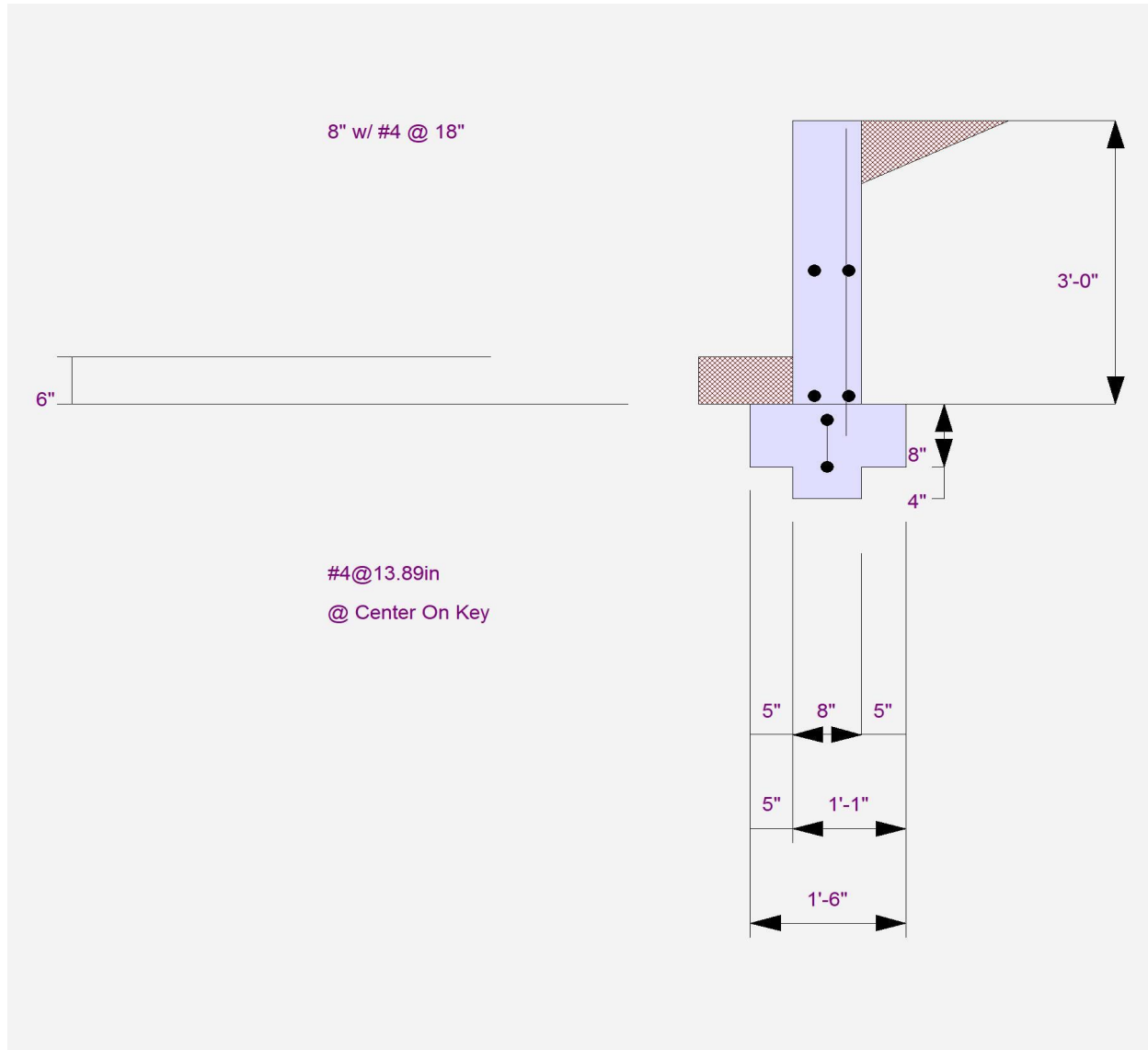
## Cantilevered Retaining Wall

Project File: Typical Detail Co-04-06.EC6

LIC# : KW-06014947, Build:20.22.3.31      SWENSON SAY FAGET      (c) ENERCALC INC 1983-2022

**DESCRIPTION:** Retaining Wall Schedule 3'-0" Retaining Wall

### Summary of Overturning & Resisting Forces & Moments

| Item | .....OVERTURNING..... Force lbs | Distance ft | Moment ft-# | | .....RESISTING..... Force lbs | Distance ft | Moment ft-# |
|---|---|---|---|---|---|---|---|
| HL Act Pres (ab water tbl) | 235.3 | 1.22 | 287.6 | Soil Over HL  (ab. water tbl) | 162.5 | 1.30 | 211.1 |
| HL Act Pres (be water tbl) | | | | Soil Over HL  (bel. water tbl) | | 1.30 | 211.1 |
| Hydrostatic Force | | | | Watre Table | | | |
| Buoyant Force | = | | | Sloped Soil Over Heel = | | | |
| Surcharge over Heel | = | | | Surcharge Over Heel = | | | |
| Surcharge Over Toe | = | | | Adjacent Footing Load = | | | |
| Adjacent Footing Load | = | | | Axial Dead Load on Stem = | | | |
| Added Lateral Load | = | | | * Axial Live Load on Stem = | | | |
| Load @ Stem Above Soil | = | | | Soil Over Toe = | | 0.21 | |
| | = | | | Surcharge Over Toe = | | | |
| | | | | Stem Weight(s) = | 300.0 | 0.75 | 224.8 |
| | | | | Earth @ Stem Transitions = | | | |
| **Total** | = 235.3 | **O.T.M.** = | 287.6 | Footing Weight = | 151.6 | 0.76 | 114.9 |
| | | | | Key Weight = | 33.3 | 0.75 | 25.0 |
| | | | | Vert. Component = | | | |

**Resisting/Overturning Ratio**    =   **2.00**
Vertical Loads used for Soil Pressure =    647.4   lbs

                                                 **Total =**    647.4   lbs   **R.M.=**      575.8

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

Vertical component of active lateral soil pressure IS NOT considered in
the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in
the calculation of Overturning Resistance.

### Tilt

#### Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

| | | |
|---|---|---|
| Soil Spring Reaction Modulus | 250.0 | pci |
| Horizontal Defl @ Top of Wall (approximate only) | 0.053 | in |

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe,

because the wall would then tend to rotate into the retained soil.

## Cantilevered Retaining Wall

**DESCRIPTION:**  Retaining Wall Schedule 3'-0" Retaining Wall

---

### Rebar Lap & Embedment Lengths Information

Stem Design Segment: Bottom
Stem Design Height:      0.00 ft above top of footing

| | |
|---|---|
| Lap Splice length for #4 bar specified in this stem design segment = | 18.72 in |
| Development length for #4 bar specified in this stem design segment = | 14.40 in |
| Hooked embedment length into footing for #4 bar specified in this stem design segment = | 7.26 in |
| As Provided = | 0.1333 in2/ft |
| As Required = | 0.1152 in2/ft |

## Cantilevered Retaining Wall

**DESCRIPTION:** Retaining Wall Schedule 3'-0" Retaining Wall

8" w/ #4 @ 18"

6"

3'-0"

8"

4"

#4@13.89in

@ Center On Key

5"   8"   5"

5"   1'-1"

1'-6"

## Cantilevered Retaining Wall

**DESCRIPTION:**  Retaining Wall Schedule 3'-0" Retaining Wall

Pp=    187.50#

235#

969.39psf

Lateral earth pressure due to the soil BELOW water table

## Cantilevered Retaining Wall

**DESCRIPTION:**  Retaining Wall Schedule 3'-0" Retaining Wall W/Seismic

### Code References

Calculations per IBC 2018 1807.3, CBC 2019, ASCE 7-16

### Criteria

| | | |
|---|---|---|
| Retained Height | = | 3.00 ft |
| Wall height above soil | = | 0.00 ft |
| Slope Behind Wall | = | 0.00 |
| Height of Soil over Toe | = | 6.00 in |
| Water height over heel | = | 0.0 ft |

