

PRRWF20250002

Supplemental Structural Calculations

For

**Wesley Bradley Park Phase II  
Care Center Site Walls  
Tacoma, WA**

*Project # 2220236.20*

**Project Principal  
Project Engineer**

Drew McEachern, PE, SE  
Kyle Gysler, PE

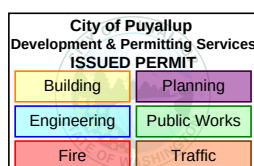


**City of Puyallup  
Building  
REVIEWED  
FOR  
COMPLIANCE**

SKinnear  
04/15/2025  
8:34:43 AM



Calculations required to be provided by  
the Permittee on site for all Inspections



**Date:  
April 2025**



AHBL, Inc.  
2215 North 30th  
Tacoma, WA 98403  
253.383.2422

Project Title: Wesley Bradley Park 2  
Engineer: KBG  
Project ID: 2220236.20  
Project Descr: Care Center

## Cantilevered Retaining Wall

Project File: 2220236\_care center redesign.ec6

LIC# : KW-06014847, Build:20.25.02.26

AHBL, INC

(c) ENERCALC, LLC 1982-2025

**DESCRIPTION:** 7' Retaining Wall - w/ LL - Rev1

### Code Reference:

Calculations per IBC 2021, ACI 318-19, TMS 402-16

#### Criteria

|                                     |   |          |
|-------------------------------------|---|----------|
| Retained Height                     | = | 7.50 ft  |
| Wall height above soil              | = | 0.00 ft  |
| Slope Behind Wall                   | = | 0.00     |
| Height of Soil over Toe             | = | 12.00 in |
| Water table above bottom of footing | = | 0.0 ft   |

#### Surcharge Loads

|                                      |   |           |
|--------------------------------------|---|-----------|
| Surcharge Over Heel                  | = | 100.0 psf |
| Used To Resist Sliding & Overturning |   |           |
| Surcharge Over Toe                   | = | 0.0       |
| Used for Sliding & Overturning       |   |           |

#### Axial Load Applied to Stem

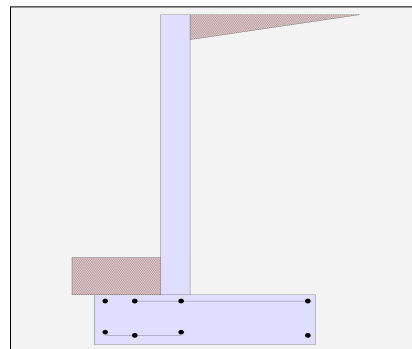
|                         |   |         |
|-------------------------|---|---------|
| Axial Dead Load         | = | 0.0 lbs |
| Axial Live Load         | = | 0.0 lbs |
| Axial Load Eccentricity | = | 0.0 in  |

#### Soil Data

|                                            |   |              |
|--------------------------------------------|---|--------------|
| Allow Soil Bearing                         | = | 3,000.0 psf  |
| Equivalent Fluid Pressure Method           |   |              |
| Active Heel Pressure                       | = | 35.0 psf/ft  |
|                                            | = |              |
| Passive Pressure                           | = | 525.0 psf/ft |
| Soil Density, Heel                         | = | 110.00 pcf   |
| Soil Density, Toe                          | = | 110.00 pcf   |
| Footing  Soil Friction                     | = | 0.525        |
| Soil height to ignore for passive pressure | = | 24.00 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)<br>(Service Level) |
| Wind on Exposed Stem | = | 0.0 psf<br>(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          |



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### DESCRIPTION: 7' Retaining Wall - w/ LL - Rev1

#### Design Summary

##### Wall Stability Ratios

|                  |   |      |    |
|------------------|---|------|----|
| Overtuning       | = | 2.54 | OK |
| Sliding          | = | 1.68 | OK |
| Global Stability | = | 2.55 |    |

|                    |   |       |     |
|--------------------|---|-------|-----|
| Total Bearing Load | = | 5,139 | lbs |
| ...resultant ecc.  | = | 8.50  | in  |

Eccentricity within middle third

|                      |   |       |     |    |
|----------------------|---|-------|-----|----|
| Soil Pressure @ Toe  | = | 1,678 | psf | OK |
| Soil Pressure @ Heel | = | 136   | psf | OK |
| Allowable            | = | 3,000 | psf |    |

Soil Pressure Less Than Allowable

|                      |   |           |    |
|----------------------|---|-----------|----|
| ACI Factored @ Toe   | = | 2,349 psf |    |
| ACI Factored @ Heel  | = | 191 psf   |    |
| Footing Shear @ Toe  | = | 5.6 psi   | OK |
| Footing Shear @ Heel | = | 10.3 psi  | OK |
| Allowable            | = | 82.2 psi  |    |

##### Sliding Calcs

|                          |     |             |    |
|--------------------------|-----|-------------|----|
| Lateral Sliding Force    | =   | 1,646.5 lbs |    |
| less 100% Passive Force  | -   | 379.2 lbs   |    |
| less 100% Friction Force | = - | 2,381.3 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

##### Design Height Above Ftg

|                          |         |          |
|--------------------------|---------|----------|
| ft =                     | Stem OK | 0.00     |
| Wall Material Above "Ht" | =       | Concrete |
| Design Method            | =       | SD       |
| Thickness                | =       | 8.00     |
| Rebar Size               | =       | # 6      |
| Rebar Spacing            | =       | 12.00    |
| Rebar Placed at          | =       | Edge     |

##### Design Data

|               |   |       |
|---------------|---|-------|
| fb/FB + fa/Fa | = | 0.511 |
|---------------|---|-------|

##### Total Force @ Section

|                |       |         |
|----------------|-------|---------|
| Service Level  | lbs = |         |
| Strength Level | lbs = | 1,956.8 |

##### Moment....Actual

|                |        |         |
|----------------|--------|---------|
| Service Level  | ft-# = |         |
| Strength Level | ft-# = | 5,369.3 |

|                      |   |          |
|----------------------|---|----------|
| Moment.....Allowable | = | 10,495.0 |
|----------------------|---|----------|

##### Shear.....Actual

|                |       |      |
|----------------|-------|------|
| Service Level  | psi = |      |
| Strength Level | psi = | 29.0 |

|                     |       |      |
|---------------------|-------|------|
| Shear.....Allowable | psi = | 70.9 |
|---------------------|-------|------|

|                |       |  |
|----------------|-------|--|
| Anet (Masonry) | in2 = |  |
|----------------|-------|--|

|             |       |       |
|-------------|-------|-------|
| Wall Weight | psf = | 100.0 |
|-------------|-------|-------|

|                 |      |      |
|-----------------|------|------|
| Rebar Depth 'd' | in = | 5.63 |
|-----------------|------|------|

##### 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 |

#### Bottom

SD SD



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**DESCRIPTION:** 7' Retaining Wall - w/ LL - Rev1

Used #5 @ 12"oc  
(0.31sqin/ft...ok)

### Concrete Stem Rebar Area Details

Bottom Stem

As (based on applied moment) :

0.0018bh : 0.0018(12)(8) :

Required Area :

Provided Area :

Maximum Area :

Vertical Reinforcing

0.2249 in<sup>2</sup>/ft

0.1728 in<sup>2</sup>/ft

=====

0.2249 in<sup>2</sup>/ft

0.44 in<sup>2</sup>/ft

1.2192 in<sup>2</sup>/ft

Horizontal Reinforcing

Horizontal Reinforcing Options :

One layer of :

Two layers of :

#4@ 13.89 in

#4@ 27.78 in

#5@ 21.53 in

#5@ 43.06 in

#6@ 30.56 in

#6@ 61.11 in

### Footing Data

|                     |   |          |
|---------------------|---|----------|
| Toe Width           | = | 1.50 ft  |
| Heel Width          | = | 3.50     |
| Total Footing Width | = | 5.00     |
| Footing Thickness   | = | 16.00 in |

|                          |           |            |            |
|--------------------------|-----------|------------|------------|
| f'c =                    | 3,000 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

|                              | <u>Toe</u>       | <u>Heel</u> |      |
|------------------------------|------------------|-------------|------|
| Factored Pressure            | = 2,349          | 191         | psf  |
| Mu' : Upward                 | = 2,400          | 2,403       | ft-# |
| Mu' : Downward               | = 419            | 5,579       | ft-# |
| Mu: Design                   | = 1,981          | 3,176       | ft-# |
| φ Mn                         | = 24,143         | 26,123      | ft-# |
| Actual 1-Way Shear           | = 5.60           | 10.28       | psi  |
| Allow 1-Way Shear            | = 46.89          | 45.71       | psi  |
| Toe Reinforcing              | = # 6 @ 12.00 in |             |      |
| Heel Reinforcing             | = # 6 @ 12.00 in |             |      |
| Key Reinforcing              | = None Spec'd    |             |      |
| Footing Torsion, Tu          | =                | 0.00 ft-lbs |      |
| Footing Allow. Torsion, φ Tn | =                | 0.00 ft-lbs |      |

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

#### Other Acceptable Sizes & Spacings

Toe: #4@ 6.94 in, #5@ 10.76 in, #6@ 15.27 in, #7@ 18 in, #8@ 18 in, #9@ 18 in, #10@ 18 in

Heel: #4@ 6.94 in, #5@ 10.76 in, #6@ 15.27 in, #7@ 18 in, #8@ 18 in, #9@ 18 in, #10@ 18 in

Key: No key defined

|                                     |      |                     |
|-------------------------------------|------|---------------------|
| Min footing T&S reinf Area          | 1.73 | in <sup>2</sup>     |
| Min footing T&S reinf Area per foot | 0.35 | in <sup>2</sup> /ft |

If one layer of horizontal bars:

#4@ 6.94 in

#5@ 10.76 in

#6@ 15.28 in

If two layers of horizontal bars:

#4@ 13.89 in

#5@ 21.53 in

#6@ 30.56 in

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**DESCRIPTION:** 7' Retaining Wall - w/ LL - Rev1