### Soil Data

| | | |
|---|---|---|
| Allow Soil Bearing | = | 4,000.0 psf |
| Equivalent Fluid Pressure Method | | |
| Active Heel Pressure | = | 35.0 psf/ft |
| | = | |
| Passive Pressure | = | 300.0 psf/ft |
| Soil Density, Heel | = | 125.00 pcf |
| Soil Density, Toe | = | 0.00 pcf |
| Footing||Soil Friction | = | 0.300 |
| Soil height to ignore for passive pressure | = | 12.00 in |

### Surcharge Loads

| | | |
|---|---|---|
| Surcharge Over Heel | = | 0.0 psf |
| Used To Resist Sliding & Overturning | | |
| Surcharge Over Toe | = | 0.0 |
| 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 |

### Earth Pressure Seismic Load

Method  : Uniform
Multiplier Used          =          6.000
(Multiplier used on soil density)

### Lateral Load Applied to Stem

| | | |
|---|---|---|
| Lateral Load | = | 0.0 #/ft |
| ...Height to Top | = | 0.00 ft |
| ...Height to Bottom | = | 0.00 ft |
| Load Type | = | Wind (W) |
| | | (Service Level) |
| Wind on Exposed Stem (Strength Level) | = | 0.0 psf |

| | | |
|---|---|---|
| Uniform Seismic Force | = | 22.000 |
| Total Seismic Force | = | 80.667 |

### 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 | | Spread Footing |
| Base Above/Below Soil at Back of Wall | = | 0.0 ft |
| Poisson's Ratio | = | 0.300 |

## Cantilevered Retaining Wall

Project File: Typical Detail Co-04-06.EC6

**DESCRIPTION:**  Retaining Wall Schedule 3'-0" Retaining Wall W/Seismic

### Design Summary

**Wall Stability Ratios**

| | | |
|---|---|---|
| Overturning | = | 1.44 Ratio < 1.5! |
| Sliding | = | 1.30 Ratio < 1.5! |
| Global Stability | = | 2.65 |
| Total Bearing Load | = | 638 lbs |
| ...resultant ecc. | = | 5.77 in |
| Soil Pressure @ Toe | = | 1,592 psf OK |
| Soil Pressure @ Heel | = | 0 psf OK |
| Allowable | = | 4,000 psf |

Soil Pressure Less Than Allowable

| | | |
|---|---|---|
| ACI Factored @ Toe | = | 2,228 psf |
| ACI Factored @ Heel | = | 0 psf |
| Footing Shear @ Toe | = | 1.1 psi OK |
| Footing Shear @ Heel | = | 3.3 psi OK |
| Allowable | = | 75.0 psi |

**Sliding Calcs**

| | | | |
|---|---|---|---|
| Lateral Sliding Force | = | | 291.7 lbs |
| less 100% Passive Force | - | | 187.5 lbs |
| less 100% Friction Force | ≡ - | | 191.4 lbs |
| Added Force Req'd | = | | 0.0 lbs OK |
| ....for 1.5 Stability | = | | 58.7 lbs NG |

Vertical component of active lateral soil pressure IS
NOT considered in the calculation of soil bearing

**Load Factors**

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

### Stem Construction

|  | Bottom | | | | |
|---|---|---|---|---|---|
|  | Stem OK | | | | |
| **Design Height Above Ftg** ft = | 0.00 | | | | |
| Wall Material Above "Ht" = | Concrete | | | | |
| Design Method = | SD | SD | SD | SD | SD |
| Thickness = | 8.00 | | | | |
| Rebar Size = | # 4 | | | | |
| Rebar Spacing = | 18.00 | | | | |
| Rebar Placed at = | Edge | | | | |

**Design Data**

| | | |
|---|---|---|
| fb/FB + fa/Fa | = | **0.096** |

**Total Force @ Section**

| | | |
|---|---|---|
| Service Level | lbs = | |
| Strength Level | lbs = | 318.0 |

**Moment....Actual**

| | | |
|---|---|---|
| Service Level | ft-# = | |
| Strength Level | ft-# = | 351.0 |
| Moment.....Allowable | = | 3,655.6 |

**Shear.....Actual**

| | | |
|---|---|---|
| Service Level | psi = | |
| Strength Level | psi = | 4.2 |
| Shear.....Allowable | psi = | 75.0 |
| Anet (Masonry) | in2 = | |
| Wall Weight | psf = | 100.0 |
| Rebar Depth 'd' | in = | 6.25 |

**Masonry Data**

| | | |
|---|---|---|
| f'm | psi = | |
| Fs | psi = | |
| Solid Grouting | = | |
| Modular Ratio 'n' | = | |
| Equiv. Solid Thick. | = | |
| Masonry Block Type | = | |
| Masonry Design Method | = | ASD |

**Concrete Data**

| | | |
|---|---|---|
| f'c | psi = | 2,500.0 |
| Fy | psi = | 60,000.0 |

## Cantilevered Retaining Wall

Project File: Typical Detail Co-04-06.EC6

**DESCRIPTION:**  Retaining Wall Schedule 3'-0" Retaining Wall W/Seismic

---

### Concrete Stem Rebar Area Details

| Bottom Stem | Vertical Reinforcing | Horizontal Reinforcing |
|---|---|---|
| As (based on applied moment) : | 0.0132 in2/ft | |
| (4/3) * As : | 0.0175 in2/ft | Min Stem T&S Reinf Area 0.576 in2 |
| 200bd/fy : 200(12)(6.25)/60000 : | 0.25 in2/ft | Min Stem T&S Reinf Area per ft of stem Height : 0.192 in2/ft |
| 0.0012bh : 0.0012(12)(8) : | 0.1152 in2/ft | Horizontal Reinforcing Options : |
| | ============ | One layer of : |  Two layers of : |
| Required Area : | 0.1152 in2/ft | #4@ 12.50 in |  #4@ 25.00 in |
| Provided Area : | 0.1333 in2/ft | #5@ 19.38 in |  #5@ 38.75 in |
| Maximum Area : | 0.8467 in2/ft | #6@ 27.50 in |  #6@ 55.00 in |

### Footing Data

| | | |
|---|---|---|
| Toe Width | = | 0.42 ft |
| Heel Width | = | 1.08 |
| Total Footing Width | = | 1.50 |
| Footing Thickness | = | 8.00 in |
| Key Width | = | 8.00 in |
| Key Depth | = | 4.00 in |
| Key Distance from Toe | = | 0.42 ft |

| | | | |
|---|---|---|---|
| f'c = | 2,500 psi | Fy = | 60,000 psi |
| Footing Concrete Density | = | | 150.00 pcf |
| Min. As % | = | | 0.0018 |
| Cover @ Top | 2.00 | @ Btm = | 3.00 in |

### Footing Design Results

| | | Toe | Heel |
|---|---|---|---|
| Factored Pressure | = | 2,228 | 0 psf |
| Mu' : Upward | = | 159 | 0 ft-# |
| Mu' : Downward | = | 17 | 49 ft-# |
| Mu: Design | = | 143 | 49 ft-# |
| phiMn | = | 900 | 900 ft-# |
| Actual 1-Way Shear | = | 1.11 | 3.27 psi |
| Allow 1-Way Shear | = | 40.00 | 40.00 psi |
| Toe Reinforcing | = None Spec'd | | |
| Heel Reinforcing | = None Spec'd | | |
| Key Reinforcing | = None Spec'd | | |
| Footing Torsion, Tu | = | | 0.00 ft-lbs |
| Footing Allow. Torsion, phi Tu | = | | 0.00 ft-lbs |