### Summary of Overturning & Resisting Forces & Moments

| .....OVERTURNING.....                   |              |                |                | .....RESISTING.....                                                                                                                   |              |                |                |
|-----------------------------------------|--------------|----------------|----------------|---------------------------------------------------------------------------------------------------------------------------------------|--------------|----------------|----------------|
| Item                                    | Force<br>lbs | Distance<br>ft | Moment<br>ft-# |                                                                                                                                       | Force<br>lbs | Distance<br>ft | Moment<br>ft-# |
| HL Act Pres (ab water tbl)              | 1,365.5      | 2.94           | 4,020.6        | Soil Over HL (ab. water tbl)                                                                                                          | 2,337.5      | 3.58           | 8,376.0        |
| HL Act Pres (be water tbl)              |              |                |                | Soil Over HL (bel. water tbl)                                                                                                         |              | 3.58           | 8,376.0        |
| Hydrostatic Force                       |              |                |                | Water Table                                                                                                                           |              |                |                |
| Buoyant Force                           | =            |                |                | Sloped Soil Over Heel                                                                                                                 | =            |                |                |
| Surcharge over Heel                     | = 281.1      | 4.42           | 1,241.4        | Surcharge Over Heel                                                                                                                   | = 283.3      | 3.58           | 1,015.3        |
| 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                                                                                                                         | = 165.0      | 0.75           | 123.8          |
|                                         | =            |                |                | Surcharge Over Toe                                                                                                                    | =            |                |                |
|                                         |              |                |                | Stem Weight(s)                                                                                                                        | = 750.0      | 1.83           | 1,375.0        |
|                                         |              |                |                | Earth @ Stem Transitions                                                                                                              | =            |                |                |
| <b>Total</b>                            | = 1,646.5    | <b>O.T.M.</b>  | = 5,261.9      | Footing Weight                                                                                                                        | = 1,000.0    | 2.50           | 2,500.0        |
|                                         |              |                |                | Key Weight                                                                                                                            | =            |                |                |
|                                         |              |                |                | Vert. Component                                                                                                                       | =            |                |                |
| <b>Resisting/Overturning Ratio</b>      |              | =              | <b>2.54</b>    | <b>Total =</b>                                                                                                                        | 4,535.8 lbs  | <b>R.M.=</b>   | 13,390.1       |
| Vertical Loads used for Soil Pressure = |              | 5,138.6        | lbs            | * 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) | 0.070 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.



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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 #6 bar specified in this stem design segment (25.4.2.4a) =

Development length for #6 bar specified in this stem design segment =

Hooked embedment length into footing for #6 bar specified in this stem design segment =

As Provided =

As Required =

22.20 in

17.08 in

10.35 in

0.4400 in<sup>2</sup>/ft

0.2250 in<sup>2</sup>/ft

Used #5 @ 12"oc  
(0.31sqin/ft...ok)



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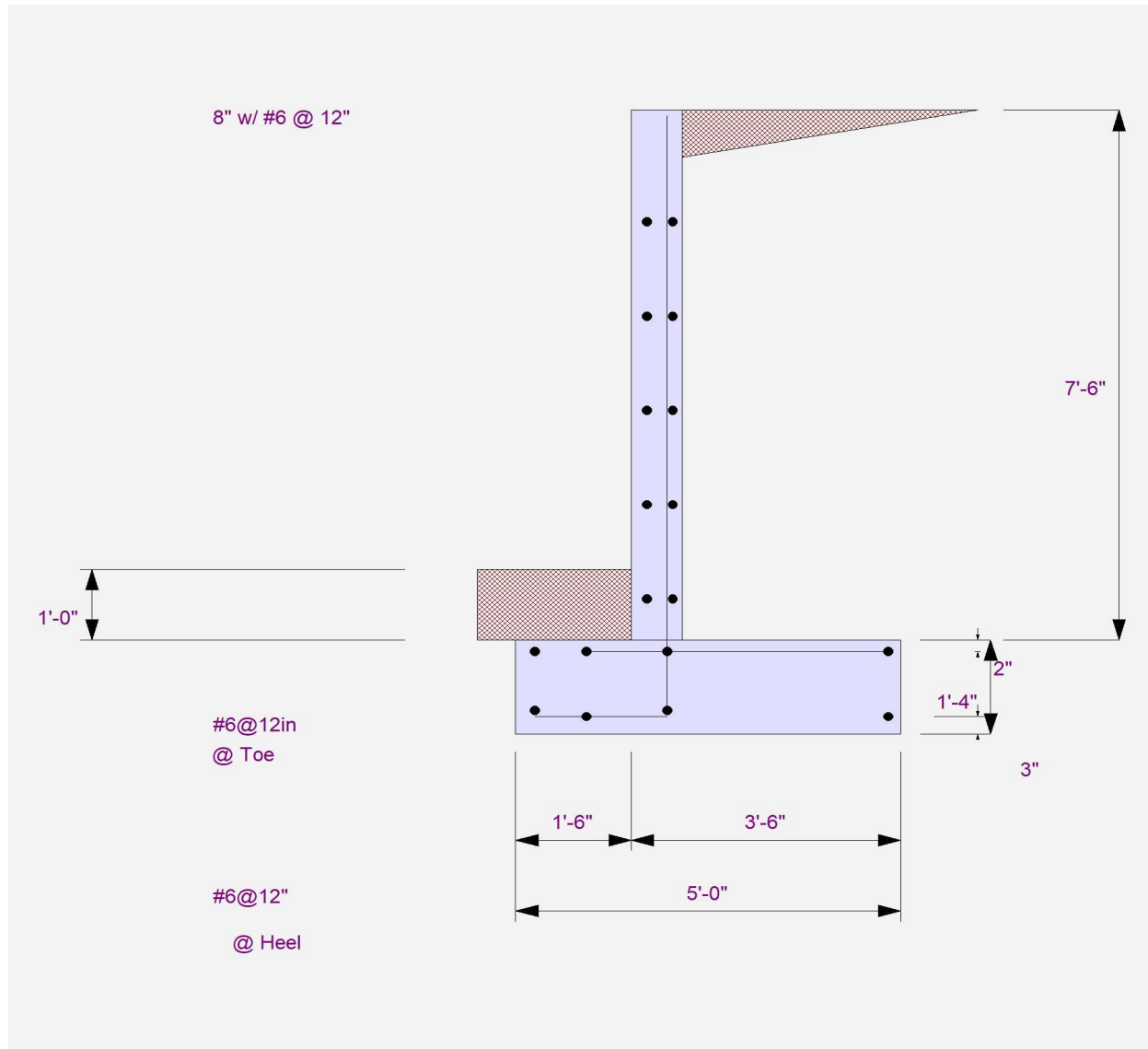
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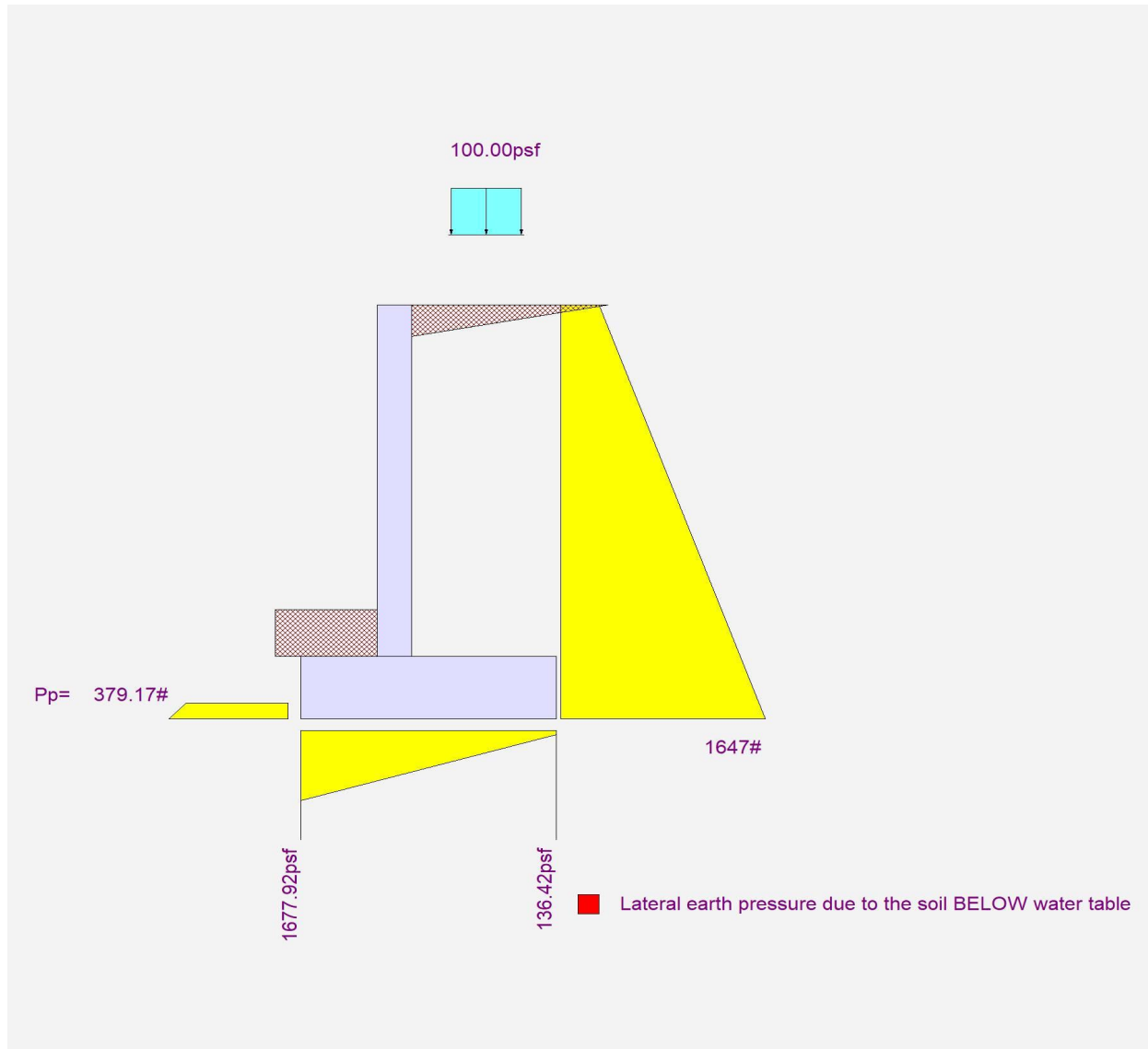
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### Code Reference:

Calculations per IBC 2021, ACI 318-19, TMS 402-16

#### Criteria

|                                     |   |          |
|-------------------------------------|---|----------|
| Retained Height                     | = | 7.50 ft  |
| Wall height above soil              | = | 0.00 ft  |
| Slope Behind Wall                   | = | 0.00     |
| Height of Soil over Toe             | = | 12.00 in |
| Water table above bottom of footing | = | 0.0 ft   |

#### 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                   | = 8.000   |
| (Multiplier used on soil density) |           |

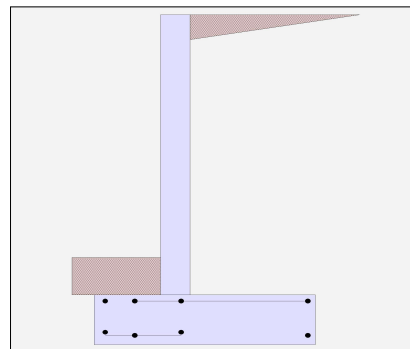
#### Soil Data

|                                            |   |              |
|--------------------------------------------|---|--------------|
| Allow Soil Bearing                         | = | 3,000.0 psf  |
| Equivalent Fluid Pressure Method           |   |              |
| Active Heel Pressure                       | = | 35.0 psf/ft  |
|                                            | = |              |
| Passive Pressure                           | = | 525.0 psf/ft |
| Soil Density, Heel                         | = | 110.00 pcf   |
| Soil Density, Toe                          | = | 110.00 pcf   |
| Footing  Soil Friction                     | = | 0.525        |
| Soil height to ignore for passive pressure | = | 22.50 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)<br>(Service Level) |
| Wind on Exposed Stem | = | 0.0 psf<br>(Strength Level) |

|                       |   |         |
|-----------------------|---|---------|
| Uniform Seismic Force | = | 70.667  |
| Total Seismic Force   | = | 624.222 |



#### 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          |



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### DESCRIPTION: 7' Retaining Wall - w/ EQ - Rev1

#### Design Summary

##### Wall Stability Ratios

|                  |   |      |    |
|------------------|---|------|----|
| Overtuning       | = | 2.08 | OK |
| Sliding          | = | 1.52 | OK |
| Global Stability | = | 2.43 |    |

|                    |   |           |
|--------------------|---|-----------|
| Total Bearing Load | = | 4,855 lbs |
| ...resultant ecc.  | = | 11.87 in  |

Eccentricity outside middle third

|                      |   |           |    |
|----------------------|---|-----------|----|
| Soil Pressure @ Toe  | = | 1,877 psf | OK |
| Soil Pressure @ Heel | = | 0 psf     | OK |
| Allowable            | = | 3,000 psf |    |

Soil Pressure Less Than Allowable

|                      |   |           |    |
|----------------------|---|-----------|----|
| ACI Factored @ Toe   | = | 2,627 psf |    |
| ACI Factored @ Heel  | = | 0 psf     |    |
| Footing Shear @ Toe  | = | 6.4 psi   | OK |
| Footing Shear @ Heel | = | 11.5 psi  | OK |
| Allowable            | = | 82.2 psi  |    |

##### Sliding Calcs

|                          |     |             |    |
|--------------------------|-----|-------------|----|
| Lateral Sliding Force    | =   | 1,802.4 lbs |    |
| less 100% Passive Force  | -   | 506.3 lbs   |    |
| less 100% Friction Force | = - | 2,232.6 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

##### Design Height Above Ftg

|                          |            |
|--------------------------|------------|
| ft =                     | 0.00       |
| Wall Material Above "Ht" | = Concrete |
| Design Method            | = SD       |
| Thickness                | = 8.00     |
| Rebar Size               | = # 6      |
| Rebar Spacing            | = 12.00    |
| Rebar Placed at          | = Edge     |

##### Design Data

|               |   |       |
|---------------|---|-------|
| fb/FB + fa/Fa | = | 0.564 |
|---------------|---|-------|

##### Total Force @ Section

|                |               |
|----------------|---------------|
| Service Level  | lbs =         |
| Strength Level | lbs = 2,105.0 |

##### Moment....Actual

|                |                |
|----------------|----------------|
| Service Level  | ft-# =         |
| Strength Level | ft-# = 5,925.0 |

|                      |   |          |
|----------------------|---|----------|
| Moment.....Allowable | = | 10,495.0 |
|----------------------|---|----------|

##### Shear.....Actual

|                |            |
|----------------|------------|
| Service Level  | psi =      |
| Strength Level | psi = 31.2 |

|                     |            |
|---------------------|------------|
| Shear.....Allowable | psi = 70.9 |
|---------------------|------------|

|                |       |
|----------------|-------|
| Anet (Masonry) | in2 = |
|----------------|-------|

|             |             |
|-------------|-------------|
| Wall Weight | psf = 100.0 |
|-------------|-------------|

|                 |           |
|-----------------|-----------|
| Rebar Depth 'd' | in = 5.63 |
|-----------------|-----------|

##### 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 |

#### Bottom

Stem OK

ft = 0.00

= Concrete

= SD

= 8.00

= # 6

= 12.00

= Edge

= 0.564

lbs =

lbs = 2,105.0

ft-# =

ft-# = 5,925.0

= 10,495.0

psi =

psi = 31.2

psi = 70.9

in2 =

psf = 100.0

in = 5.63



AHBL, Inc.  
2215 North 30th  
Tacoma, WA 98403  
253.383.2422

Project Title: Wesley Bradley Park 2  
Engineer: KBG  
Project ID: 2220236.20  
Project Descr: Care Center

## Cantilevered Retaining Wall

Project File: 2220236\_care center redesign.ec6

LIC# : KW-06014847, Build:20.25.02.26

AHBL, INC

(c) ENERCALC, LLC 1982-2025

**DESCRIPTION:** 7' Retaining Wall - w/ EQ - Rev1

Used #5 @ 12"oc  
(0.31sqin/ft...ok)

### Concrete Stem Rebar Area Details

Bottom Stem

As (based on applied moment) :

0.0018bh : 0.0018(12)(8) :

Required Area :

Provided Area :

Maximum Area :

Vertical Reinforcing

0.2481 in<sup>2</sup>/ft

0.1728 in<sup>2</sup>/ft

=====

0.2481 in<sup>2</sup>/ft

0.44 in<sup>2</sup>/ft

1.2192 in<sup>2</sup>/ft

Horizontal Reinforcing

Horizontal Reinforcing Options :

One layer of :

Two layers of :

#4@ 13.89 in

#4@ 27.78 in

#5@ 21.53 in

#5@ 43.06 in

#6@ 30.56 in

#6@ 61.11 in

### Footing Data

|                     |   |          |
|---------------------|---|----------|
| Toe Width           | = | 1.50 ft  |
| Heel Width          | = | 3.50     |
| Total Footing Width | = | 5.00     |
| Footing Thickness   | = | 16.00 in |

|                          |           |            |            |
|--------------------------|-----------|------------|------------|
| f'c =                    | 3,000 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

|                              | <u>Toe</u>       | <u>Heel</u> |      |
|------------------------------|------------------|-------------|------|
| Factored Pressure            | = 2,627          | 0           | psf  |
| Mu' : Upward                 | = 2,630          | 1,279       | ft-# |
| Mu' : Downward               | = 419            | 4,937       | ft-# |
| Mu: Design                   | = 2,211          | 3,658       | ft-# |
| φ Mn                         | = 24,143         | 26,123      | ft-# |
| Actual 1-Way Shear           | = 6.35           | 11.50       | psi  |
| Allow 1-Way Shear            | = 46.89          | 45.71       | psi  |
| Toe Reinforcing              | = # 6 @ 12.00 in |             |      |
| Heel Reinforcing             | = # 6 @ 12.00 in |             |      |
| Key Reinforcing              | = None Spec'd    |             |      |
| Footing Torsion, Tu          | =                | 0.00 ft-lbs |      |
| Footing Allow. Torsion, φ Tn | =                | 0.00 ft-lbs |      |

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

#### Other Acceptable Sizes & Spacings

Toe: #4@ 6.94 in, #5@ 10.76 in, #6@ 15.27 in, #7@ 18 in, #8@ 18 in, #9@ 18 in, #10@ 18 in

Heel: #4@ 6.94 in, #5@ 10.76 in, #6@ 15.27 in, #7@ 18 in, #8@ 18 in, #9@ 18 in, #10@ 18 in

Key: No key defined

|                                     |      |                     |
|-------------------------------------|------|---------------------|
| Min footing T&S reinf Area          | 1.73 | in <sup>2</sup>     |
| Min footing T&S reinf Area per foot | 0.35 | in <sup>2</sup> /ft |

If one layer of horizontal bars:

#4@ 6.94 in

#5@ 10.76 in

#6@ 15.28 in

If two layers of horizontal bars:

#4@ 13.89 in

#5@ 21.53 in

#6@ 30.56 in



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## Cantilevered Retaining Wall

Project File: 2220236\_care center redesign.ec6

LIC# : KW-06014847, Build:20.25.02.26

AHBL, INC

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**DESCRIPTION:** 7' Retaining Wall - w/ EQ - Rev1

### Summary of Overturning & Resisting Forces & Moments

| Item                                  | .....OVERTURNING..... |                |                         | .....RESISTING.....           |                |                |          |
|---------------------------------------|-----------------------|----------------|-------------------------|-------------------------------|----------------|----------------|----------|
|                                       | Force<br>lbs          | Distance<br>ft | Moment<br>ft-#          | Force<br>lbs                  | Distance<br>ft | Moment<br>ft-# |          |
| HL Act Pres (ab water tbl)            | 1,365.5               | 2.94           | 4,020.6                 | Soil Over HL (ab. water tbl)  | 2,337.5        | 3.58           | 8,376.0  |
| HL Act Pres (be water tbl)            |                       |                |                         | Soil Over HL (bel. water tbl) |                | 3.58           | 8,376.0  |
| Hydrostatic Force                     |                       |                |                         | Water 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                 | =              | 165.0          | 123.8    |
| Seismic Earth Load                    | =                     | 437.0          | 1,929.9                 | Surcharge Over Toe            | =              |                |          |
|                                       | =                     |                |                         | Stem Weight(s)                | =              | 750.0          | 1,375.0  |
|                                       |                       |                |                         | Earth @ Stem Transitions      | =              |                |          |
|                                       |                       |                |                         | Footing Weight                | =              | 1,000.0        | 2,500.0  |
|                                       |                       |                |                         | Key Weight                    | =              |                |          |
|                                       |                       |                |                         | Vert. Component               | =              |                |          |
| <b>Total</b>                          | =                     | 1,802.4        | <b>O.T.M. = 5,950.5</b> | <b>Total =</b>                | 4,252.5 lbs    | <b>R.M.=</b>   | 12,374.8 |
| <b>Resisting/Overturning Ratio</b>    |                       | =              | <b>2.08</b>             |                               |                |                |          |
| Vertical Loads used for Soil Pressure | =                     | 4,855.3        | lbs                     |                               |                |                |          |

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) 0.078 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.