**If torsion exceeds allowable, provide
supplemental design for footing torsion.**

Other Acceptable Sizes & Spacings

Toe:
Heel:
Key:

| | | |
|---|---|---|
| Min footing T&S reinf Area | 0.26 | in2 |
| Min footing T&S reinf Area per foot | 0.17 | in2 /ft |

| If one layer of horizontal bars: | If two layers of horizontal bars: |
|---|---|
| #4@ 13.89 in | #4@ 27.78 in |
| #5@ 21.53 in | #5@ 43.06 in |
| #6@ 30.56 in | #6@ 61.11 in |

## Cantilevered Retaining Wall

Project File: Typical Detail Co-04-06.EC6

**DESCRIPTION:** Retaining Wall Schedule 3'-0" Retaining Wall W/Seismic

### Summary of Overturning & Resisting Forces & Moments

| Item | .....OVERTURNING..... | | | | .....RESISTING..... | | |
| --- | --- | --- | --- | --- | --- | --- | --- |
| | Force lbs | Distance ft | Moment ft-# | | Force lbs | Distance ft | Moment ft-# |
| HL Act Pres (ab water tbl) | 235.3 | 1.22 | 287.6 | Soil Over HL  (ab. water tbl) | 155.0 | 1.29 | 199.8 |
| HL Act Pres (be water tbl) | | | | Soil Over HL  (bel. water tbl) | | 1.29 | 199.8 |
| Hydrostatic Force | | | | Watre Table | | | |
| Buoyant Force = | | | | Sloped Soil Over Heel    = | | | |
| Surcharge over Heel = | | | | Surcharge Over Heel    = | | | |
| Surcharge Over Toe = | | | | Adjacent Footing Load    = | | | |
| Adjacent Footing Load = | | | | Axial Dead Load on Stem = | | | |
| Added Lateral Load = | | | | * Axial Live Load on Stem  = | | | |
| Load @ Stem Above Soil = | | | | Soil Over Toe    = | | 0.21 | |
| Seismic Earth Load = | 56.5 | 1.83 | 103.5 | Surcharge Over Toe    = | | | |
| = | | | | Stem Weight(s)    = | 300.0 | 0.75 | 224.8 |
| | | | | Earth @ Stem Transitions = | | | |
| **Total** = | 291.7 | **O.T.M.** = | 391.1 | Footing Weight    = | 149.6 | 0.75 | 111.9 |
| | | | | Key Weight    = | 33.3 | 0.75 | 25.0 |
| | | | | Vert. Component    = | | | |
| | | | | **Total =** | 637.9  lbs | **R.M.=** | 561.5 |

**Resisting/Overturning Ratio          =      1.44**
  Vertical Loads used for Soil Pressure =        637.9   lbs

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

If seismic is included, the OTM and sliding ratios
may be 1.1 per section 1807.2.3 of IBC.

Vertical component of active lateral soil pressure IS NOT considered in
the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in
the calculation of Overturning Resistance.

### Tilt

#### Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

| | | |
| --- | --- | --- |
| Soil Spring Reaction Modulus | 250.0 | pci |
| Horizontal Defl @ Top of Wall (approximate only) | 0.089 | in |

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe,

because the wall would then tend to rotate into the retained soil.

## Cantilevered Retaining Wall

Project File: Typical Detail Co-04-06.EC6

**DESCRIPTION:**  Retaining Wall Schedule 3'-0" Retaining Wall W/Seismic

---

### Rebar Lap & Embedment Lengths Information

Stem Design Segment: Bottom
Stem Design Height:     0.00 ft above top of footing

| | |
|---|---:|
| Lap Splice length for #4 bar specified in this stem design segment = | 18.72 in |
| Development length for #4 bar specified in this stem design segment = | 14.40 in |
| | |
| Hooked embedment length into footing for #4 bar specified in this stem design segment = | 7.26 in |
| As Provided = | 0.1333 in2/ft |
| As Required = | 0.1152 in2/ft |