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## Cantilevered Retaining Wall

Project File: 2220236\_care center redesign.ec6

LIC# : KW-06014847, Build:20.25.02.26

AHBL, INC

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**DESCRIPTION:** 7' Retaining Wall - w/ EQ - Rev1

### Rebar Lap & Embedment Lengths Information

Stem Design Segment: Bottom

Stem Design Height: 0.00 ft above top of footing

Lap Splice length for #6 bar specified in this stem design segment (25.4.2.4a) =

Development length for #6 bar specified in this stem design segment =

Hooked embedment length into footing for #6 bar specified in this stem design segment =

As Provided =

As Required =

22.20 in

17.08 in

10.35 in

0.4400 in<sup>2</sup>/ft

0.2481 in<sup>2</sup>/ft

Used #5 @ 12"oc  
(0.31sqin/ft...ok)



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Project Descr: Care Center

## Cantilevered Retaining Wall

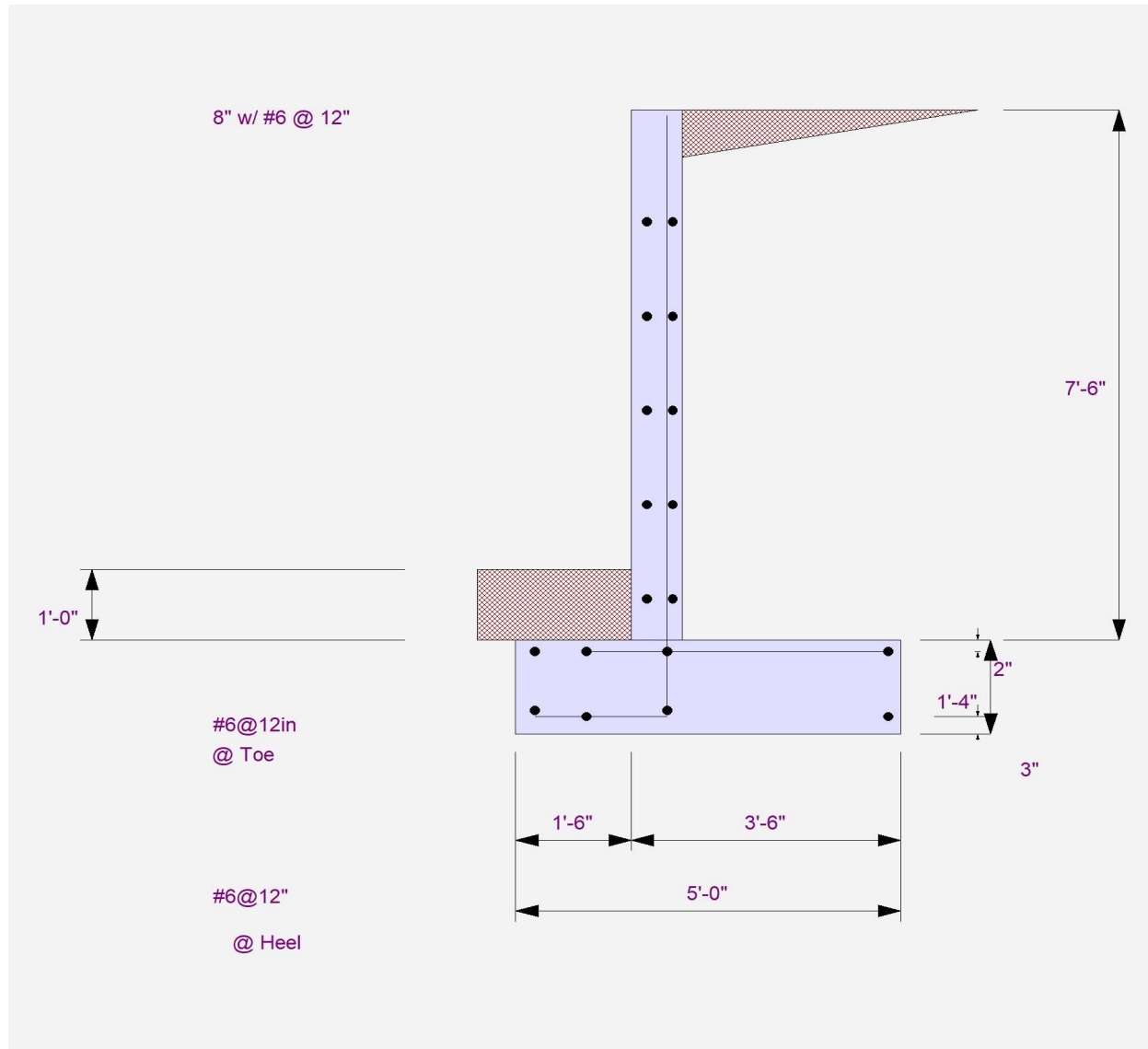
Project File: 2220236\_care center redesign.ec6

LIC# : KW-06014847, Build:20.25.02.26

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**DESCRIPTION:** 7' Retaining Wall - w/ EQ - Rev1





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Project ID: 2220236.20  
Project Descr: Care Center

## Cantilevered Retaining Wall

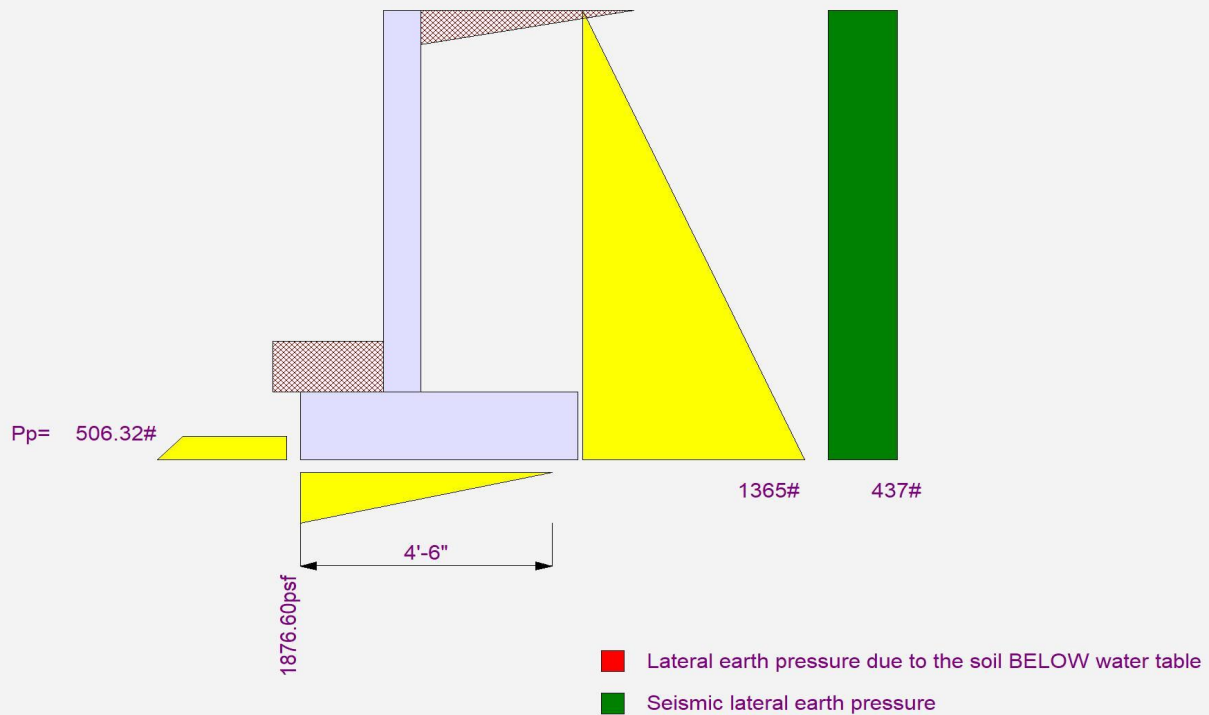
Project File: 2220236\_care center redesign.ec6

LIC# : KW-06014847, Build:20.25.02.26

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**DESCRIPTION:** 7' Retaining Wall - w/ EQ - Rev1





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Project Title: Wesley Bradley Park 2  
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Project ID: 2220236.20  
Project Descr: Care Center

## Cantilevered Retaining Wall

Project File: 2220236\_care center redesign.ec6

LIC# : KW-06014847, Build:20.25.02.26

AHBL, INC

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**DESCRIPTION:** 4' Retaining Wall - w/ LL - Rev1

### Code Reference:

Calculations per IBC 2021, ACI 318-19, TMS 402-16

#### Criteria

|                                     |   |          |
|-------------------------------------|---|----------|
| Retained Height                     | = | 4.50 ft  |
| Wall height above soil              | = | 0.00 ft  |
| Slope Behind Wall                   | = | 0.00     |
| Height of Soil over Toe             | = | 12.00 in |
| Water table above bottom of footing | = | 0.0 ft   |

#### Surcharge Loads

|                                      |   |           |
|--------------------------------------|---|-----------|
| Surcharge Over Heel                  | = | 100.0 psf |
| Used To Resist Sliding & Overturning |   |           |
| Surcharge Over Toe                   | = | 0.0       |
| Used for Sliding & Overturning       |   |           |

#### Axial Load Applied to Stem

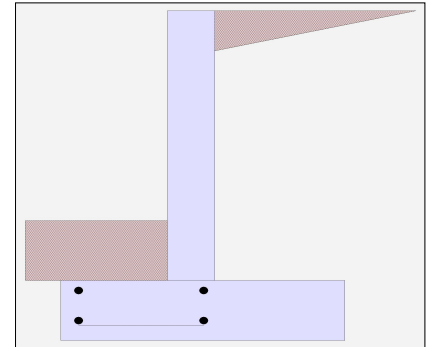
|                         |   |         |
|-------------------------|---|---------|
| Axial Dead Load         | = | 0.0 lbs |
| Axial Live Load         | = | 0.0 lbs |
| Axial Load Eccentricity | = | 0.0 in  |

#### Soil Data

|                                            |   |              |
|--------------------------------------------|---|--------------|
| Allow Soil Bearing                         | = | 3,000.0 psf  |
| Equivalent Fluid Pressure Method           |   |              |
| Active Heel Pressure                       | = | 35.0 psf/ft  |
|                                            | = |              |
| Passive Pressure                           | = | 525.0 psf/ft |
| Soil Density, Heel                         | = | 110.00 pcf   |
| Soil Density, Toe                          | = | 110.00 pcf   |
| Footing  Soil Friction                     | = | 0.525        |
| Soil height to ignore for passive pressure | = | 24.00 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)<br>(Service Level) |
| Wind on Exposed Stem | = | 0.0 psf<br>(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          |





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Project Descr: Care Center

## Cantilevered Retaining Wall

Project File: 2220236\_care center redesign.ec6

LIC# : KW-06014847, Build:20.25.02.26

AHBL, INC

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### DESCRIPTION: 4' Retaining Wall - w/ LL - Rev1

#### Design Summary

##### Wall Stability Ratios

|                  |   |      |    |
|------------------|---|------|----|
| Overtuning       | = | 3.80 | OK |
| Sliding          | = | 1.72 | OK |
| Global Stability | = | 1.72 |    |

|                    |   |           |
|--------------------|---|-----------|
| Total Bearing Load | = | 2,540 lbs |
| ...resultant ecc.  | = | 2.87 in   |

Eccentricity within middle third

|                      |   |           |    |
|----------------------|---|-----------|----|
| Soil Pressure @ Toe  | = | 783 psf   | OK |
| Soil Pressure @ Heel | = | 370 psf   | OK |
| Allowable            | = | 3,000 psf |    |

Soil Pressure Less Than Allowable

|                      |   |           |    |
|----------------------|---|-----------|----|
| ACI Factored @ Toe   | = | 1,096 psf |    |
| ACI Factored @ Heel  | = | 518 psf   |    |
| Footing Shear @ Toe  | = | 5.3 psi   | OK |
| Footing Shear @ Heel | = | 4.3 psi   | OK |
| Allowable            | = | 82.2 psi  |    |

##### Sliding Calcs

|                          |     |             |    |
|--------------------------|-----|-------------|----|
| Lateral Sliding Force    | =   | 704.4 lbs   |    |
| less 100% Passive Force  | -   | 0.0 lbs     |    |
| less 100% Friction Force | = - | 1,210.6 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

##### Design Height Above Ftg

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

##### Design Data

|               |   |       |
|---------------|---|-------|
| fb/FB + fa/Fa | = | 0.164 |
|---------------|---|-------|

##### Total Force @ Section

|                |             |
|----------------|-------------|
| Service Level  | lbs =       |
| Strength Level | lbs = 796.1 |

##### Moment....Actual

|                |                |
|----------------|----------------|
| Service Level  | ft-# =         |
| Strength Level | ft-# = 1,366.0 |

|                      |   |         |
|----------------------|---|---------|
| Moment.....Allowable | = | 8,312.6 |
|----------------------|---|---------|

##### Shear.....Actual

|                |            |
|----------------|------------|
| Service Level  | psi =      |
| Strength Level | psi = 10.7 |

|                     |            |
|---------------------|------------|
| Shear.....Allowable | psi = 61.1 |
|---------------------|------------|

|                |       |
|----------------|-------|
| 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 = 4,000.0  |
| Fy  | psi = 60,000.0 |

#### Bottom

Stem OK

ft = 0.00

= Concrete

= SD

= 8.00

= # 5

= 12.00

= Edge

= 0.164

lbs =

lbs = 796.1

ft-# =

ft-# = 1,366.0

= 8,312.6

psi =

psi = 10.7

psi = 61.1

in2 =

psf = 100.0

in = 6.19



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253.383.2422

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## Cantilevered Retaining Wall

Project File: 2220236\_care center redesign.ec6

LIC# : KW-06014847, Build:20.25.02.26

AHBL, INC

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**DESCRIPTION: 4' Retaining Wall - w/ LL - Rev1**

### Concrete Stem Rebar Area Details

| Bottom Stem                    | Vertical Reinforcing       | Horizontal Reinforcing                       |
|--------------------------------|----------------------------|----------------------------------------------|
| As (based on applied moment) : | 0.0517 in <sup>2</sup> /ft |                                              |
| 0.0018bh : 0.0018(12)(8) :     | 0.1728 in <sup>2</sup> /ft | Horizontal Reinforcing Options :             |
|                                | =====                      | <u>One layer of :</u> <u>Two layers of :</u> |
| Required Area :                | 0.1728 in <sup>2</sup> /ft | #4@ 13.89 in      #4@ 27.78 in               |
| Provided Area :                | 0.31 in <sup>2</sup> /ft   | #5@ 21.53 in      #5@ 43.06 in               |
| Maximum Area :                 | 1.3411 in <sup>2</sup> /ft | #6@ 30.56 in      #6@ 61.11 in               |

### Footing Data

|                     |   |          |
|---------------------|---|----------|
| Toe Width           | = | 1.50 ft  |
| Heel Width          | = | 2.50     |
| Total Footing Width | = | 4.00     |
| Footing Thickness   | = | 12.00 in |

f'c = 3,000 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            | = 1,096          | 518   | psf    |
| Mu' : Upward                 | = 1,152          | 1,019 | ft-#   |
| Mu' : Downward               | = 351            | 1,570 | ft-#   |
| Mu: Design                   | = 801            | 551   | ft-#   |
| φ Mn                         | = 11,695         | 2,739 | ft-#   |
| Actual 1-Way Shear           | = 5.30           | 4.33  | psi    |
| Allow 1-Way Shear            | = 47.26          | 43.82 | psi    |
| Toe Reinforcing              | = # 5 @ 12.00 in |       |        |
| Heel Reinforcing             | = None Spec'd    |       |        |
| Key Reinforcing              | = None Spec'd    |       |        |
| Footing Torsion, Tu          | =                | 0.00  | ft-lbs |
| Footing Allow. Torsion, φ Tn | =                | 0.00  | ft-lbs |

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

#### Other Acceptable Sizes & Spacings

Toe: #4@ 9.25 in, #5@ 14.35 in, #6@ 18 in, #7@ 18 in, #8@ 18 in, #9@ 18 in, #10@ 18 in

Heel:  $\phi Mn = \phi * 5 * \lambda * \sqrt{f'c} * S_m$

Key: No key defined

Min footing T&S reinf Area 1.04 in<sup>2</sup>  
Min footing T&S reinf Area per foot 0.26 in<sup>2</sup> /ft

#### If one layer of horizontal bars:

#4@ 9.26 in  
#5@ 14.35 in  
#6@ 20.37 in

#### If two layers of horizontal bars:

#4@ 18.52 in  
#5@ 28.70 in  
#6@ 40.74 in



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Project Title: Wesley Bradley Park 2  
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## Cantilevered Retaining Wall

Project File: 2220236\_care center redesign.ec6

LIC# : KW-06014847, Build:20.25.02.26

AHBL, INC

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**DESCRIPTION:** 4' Retaining Wall - w/ LL - Rev1

### Summary of Overturning & Resisting Forces & Moments

| .....OVERTURNING.....                                                                                                                 |              |                |                | .....RESISTING.....           |                     |                |                |              |         |
|---------------------------------------------------------------------------------------------------------------------------------------|--------------|----------------|----------------|-------------------------------|---------------------|----------------|----------------|--------------|---------|
| Item                                                                                                                                  | Force<br>lbs | Distance<br>ft | Moment<br>ft-# |                               | Force<br>lbs        | Distance<br>ft | Moment<br>ft-# |              |         |
| HL Act Pres (ab water tbl)                                                                                                            | 529.4        | 1.83           | 970.5          | Soil Over HL (ab. water tbl)  | 907.5               | 3.08           | 2,798.1        |              |         |
| HL Act Pres (be water tbl)                                                                                                            |              |                |                | Soil Over HL (bel. water tbl) |                     | 3.08           | 2,798.1        |              |         |
| Hydrostatic Force                                                                                                                     |              |                |                | Water Table                   |                     |                |                |              |         |
| Buoyant Force                                                                                                                         | =            |                |                | Sloped Soil Over Heel         | =                   |                |                |              |         |
| Surcharge over Heel                                                                                                                   | =            | 175.0          | 2.75           | 481.3                         | Surcharge Over Heel | =              | 183.3          | 3.08         | 565.3   |
| 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                 | =                   | 165.0          | 0.75           | 123.8        |         |
|                                                                                                                                       | =            |                |                | Surcharge Over Toe            | =                   |                |                |              |         |
|                                                                                                                                       |              |                |                | Stem Weight(s)                | =                   | 450.0          | 1.83           | 825.0        |         |
|                                                                                                                                       |              |                |                | Earth @ Stem Transitions      | =                   |                |                |              |         |
|                                                                                                                                       |              |                |                | Footing Weight                | =                   | 600.0          | 2.00           | 1,200.0      |         |
|                                                                                                                                       |              |                |                | Key Weight                    | =                   |                |                |              |         |
|                                                                                                                                       |              |                |                | Vert. Component               | =                   |                |                |              |         |
| <b>Total</b>                                                                                                                          | =            | 704.4          | <b>O.T.M.</b>  | =                             |                     |                |                |              |         |
|                                                                                                                                       |              |                |                |                               |                     |                |                |              |         |
| <b>Resisting/Overturning Ratio</b>                                                                                                    |              |                | =              | <b>3.80</b>                   |                     |                |                |              |         |
| Vertical Loads used for Soil Pressure                                                                                                 | =            | 2,539.5        | lbs            |                               |                     |                |                |              |         |
|                                                                                                                                       |              |                |                |                               |                     |                |                |              |         |
|                                                                                                                                       |              |                |                |                               | <b>Total =</b>      | 2,305.8        | lbs            | <b>R.M.=</b> | 5,512.2 |
| * Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation. |              |                |                |                               |                     |                |                |              |         |

\* 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) 0.024 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.