# Cantilevered Retaining Wall

**DESCRIPTION:**  Retaining Wall Schedule 3'-0" Retaining Wall W/Seismic

## Cantilevered Retaining Wall
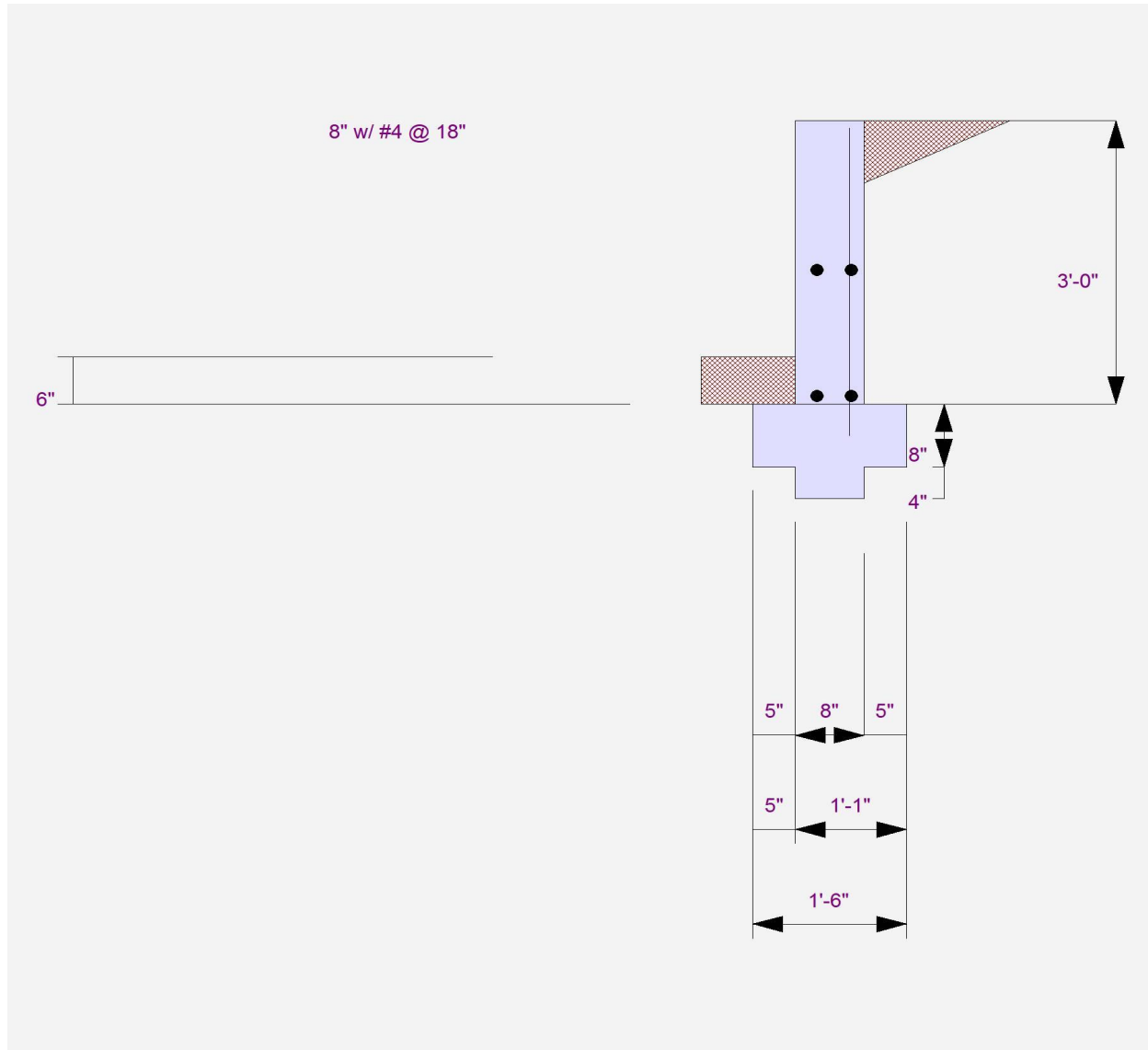
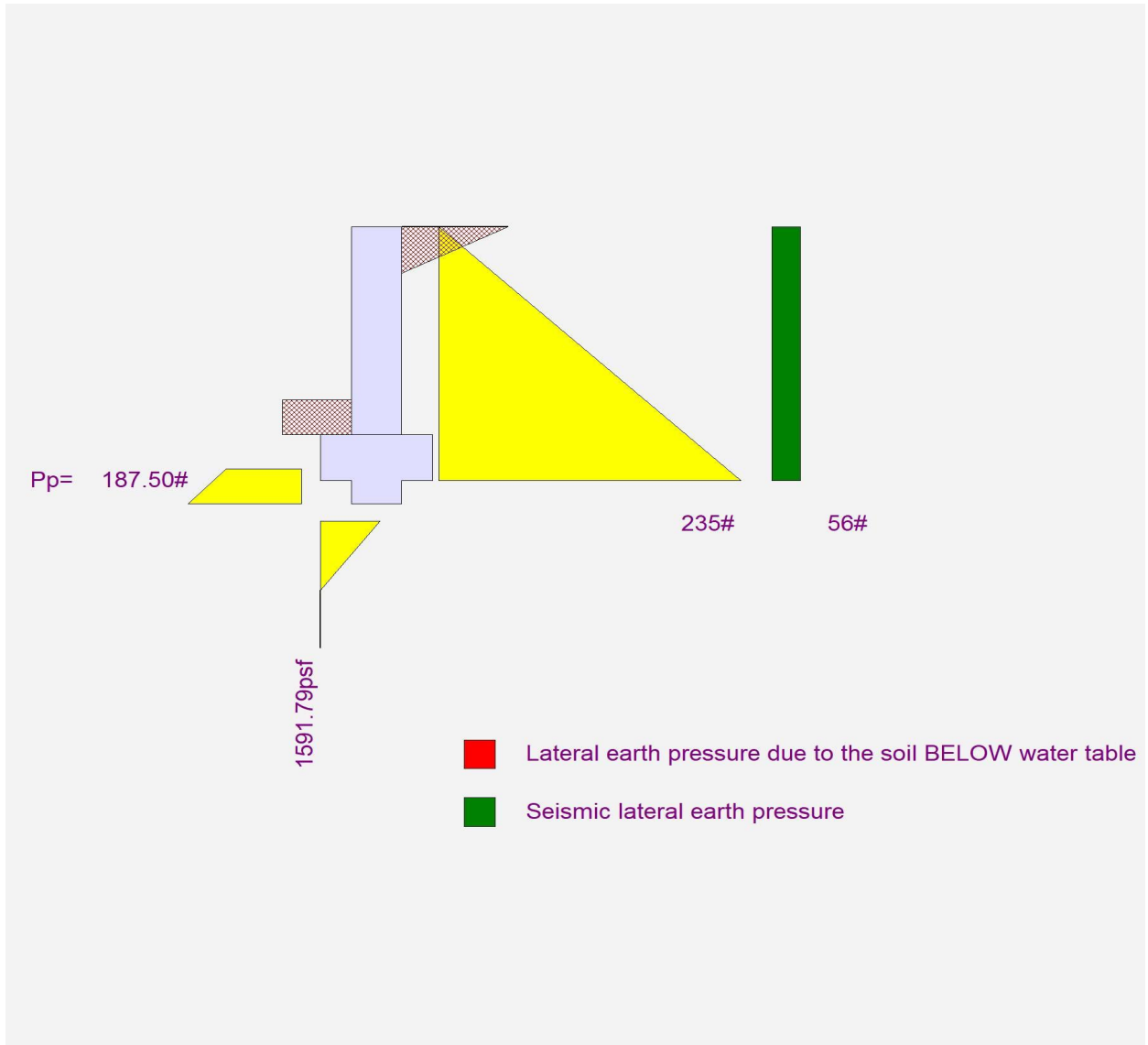Project File: Typical Detail Co-04-06.EC6

LIC# : KW-06014947, Build:20.22.3.31                    SWENSON SAY FAGET                    (c) ENERCALC INC 1983-2022

**DESCRIPTION:**  Retaining Wall Schedule 3'-0" Retaining Wall W/Seismic



Pp=    187.50#

235#          56#

1591.79psf

■ Lateral earth pressure due to the soil BELOW water table

■ Seismic lateral earth pressure

# Cantilevered Retaining Wall

Project File: Typical Detail Co-04-07.EC6

LIC# : KW-06014947, Build:20.22.3.31     SWENSON SAY FAGET     (c) ENERCALC INC 1983-2022

**DESCRIPTION:**  Retaining Wall Schedule 12'-0" Retaining Wall w/ Slab and Traffic
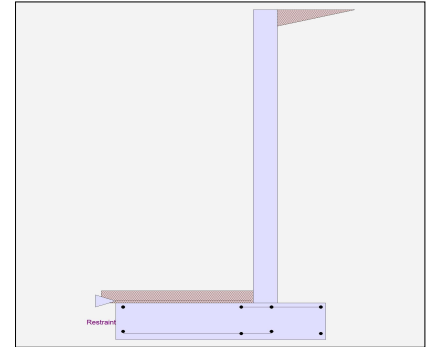
## *Code Reference*s

Calculations per IBC 2018 1807.3, CBC 2019, ASCE 7-16

### Criteria

| | | |
|---|---|---|
| Retained Height | = | 12.00 ft |
| Wall height above soil | = | 0.00 ft |
| Slope Behind Wall | = | 0.00 |
| Height of Soil over Toe | = | 6.00 in |
| Water height over heel | = | 0.0 ft |

### Soil Data

| | | |
|---|---|---|
| Allow Soil Bearing | = | 3,000.0 psf |
| Equivalent Fluid Pressure Method | | |
| Active Heel Pressure | = | 35.0 psf/ft |
| | = | |
| Passive Pressure | = | 300.0 psf/ft |
| Soil Density, Heel | = | 125.00 pcf |
| Soil Density, Toe | = | 0.00 pcf |
| Footing\|\|Soil Friction | = | 0.450 |
| Soil height to ignore for passive pressure | = | 12.00 in |

### Surcharge Loads

| | | |
|---|---|---|
| Surcharge Over Heel | = | 250.0 psf |
| Used To Resist Sliding & Overturning | | |
| Surcharge Over Toe | = | 0.0 |
| 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 |

### Lateral Load Applied to Stem

| | | |
|---|---|---|
| Lateral Load | = | 0.0 #/ft |
| ...Height to Top | = | 0.00 ft |
| ...Height to Bottom | = | 0.00 ft |
| Load Type | = | Wind (W) |
| | | (Service Level) |
| Wind on Exposed Stem | = | 0.0 psf |
| (Service Level) | | |

### 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 | | Spread Footing |
| Base Above/Below Soil at Back of Wall | = | 0.0 ft |
| Poisson's Ratio | = | 0.300 |

## Cantilevered Retaining Wall

| | |
|---|---|
| LIC# : KW-06014947, Build:20.22.3.31 | Project File: Typical Detail Co-04-07.EC6 |
| SWENSON SAY FAGET | (c) ENERCALC INC 1983-2022 |

**DESCRIPTION:** Retaining Wall Schedule 12'-0" Retaining Wall w/ Slab and Traffic

### Design Summary

**Wall Stability Ratios**

| | | | |
|---|---|---|---|
| Overturning | = | 1.56 | OK |

Slab Resists All Sliding !