AHBL, Inc.  
2215 North 30th  
Tacoma, WA 98403  
253.383.2422

Project Title: Wesley Bradley Park 2  
Engineer: KBG  
Project ID: 2220236.20  
Project Descr: Care Center

## Cantilevered Retaining Wall

Project File: 2220236\_care center redesign.ec6

LIC# : KW-06014847, Build:20.25.02.26

AHBL, INC

(c) ENERCALC, LLC 1982-2025

**DESCRIPTION:** 4' Retaining Wall - w/ LL - Rev1

### 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 (25.4.2.4a) = 18.50 in

Development length for #5 bar specified in this stem design segment = 14.23 in

Hooked embedment length into footing for #5 bar specified in this stem design segment = 7.87 in

As Provided = 0.3100 in<sup>2</sup>/ft

As Required = 0.1728 in<sup>2</sup>/ft

## Cantilevered Retaining Wall

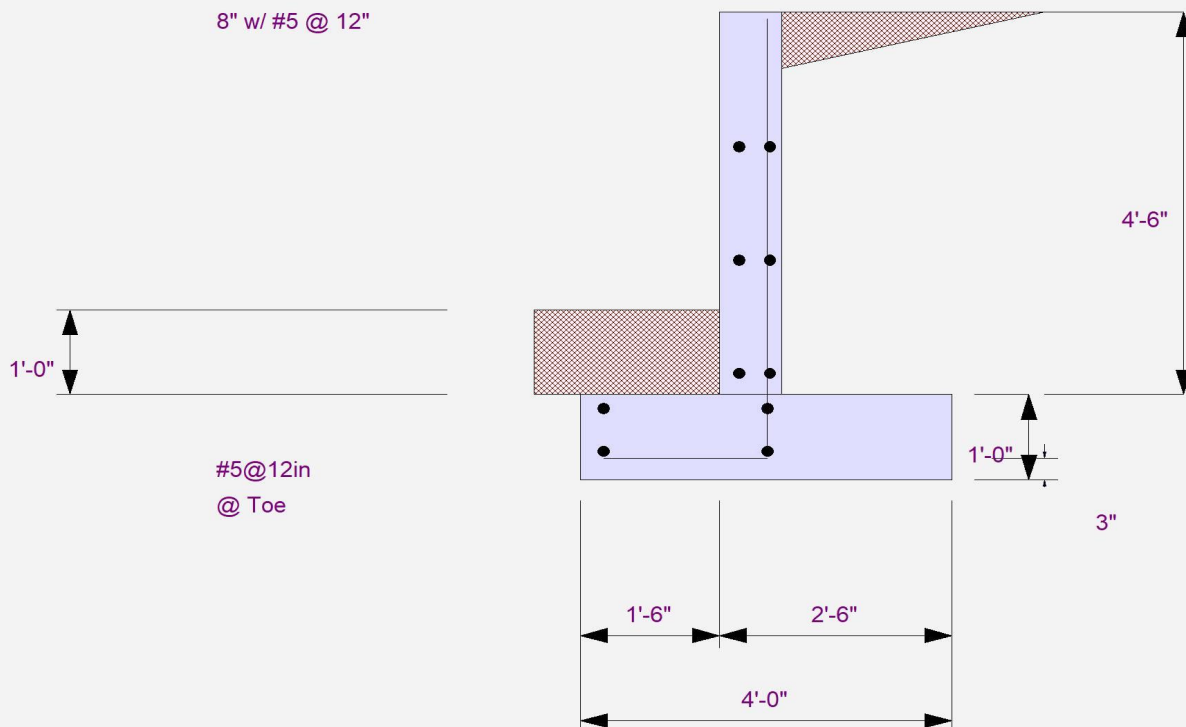
Project File: 2220236\_care center redesign.ec6

LIC# : KW-06014847, Build:20.25.02.26

AHBL, INC

(c) ENERCALC, LLC 1982-2025

**DESCRIPTION:** 4' Retaining Wall - w/ LL - Rev1



## Cantilevered Retaining Wall

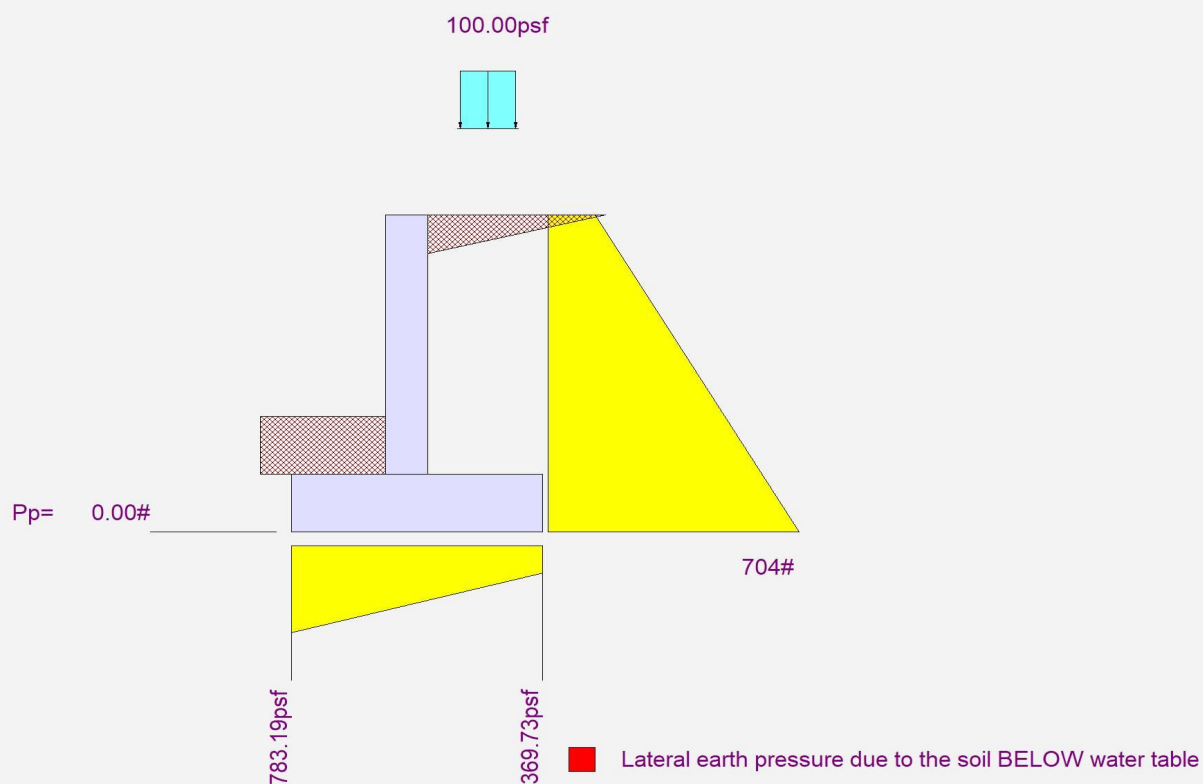
Project File: 2220236\_care center redesign.ec6

LIC# : KW-06014847, Build:20.25.02.26

AHBL, INC

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**DESCRIPTION:** 4' Retaining Wall - w/ LL - Rev1





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2215 North 30th  
Tacoma, WA 98403  
253.383.2422

Project Title: Wesley Bradley Park 2  
Engineer: KBG  
Project ID: 2220236.20  
Project Descr: Care Center

## Cantilevered Retaining Wall

Project File: 2220236\_care center redesign.ec6

LIC# : KW-06014847, Build:20.25.02.26

AHBL, INC

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**DESCRIPTION:** 4' Retaining Wall - w/ EQ - Rev1

### Code Reference:

Calculations per IBC 2021, ACI 318-19, TMS 402-16

#### Criteria

|                                     |   |          |
|-------------------------------------|---|----------|
| Retained Height                     | = | 4.50 ft  |
| Wall height above soil              | = | 0.00 ft  |
| Slope Behind Wall                   | = | 0.00     |
| Height of Soil over Toe             | = | 12.00 in |
| Water table above bottom of footing | = | 0.0 ft   |

#### 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                   | = 8.000   |
| (Multiplier used on soil density) |           |

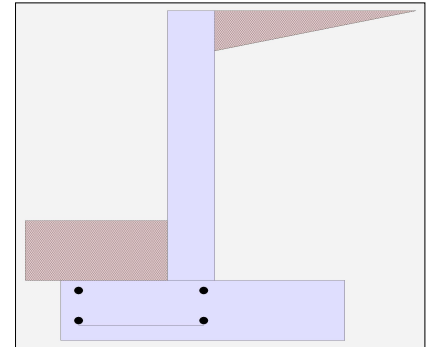
#### Soil Data

|                                            |   |              |
|--------------------------------------------|---|--------------|
| Allow Soil Bearing                         | = | 3,000.0 psf  |
| Equivalent Fluid Pressure Method           |   |              |
| Active Heel Pressure                       | = | 35.0 psf/ft  |
|                                            | = |              |
| Passive Pressure                           | = | 525.0 psf/ft |
| Soil Density, Heel                         | = | 110.00 pcf   |
| Soil Density, Toe                          | = | 110.00 pcf   |
| Footing  Soil Friction                     | = | 0.525        |
| Soil height to ignore for passive pressure | = | 24.00 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)<br>(Service Level) |
| Wind on Exposed Stem | = | 0.0 psf<br>(Strength Level) |

|                       |   |         |
|-----------------------|---|---------|
| Uniform Seismic Force | = | 44.000  |
| Total Seismic Force   | = | 242.000 |