| | | | |
|---|---|---|---|
| Global Stability | = | 1.47 | |
| | | | |
| Total Bearing Load | = | 6,048 | lbs |
| ...resultant ecc. | = | 20.39 | in |
| | | | |
| Soil Pressure @ Toe | = | 2,094 psf | OK |
| Soil Pressure @ Heel | = | 0 psf | OK |
| Allowable | = | 3,000 psf | |

Soil Pressure Less Than Allowable

| | | | |
|---|---|---|---|
| ACI Factored @ Toe | = | 2,931 psf | |
| ACI Factored @ Heel | = | 0 psf | |
| Footing Shear @ Toe | = | 33.8 psi | OK |
| Footing Shear @ Heel | = | 22.1 psi | OK |
| Allowable | = | 75.0 psi | |

**Sliding Calcs**

| | | | |
|---|---|---|---|
| Lateral Sliding Force | = | 4,134.4 | lbs |

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

**Load Factors**

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

### Stem Construction

| | | **Bottom** | | | | |
|---|---|---|---|---|---|---|
| | | Stem OK | | | | |
| **Design Height Above Ftg** | ft = | 0.00 | | | | |
| Wall Material Above "Ht" | = | Concrete | | | | |
| Design Method | = | SD | SD | SD | SD | SD |
| Thickness | = | 10.00 | | | | |
| Rebar Size | = | # 7 | | | | |
| Rebar Spacing | = | 8.00 | | | | |
| Rebar Placed at | = | Edge | | | | |

**Design Data**

| | | |
|---|---|---|
| fb/FB + fa/Fa | = | **0.918** |

**Total Force @ Section**

| | | |
|---|---|---|
| Service Level | lbs = | |
| Strength Level | lbs = | 5,376.0 |

**Moment....Actual**

| | | |
|---|---|---|
| Service Level | ft-# = | |
| Strength Level | ft-# = | 24,192.0 |
| Moment.....Allowable | = | 26,327.0 |

**Shear.....Actual**

| | | |
|---|---|---|
| Service Level | psi = | |
| Strength Level | psi = | 59.2 |
| Shear.....Allowable | psi = | 75.0 |
| Anet (Masonry) | in2 = | |
| Wall Weight | psf = | 125.0 |
| Rebar Depth 'd' | in = | 7.56 |

**Masonry Data**

| | | |
|---|---|---|
| f'm | psi = | |
| Fs | psi = | |
| Solid Grouting | = | |
| Modular Ratio 'n' | = | |
| Equiv. Solid Thick. | = | |
| Masonry Block Type | = | |
| Masonry Design Method | = | ASD |

**Concrete Data**

| | | |
|---|---|---|
| f'c | psi = | 2,500.0 |
| Fy | psi = | 60,000.0 |

## Cantilevered Retaining Wall

Project File: Typical Detail Co-04-07.EC6

**DESCRIPTION:** Retaining Wall Schedule 12'-0" Retaining Wall w/ Slab and Traffic

### Concrete Stem Rebar Area Details

| Bottom Stem | Vertical Reinforcing | Horizontal Reinforcing |
|---|---|---|
| As (based on applied moment) : | 0.7422 in2/ft | |
| (4/3) * As : | 0.9895 in2/ft | Min Stem T&S Reinf Area 2.880 in2 |
| 200bd/fy : 200(12)(7.5625)/60000 : | 0.3025 in2/ft | Min Stem T&S Reinf Area per ft of stem Height : 0.240 in2/ft |
| 0.0018bh : 0.0018(12)(10) : | 0.216 in2/ft | Horizontal Reinforcing Options : |
| | ============ | One layer of :    Two layers of : |
| Required Area : | 0.7422 in2/ft | #4@ 10.00 in    #4@ 20.00 in |
| Provided Area : | 0.9 in2/ft | #5@ 15.50 in    #5@ 31.00 in |
| Maximum Area : | 1.0245 in2/ft | #6@ 22.00 in    #6@ 44.00 in |

### Footing Data

| | | |
|---|---|---|
| Toe Width | = | 4.75 ft |
| Heel Width | = | 2.50 |
| Total Footing Width | = | 7.25 |
| Footing Thickness | = | 18.00 in |
| Key Width | = | 0.00 in |
| Key Depth | = | 0.00 in |
| Key Distance from Toe | = | 0.00 ft |

f'c = 2,500 psi    Fy = 60,000 psi
Footing Concrete Density = 150.00 pcf
Min. As % = 0.0018
Cover @ Top   2.00   @ Btm = 3.00 in

### Footing Design Results

| | | Toe | Heel |
|---|---|---|---|
| Factored Pressure | = | 2,931 | 0 psf |
| Mu' : Upward | = | 24,004 | 1 ft-# |
| Mu' : Downward | = | 3,892 | 3,431 ft-# |
| Mu: Design | = | 20,112 | 3,430 ft-# |
| phiMn | = | 54,690 | 29,913 ft-# |
| Actual 1-Way Shear | = | 33.84 | 22.08 psi |
| Allow 1-Way Shear | = | 75.00 | 75.00 psi |
| Toe Reinforcing | = | # 7 @ 8.00 in | |
| Heel Reinforcing | = | # 6 @ 12.00 in | |
| Key Reinforcing | = | None Spec'd | |
| Footing Torsion, Tu | = | | 0.00 ft-lbs |
| Footing Allow. Torsion, phi Tu | = | | 0.00 ft-lbs |

**If torsion exceeds allowable, provide**
**supplemental design for footing torsion.**

Other Acceptable Sizes & Spacings
   Toe:
   Heel:
   Key:

| | | |
|---|---|---|
| Min footing T&S reinf Area | 2.82 | in2 |
| Min footing T&S reinf Area per foot | 0.39 | in2 /ft |

If one layer of horizontal bars:    If two layers of horizontal bars:
   #4@ 6.17 in        #4@ 12.35 in
   #5@ 9.57 in        #5@ 19.14 in
   #6@ 13.58 in       #6@ 27.16 in

## Cantilevered Retaining Wall

Project File: Typical Detail Co-04-07.EC6

**DESCRIPTION:** Retaining Wall Schedule 12'-0" Retaining Wall w/ Slab and Traffic

### Summary of Overturning & Resisting Forces & Moments

| Item | .....OVERTURNING..... Force lbs | Distance ft | Moment ft-# | | .....RESISTING..... Force lbs | Distance ft | Moment ft-# |
|---|---|---|---|---|---|---|---|
| HL Act Pres (ab water tbl) | 3,189.4 | 4.50 | 14,352.2 | Soil Over HL  (ab. water tbl) | 2,500.0 | 6.42 | 16,041.7 |
| HL Act Pres (be water tbl) | | | | Soil Over HL  (bel. water tbl) | | 6.42 | 16,041.7 |
| Hydrostatic Force | | | | Watre Table | | | |
| Buoyant Force = | | | | Sloped Soil Over Heel = | | | |
| Surcharge over Heel = | 945.0 | 6.75 | 6,378.8 | Surcharge Over Heel = | 416.7 | 6.42 | 2,673.6 |
| Surcharge Over Toe = | | | | Adjacent Footing Load = | | | |
| Adjacent Footing Load = | | | | Axial Dead Load on Stem = | | | |
| Added Lateral Load = | | | | * Axial Live Load on Stem = | | | |
| Load @ Stem Above Soil = | | | | Soil Over Toe = | | 2.38 | |
| = | | | | Surcharge Over Toe = | | | |
| | | | | Stem Weight(s) = | 1,500.0 | 5.17 | 7,750.0 |
| | | | | Earth @ Stem Transitions = | | | |
| **Total** = | 4,134.4 | **O.T.M.** = | 20,730.9 | Footing Weight = | 1,631.3 | 3.63 | 5,913.3 |
| | | | | Key Weight = | | | |
| **Resisting/Overturning Ratio** = | **1.56** | | | Vert. Component = | | | |

Vertical Loads used for Soil Pressure = 6,047.9 lbs

**Total =** 6,047.9 lbs  **R.M.=** 32,378.6

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

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

### Tilt

#### Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

| | | |
|---|---|---|
| Soil Spring Reaction Modulus | 250.0 | pci |
| Horizontal Defl @ Top of Wall (approximate only) | 0.096 | in |

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe,

because the wall would then tend to rotate into the retained soil.

## Cantilevered Retaining Wall

**DESCRIPTION:**  Retaining Wall Schedule 12'-0" Retaining Wall w/ Slab and Traffic

---

### Rebar Lap & Embedment Lengths Information

Stem Design Segment: Bottom
Stem Design Height:       0.00 ft above top of footing


| | |
|---|---:|
| Lap Splice length for #7 bar specified in this stem design segment = | 40.95 in |
| Development length for #7 bar specified in this stem design segment = | 31.50 in |
| | |
| Hooked embedment length into footing for #7 bar specified in this stem design segment = | 12.12 in |
| As Provided = | 0.9000 in2/ft |
| As Required = | 0.7422 in2/ft |

# Cantilevered Retaining Wall

Project File: Typical Detail Co-04-07.EC6

**DESCRIPTION:** Retaining Wall Schedule 12'-0" Retaining Wall w/ Slab and Traffic

**DESCRIPTION:** Retaining Wall Schedule 12'-0" Retaining Wall w/ Slab and Traffic

250.00psf

Restraint

2093.55psf

4134#

■ Lateral earth pressure due to the soil BELOW water table

# Cantilevered Retaining Wall
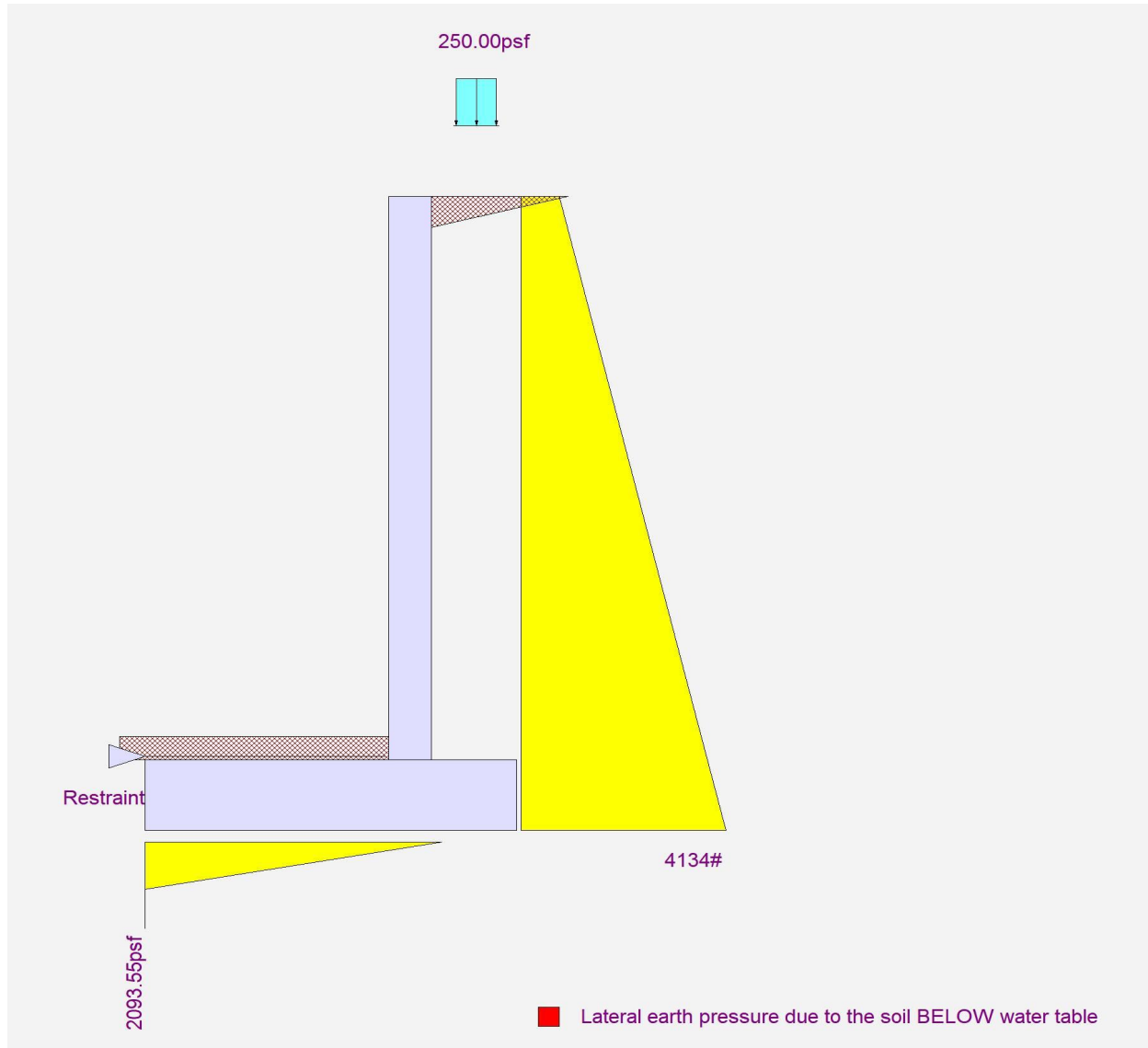
Project File: Typical Detail Co-04-07.EC6

LIC# : KW-06014947, Build:20.22.3.31          SWENSON SAY FAGET          (c) ENERCALC INC 1983-2022

**DESCRIPTION:**  Retaining Wall Schedule 12'-0" Retaining Wall w/ Slab and Traffic and Seismic
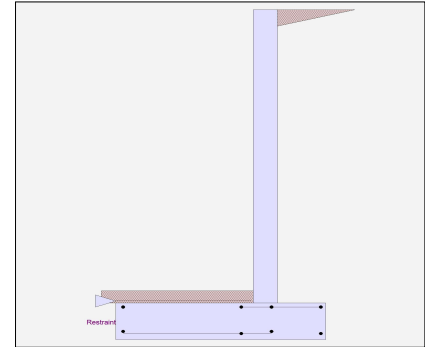
## *Code Reference*

Calculations per IBC 2018 1807.3, CBC 2019, ASCE 7-16

## Criteria

| | | |
|---|---|---|
| Retained Height | = | 12.00 ft |
| Wall height above soil | = | 0.00 ft |
| Slope Behind Wall | = | 0.00 |
| Height of Soil over Toe | = | 6.00 in |
| Water height over heel | = | 0.0 ft |

## Soil Data

| | | |
|---|---|---|
| Allow Soil Bearing | = | 4,000.0 psf |
| Equivalent Fluid Pressure Method | | |
| Active Heel Pressure | = | 35.0 psf/ft |
| | = | |
| Passive Pressure | = | 300.0 psf/ft |
| Soil Density, Heel | = | 125.00 pcf |
| Soil Density, Toe | = | 0.00 pcf |
| Footing||Soil Friction | = | 0.450 |
| Soil height to ignore for passive pressure | = | 12.00 in |

## Surcharge Loads

| | | |
|---|---|---|
| Surcharge Over Heel | = | 250.0 psf |
| Used To Resist Sliding & Overturning | | |
| Surcharge Over Toe | = | 0.0 |
| 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 |

## Earth Pressure Seismic Load

Method  : Uniform

| | | |
|---|---|---|
| Multiplier Used | = | 6.000 |
| (Multiplier used on soil density) | | |