#### 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          |



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253.383.2422

Project Title: Wesley Bradley Park 2  
Engineer: KBG  
Project ID: 2220236.20  
Project Descr: Care Center

## Cantilevered Retaining Wall

Project File: 2220236\_care center redesign.ec6

LIC# : KW-06014847, Build:20.25.02.26

AHBL, INC

(c) ENERCALC, LLC 1982-2025

### DESCRIPTION: 4' Retaining Wall - w/ EQ - Rev1

#### Design Summary

##### Wall Stability Ratios

|                  |   |      |    |
|------------------|---|------|----|
| Overtuning       | = | 3.44 | OK |
| Sliding          | = | 1.59 | OK |
| Global Stability | = | 3.13 |    |

|                    |   |           |
|--------------------|---|-----------|
| Total Bearing Load | = | 2,356 lbs |
| ...resultant ecc.  | = | 4.15 in   |

Eccentricity within middle third

|                      |   |           |    |
|----------------------|---|-----------|----|
| Soil Pressure @ Toe  | = | 806 psf   | OK |
| Soil Pressure @ Heel | = | 255 psf   | OK |
| Allowable            | = | 3,000 psf |    |

Soil Pressure Less Than Allowable

|                      |   |           |    |
|----------------------|---|-----------|----|
| ACI Factored @ Toe   | = | 1,128 psf |    |
| ACI Factored @ Heel  | = | 357 psf   |    |
| Footing Shear @ Toe  | = | 5.4 psi   | OK |
| Footing Shear @ Heel | = | 3.7 psi   | OK |
| Allowable            | = | 82.2 psi  |    |

##### Sliding Calcs

|                          |   |             |    |
|--------------------------|---|-------------|----|
| Lateral Sliding Force    | = | 698.8 lbs   |    |
| less 100% Passive Force  | = | 0.0 lbs     |    |
| less 100% Friction Force | = | 1,114.3 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

##### Design Height Above Ftg

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

##### Design Data

|               |   |       |
|---------------|---|-------|
| fb/FB + fa/Fa | = | 0.155 |
|---------------|---|-------|

##### Total Force @ Section

|                |       |       |
|----------------|-------|-------|
| Service Level  | lbs = |       |
| Strength Level | lbs = | 765.0 |

##### Moment....Actual

|                |        |         |
|----------------|--------|---------|
| Service Level  | ft-# = |         |
| Strength Level | ft-# = | 1,296.0 |

|                      |   |         |
|----------------------|---|---------|
| Moment.....Allowable | = | 8,312.6 |
|----------------------|---|---------|

##### Shear.....Actual

|                |       |      |
|----------------|-------|------|
| Service Level  | psi = |      |
| Strength Level | psi = | 10.3 |

|                     |       |      |
|---------------------|-------|------|
| Shear.....Allowable | psi = | 61.1 |
|---------------------|-------|------|

|                |       |  |
|----------------|-------|--|
| 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 = | 4,000.0  |
| Fy  | psi = | 60,000.0 |

#### Bottom

SD SD





AHBL, Inc.  
2215 North 30th  
Tacoma, WA 98403  
253.383.2422

Project Title: Wesley Bradley Park 2  
Engineer: KBG  
Project ID: 2220236.20  
Project Descr: Care Center

## Cantilevered Retaining Wall

Project File: 2220236\_care center redesign.ec6

LIC# : KW-06014847, Build:20.25.02.26

AHBL, INC

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**DESCRIPTION: 4' Retaining Wall - w/ EQ - Rev1**

### Concrete Stem Rebar Area Details

| Bottom Stem                    | Vertical Reinforcing       | Horizontal Reinforcing                       |
|--------------------------------|----------------------------|----------------------------------------------|
| As (based on applied moment) : | 0.0491 in <sup>2</sup> /ft |                                              |
| 0.0018bh : 0.0018(12)(8) :     | 0.1728 in <sup>2</sup> /ft | Horizontal Reinforcing Options :             |
|                                | =====                      | <u>One layer of :</u> <u>Two layers of :</u> |
| Required Area :                | 0.1728 in <sup>2</sup> /ft | #4@ 13.89 in      #4@ 27.78 in               |
| Provided Area :                | 0.31 in <sup>2</sup> /ft   | #5@ 21.53 in      #5@ 43.06 in               |
| Maximum Area :                 | 1.3411 in <sup>2</sup> /ft | #6@ 30.56 in      #6@ 61.11 in               |

### Footing Data

|                     |   |          |
|---------------------|---|----------|
| Toe Width           | = | 1.50 ft  |
| Heel Width          | = | 2.50     |
| Total Footing Width | = | 4.00     |
| Footing Thickness   | = | 12.00 in |

f'c = 3,000 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

|                              |   | <u>Toe</u>     | <u>Heel</u> |      |
|------------------------------|---|----------------|-------------|------|
| Factored Pressure            | = | 1,128          | 357         | psf  |
| Mu' : Upward                 | = | 1,161          | 798         | ft-# |
| Mu' : Downward               | = | 351            | 1,301       | ft-# |
| Mu: Design                   | = | 810            | 502         | ft-# |
| φ Mn                         | = | 11,695         | 2,739       | ft-# |
| Actual 1-Way Shear           | = | 5.40           | 3.67        | psi  |
| Allow 1-Way Shear            | = | 47.26          | 43.82       | psi  |
| Toe Reinforcing              | = | # 5 @ 12.00 in |             |      |
| Heel Reinforcing             | = | None Spec'd    |             |      |
| Key Reinforcing              | = | None Spec'd    |             |      |
| Footing Torsion, Tu          | = |                | 0.00 ft-lbs |      |
| Footing Allow. Torsion, φ Tn | = |                | 0.00 ft-lbs |      |

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

#### Other Acceptable Sizes & Spacings

Toe: #4@ 9.25 in, #5@ 14.35 in, #6@ 18 in, #7@ 18 in, #8@ 18 in, #9@ 18 in, #10@ 18 in

Heel:  $\phi Mn = \phi * 5 * \lambda * \sqrt{f'c} * S_m$

Key: No key defined

Min footing T&S reinf Area 1.04 in<sup>2</sup>  
Min footing T&S reinf Area per foot 0.26 in<sup>2</sup> /ft

#### If one layer of horizontal bars:

#4@ 9.26 in  
#5@ 14.35 in  
#6@ 20.37 in

#### If two layers of horizontal bars:

#4@ 18.52 in  
#5@ 28.70 in  
#6@ 40.74 in



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253.383.2422

Project Title: Wesley Bradley Park 2  
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Project ID: 2220236.20  
Project Descr: Care Center

## Cantilevered Retaining Wall

Project File: 2220236\_care center redesign.ec6

LIC# : KW-06014847, Build:20.25.02.26

AHBL, INC

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**DESCRIPTION:** 4' Retaining Wall - w/ EQ - Rev1

### Summary of Overturning & Resisting Forces & Moments

| .....OVERTURNING.....                 |              |                |                | .....RESISTING.....           |                    |                |                |
|---------------------------------------|--------------|----------------|----------------|-------------------------------|--------------------|----------------|----------------|
| Item                                  | Force<br>lbs | Distance<br>ft | Moment<br>ft-# |                               | Force<br>lbs       | Distance<br>ft | Moment<br>ft-# |
| HL Act Pres (ab water tbl)            | 529.4        | 1.83           | 970.5          | Soil Over HL (ab. water tbl)  | 907.5              | 3.08           | 2,798.1        |
| HL Act Pres (be water tbl)            |              |                |                | Soil Over HL (bel. water tbl) |                    | 3.08           | 2,798.1        |
| Hydrostatic Force                     |              |                |                | Water 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                 | =                  | 165.0          | 0.75           |
| Seismic Earth Load                    | =            | 169.4          | 2.75           | 465.9                         | Surcharge Over Toe | =              |                |
|                                       | =            |                |                | Stem Weight(s)                | =                  | 450.0          | 1.83           |
|                                       |              |                |                | Earth @ Stem Transitions      | =                  |                |                |
|                                       |              |                |                | Footing Weight                | =                  | 600.0          | 2.00           |
|                                       |              |                |                | Key Weight                    | =                  |                |                |
|                                       |              |                |                | Vert. Component               | =                  |                |                |
| <b>Total</b>                          | =            | 698.8          | <b>O.T.M.</b>  | =                             |                    |                |                |
|                                       |              |                |                |                               |                    |                |                |
| <b>Resisting/Overturning Ratio</b>    |              |                | =              | <b>3.44</b>                   |                    |                |                |
| Vertical Loads used for Soil Pressure | =            | 2,356.2        | lbs            |                               |                    |                |                |
|                                       |              |                |                | <b>Total</b>                  | =                  | 2,122.5 lbs    | <b>R.M.</b>    |
|                                       |              |                |                |                               |                    |                | 4,946.9        |

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) 0.025 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.