## Lateral Load Applied to Stem

| | | |
|---|---|---|
| Lateral Load | = | 0.0 #/ft |
| ...Height to Top | = | 0.00 ft |
| ...Height to Bottom | = | 0.00 ft |
| Load Type | = | Wind (W) |
| | | (Service Level) |
| Wind on Exposed Stem | = | 0.0 psf |
| (Service Level) | | |

| | | |
|---|---|---|
| Uniform Seismic Force | = | 81.000 |
| Total Seismic Force | = | 1,093.500 |

## 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 | | Spread Footing |
| Base Above/Below Soil at Back of Wall | = | 0.0 ft |
| Poisson's Ratio | = | 0.300 |

## Cantilevered Retaining Wall

Project File: Typical Detail Co-04-07.EC6

**DESCRIPTION:** Retaining Wall Schedule 12'-0" Retaining Wall w/ Slab and Traffic and Seismic

### Design Summary

**Wall Stability Ratios**

| | | | |
|---|---|---|---|
| Overturning | = | 1.25 | Ratio < 1.5! |

Slab Resists All Sliding !

| | | | |
|---|---|---|---|
| Global Stability | = | 1.47 | |
| Total Bearing Load | = | 6,048 | lbs |
| ...resultant ecc. | = | 30.64 | in |
| Soil Pressure @ Toe | = | 3,763 | psf OK |
| Soil Pressure @ Heel | = | 0 | psf OK |
| Allowable | = | 4,000 | psf |

Soil Pressure Less Than Allowable

| | | | |
|---|---|---|---|
| ACI Factored @ Toe | = | 5,268 | psf |
| ACI Factored @ Heel | = | 0 | psf |
| Footing Shear @ Toe | = | 41.1 | psi OK |
| Footing Shear @ Heel | = | 22.1 | psi OK |
| Allowable | = | 75.0 | psi |

**Sliding Calcs**

| | | | |
|---|---|---|---|
| Lateral Sliding Force | = | 4,899.8 | lbs |

Vertical component of active lateral soil pressure IS
NOT considered in the calculation of soil bearing

**Load Factors**

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

### Stem Construction

| | | Bottom | | | | |
|---|---|---|---|---|---|---|
| | | Ratio > 1.0 | | | | |
| Design Height Above Ftg | ft = | 0.00 | | | | |
| Wall Material Above "Ht" | = | Concrete | | | | |
| Design Method | = | SD | SD | SD | SD | SD |
| Thickness | = | 10.00 | | | | |
| Rebar Size | = | # 7 | | | | |
| Rebar Spacing | = | 8.00 | | | | |
| Rebar Placed at | = | Edge | | | | |

**Design Data**

| | | |
|---|---|---|
| fb/FB + fa/Fa | = | **1.140** |

**Total Force @ Section**

| | | |
|---|---|---|
| Service Level | lbs = | |
| Strength Level | lbs = | 6,348.0 |

**Moment....Actual**

| | | |
|---|---|---|
| Service Level | ft-# = | |
| Strength Level | ft-# = | 30,024.0 |
| Moment.....Allowable | = | 26,327.0 |

**Shear.....Actual**

| | | |
|---|---|---|
| Service Level | psi = | |
| Strength Level | psi = | 70.0 |
| Shear.....Allowable | psi = | 75.0 |
| Anet (Masonry) | in2 = | |
| Wall Weight | psf = | 125.0 |
| Rebar Depth 'd' | in = | 7.56 |

**Masonry Data**

| | | |
|---|---|---|
| f'm | psi = | |
| Fs | psi = | |
| Solid Grouting | = | |
| Modular Ratio 'n' | = | |
| Equiv. Solid Thick. | = | |
| Masonry Block Type | = | |
| Masonry Design Method | = | ASD |

**Concrete Data**

| | | |
|---|---|---|
| f'c | psi = | 2,500.0 |
| Fy | psi = | 60,000.0 |

## Cantilevered Retaining Wall

Project File: Typical Detail Co-04-07.EC6

**DESCRIPTION:** Retaining Wall Schedule 12'-0" Retaining Wall w/ Slab and Traffic and Seismic

### Concrete Stem Rebar Area Details

| Bottom Stem | Vertical Reinforcing | Horizontal Reinforcing | |
|---|---|---|---|
| As (based on applied moment) : | 0.9211 in2/ft | | |
| (4/3) * As : | 1.2281 in2/ft | Min Stem T&S Reinf Area 2.880 in2 | |
| 200bd/fy : 200(12)(7.5625)/60000 : | 0.3025 in2/ft | Min Stem T&S Reinf Area per ft of stem Height : 0.240 in2/ft | |
| 0.0018bh : 0.0018(12)(10) : | 0.216 in2/ft | Horizontal Reinforcing Options : | |
| | ============ | One layer of : | Two layers of : |
| Required Area : | 0.9211 in2/ft | #4@ 10.00 in | #4@ 20.00 in |
| Provided Area : | 0.9 in2/ft | #5@ 15.50 in | #5@ 31.00 in |
| Maximum Area : | 1.0245 in2/ft | #6@ 22.00 in | #6@ 44.00 in |

### Footing Data

| | | | |
|---|---|---|---|
| Toe Width | = | 4.75 ft | |
| Heel Width | = | 2.50 | |
| Total Footing Width | = | 7.25 | |
| Footing Thickness | = | 18.00 in | |
| Key Width | = | 0.00 in | |
| Key Depth | = | 0.00 in | |
| Key Distance from Toe | = | 0.00 ft | |
| f'c = 2,500 psi | Fy = | 60,000 psi | |
| Footing Concrete Density | = | 150.00 pcf | |
| Min. As % | = | 0.0018 | |
| Cover @ Top | 2.00 | @ Btm = 3.00 in | |

### Footing Design Results

| | | Toe | Heel |
|---|---|---|---|
| Factored Pressure | = | 5,268 | 0 psf |
| Mu' : Upward | = | 31,145 | 0 ft-# |
| Mu' : Downward | = | 3,892 | 3,431 ft-# |
| Mu: Design | = | 27,253 | 3,431 ft-# |
| phiMn | = | 54,690 | 29,913 ft-# |
| Actual 1-Way Shear | = | 41.13 | 22.13 psi |
| Allow 1-Way Shear | = | 75.00 | 75.00 psi |
| Toe Reinforcing | = | # 7 @ 8.00 in | |
| Heel Reinforcing | = | # 6 @ 12.00 in | |
| Key Reinforcing | = | None Spec'd | |
| Footing Torsion, Tu | = | | 0.00 ft-lbs |
| Footing Allow. Torsion, phi Tu | = | | 0.00 ft-lbs |

**If torsion exceeds allowable, provide
supplemental design for footing torsion.**

Other Acceptable Sizes & Spacings

  Toe:
  Heel:
  Key:

| | | |
|---|---|---|
| Min footing T&S reinf Area | 2.82 | in2 |
| Min footing T&S reinf Area per foot | 0.39 | in2 /ft |

| If one layer of horizontal bars: | If two layers of horizontal bars: |
|---|---|
| #4@ 6.17 in | #4@ 12.35 in |
| #5@ 9.57 in | #5@ 19.14 in |
| #6@ 13.58 in | #6@ 27.16 in |

# Cantilevered Retaining Wall

**DESCRIPTION:**  Retaining Wall Schedule 12'-0" Retaining Wall w/ Slab and Traffic and Seismic

## Summary of Overturning & Resisting Forces & Moments

| Item | | .....OVERTURNING.....<br>Force<br>lbs | Distance<br>ft | Moment<br>ft-# | | .....RESISTING.....<br>Force<br>lbs | Distance<br>ft | Moment<br>ft-# |
|---|---|---|---|---|---|---|---|---|
| HL Act Pres (ab water tbl) | | 3,189.4 | 4.50 | 14,352.2 | Soil Over HL  (ab. water tbl) | 2,500.0 | 6.42 | 16,041.7 |
| HL Act Pres (be water tbl) | | | | | Soil Over HL  (bel. water tbl) | | 6.42 | 16,041.7 |
| Hydrostatic Force | | | | | Watre Table | | | |
| Buoyant Force | = | | | | Sloped Soil Over Heel = | | | |
| Surcharge over Heel | = | 945.0 | 6.75 | 6,378.8 | Surcharge Over Heel = | 416.7 | 6.42 | 2,673.6 |
| Surcharge Over Toe | = | | | | Adjacent Footing Load = | | | |
| Adjacent Footing Load | = | | | | Axial Dead Load on Stem = | | | |
| Added Lateral Load | = | | | | * Axial Live Load on Stem = | | | |
| Load @ Stem Above Soil | = | | | | Soil Over Toe = | | 2.38 | |
| Seismic Earth Load | = | 765.5 | 6.75 | 5,166.8 | Surcharge Over Toe = | | | |
| | = | | | | Stem Weight(s) = | 1,500.0 | 5.17 | 7,750.0 |
| | | | | | Earth @ Stem Transitions = | | | |
| **Total** | = | 4,899.8 | **O.T.M.** = | 25,897.7 | Footing Weight = | 1,631.3 | 3.63 | 5,913.3 |
| | | | | | Key Weight = | | | |
| | | | | | Vert. Component = | | | |

**Resisting/Overturning Ratio**     =    **1.25**
    Vertical Loads used for Soil Pressure =    6,047.9   lbs

                                           **Total =**    6,047.9   lbs   **R.M.=**      32,378.6

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

If seismic is included, the OTM and sliding ratios
may be 1.1 per section 1807.2.3 of IBC.

Vertical component of active lateral soil pressure IS NOT considered in
the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in
the calculation of Overturning Resistance.

## Tilt

### Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus                        250.0   pci

Horizontal Defl @ Top of Wall (approximate only)       0.173   in

<span style="color:red">The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe,</span>

<span style="color:red">because the wall would then tend to rotate into the retained soil.</span>

## Cantilevered Retaining Wall

**DESCRIPTION:**  Retaining Wall Schedule 12'-0" Retaining Wall w/ Slab and Traffic and Seismic

---

### Rebar Lap & Embedment Lengths Information

Stem Design Segment: Bottom
Stem Design Height:     0.00 ft above top of footing

| | |
|---|---:|
| Lap Splice length for #7 bar specified in this stem design segment = | 40.95 in |
| Development length for #7 bar specified in this stem design segment = | 31.50 in |
| | |
| Hooked embedment length into footing for #7 bar specified in this stem design segment = | 14.70 in |
| As Provided = | 0.9000 in2/ft |
| As Required = | 0.9211 in2/ft |

## Cantilevered Retaining Wall
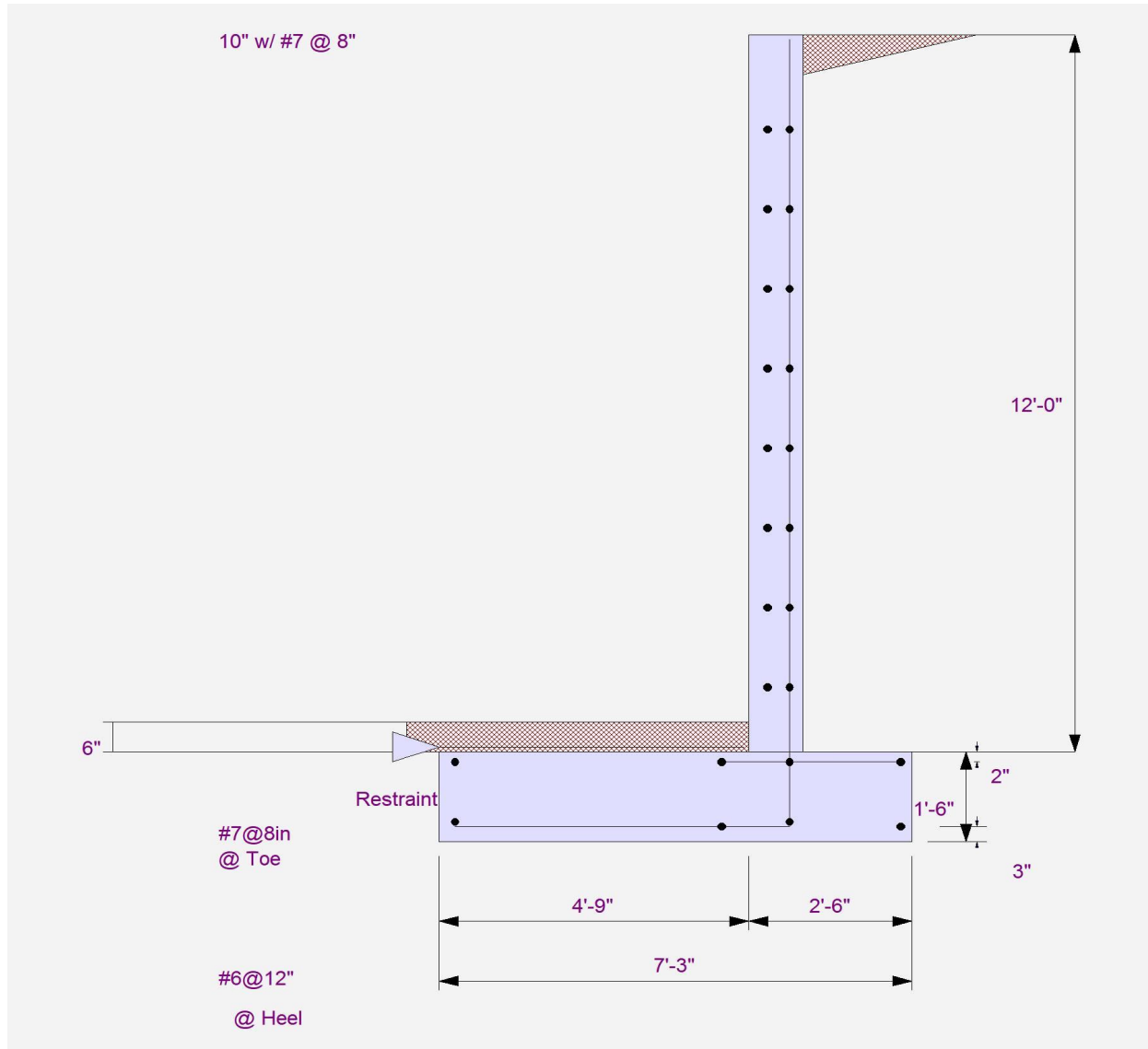
Project File: Typical Detail Co-04-07.EC6

LIC# : KW-06014947, Build:20.22.3.31          SWENSON SAY FAGET                    (c) ENERCALC INC 1983-2022

**DESCRIPTION:** Retaining Wall Schedule 12'-0" Retaining Wall w/ Slab and Traffic and Seismic



10" w/ #7 @ 8"

12'-0"

6"

Restraint

2"

1'-6"

3"

#7@8in
@ Toe

#6@12"

@ Heel

4'-9"          2'-6"

7'-3"

# Cantilevered Retaining Wall

LIC# : KW-06014947, Build:20.22.3.31                SWENSON SAY FAGET                (c) ENERCALC INC 1983-2022

**DESCRIPTION:**  Retaining Wall Schedule 12'-0" Retaining Wall w/ Slab and Traffic and Seismic

250.00psf

Restraint

3762.61psf

4134#        765#

■ Lateral earth pressure due to the soil BELOW water table

■ Seismic lateral earth pressure