**Total = 2,122.5 lbs R.M.= 4,946.9**  
\* Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.



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## Cantilevered Retaining Wall

Project File: 2220236\_care center redesign.ec6

LIC# : KW-06014847, Build:20.25.02.26

AHBL, INC

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**DESCRIPTION:** 4' Retaining Wall - w/ EQ - Rev1

### 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 (25.4.2.4a) = 18.50 in

Development length for #5 bar specified in this stem design segment = 14.23 in

Hooked embedment length into footing for #5 bar specified in this stem design segment = 7.87 in

As Provided = 0.3100 in2/ft

As Required = 0.1728 in2/ft

## Cantilevered Retaining Wall

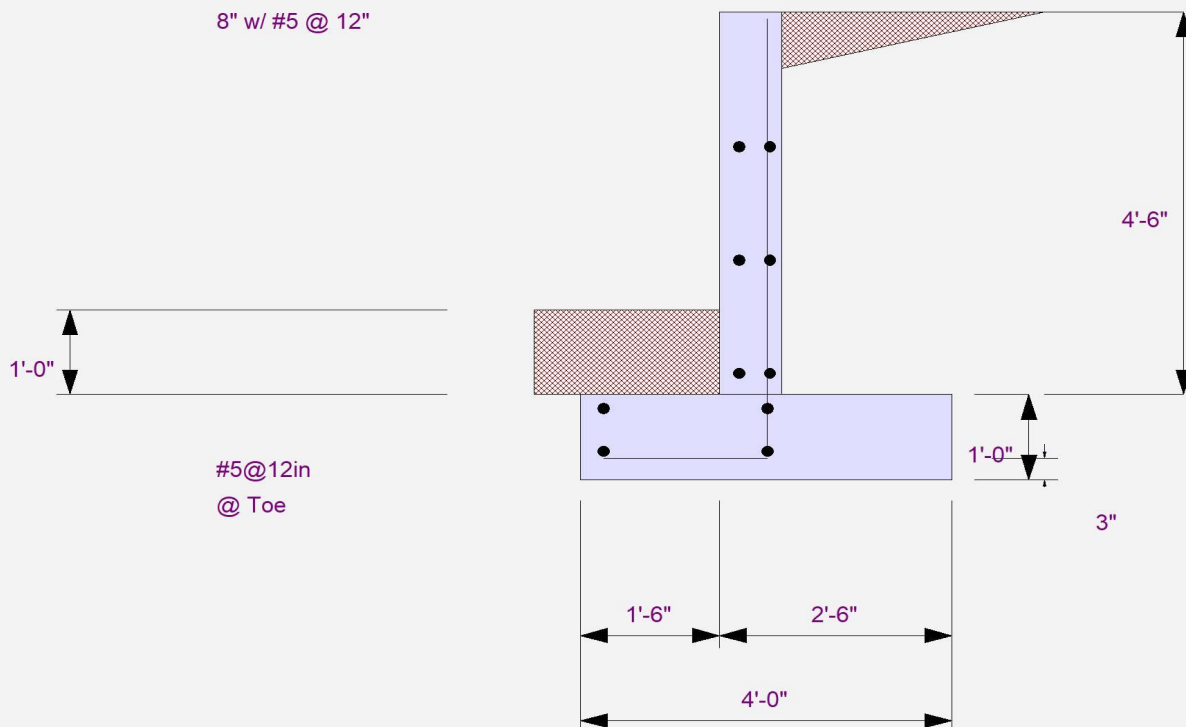
Project File: 2220236\_care center redesign.ec6

LIC# : KW-06014847, Build:20.25.02.26

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**DESCRIPTION:** 4' Retaining Wall - w/ EQ - Rev1





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2215 North 30th  
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253.383.2422

Project Title: Wesley Bradley Park 2  
Engineer: KBG  
Project ID: 2220236.20  
Project Descr: Care Center

## Cantilevered Retaining Wall

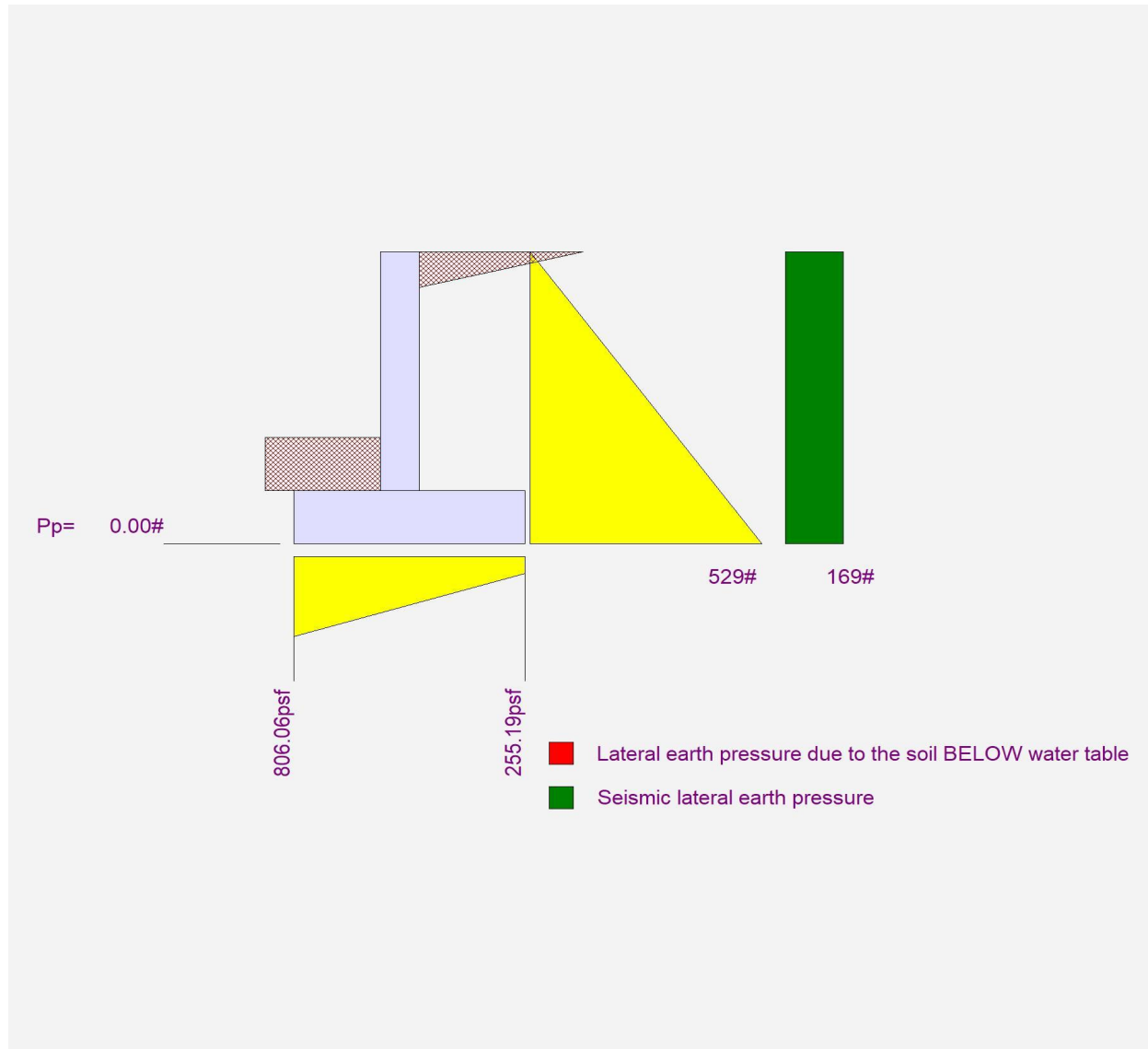
Project File: 2220236\_care center redesign.ec6

LIC# : KW-06014847, Build:20.25.02.26

AHBL, INC

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**DESCRIPTION:** 4' Retaining Wall - w/ EQ - Rev1





**Anchor Designer™**  
**Software**  
Version 3.2.2309.2

|           |                       |       |           |
|-----------|-----------------------|-------|-----------|
| Company:  | AHBL                  | Date: | 2/22/2023 |
| Engineer: | KBG                   | Page: | 1/5       |
| Project:  | Wesley Bradley Park 2 |       |           |
| Address:  |                       |       |           |
| Phone:    |                       |       |           |
| E-mail:   |                       |       |           |

### **1. Project information**

Customer company:  
Customer contact name:  
Customer e-mail:  
Comment:

Project description:  
Location: Site Wall  
Fastening description: Railing Anchorage

### **2. Input Data & Anchor Parameters**

#### **General**

Design method: ACI 318-19  
Units: Imperial units

#### **Anchor Information:**

Anchor type: Concrete screw  
Material: Stainless Steel  
Diameter (inch): 0.625  
Nominal Embedment depth (inch): 4.750  
Effective Embedment depth,  $h_{ef}$  (inch): 2.950  
Code report: IAPMO UES ER-493  
Anchor category: 1  
Anchor ductility: Yes  
 $h_{min}$  (inch): 7.25  
 $c_{ac}$  (inch): 6.19  
 $C_{min}$  (inch): 1.75  
 $S_{min}$  (inch): 3.00

#### **Base Material**

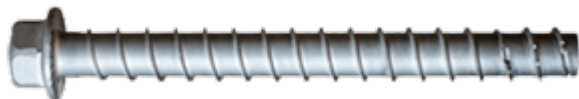
Concrete: Normal-weight  
Concrete thickness,  $h$  (inch): 8.00  
State: Cracked  
Compressive strength,  $f'_c$  (psi): 4000  
 $\Psi_{c,v}$ : 1.0  
Reinforcement condition: Supplementary reinforcement not present  
Supplemental edge reinforcement: Not applicable  
Reinforcement provided at corners: No  
Ignore concrete breakout in tension: No  
Ignore concrete breakout in shear: No  
Ignore 6do requirement: Not applicable  
Build-up grout pad: No

#### **Base Plate**

Length x Width x Thickness (inch): 8.00 x 8.00 x 0.25

#### **Recommended Anchor**

Anchor Name: Titen HD® Stainless Steel - 5/8"Ø SS Titen HD,  $h_{nom}$ : 4.75" (121mm)  
Code Report: IAPMO UES ER-493





|           |                       |       |           |
|-----------|-----------------------|-------|-----------|
| Company:  | AHBL                  | Date: | 2/22/2023 |
| Engineer: | KBG                   | Page: | 2/5       |
| Project:  | Wesley Bradley Park 2 |       |           |
| Address:  |                       |       |           |
| Phone:    |                       |       |           |
| E-mail:   |                       |       |           |

#### Load and Geometry

Load factor source: ACI 318 Section 5.3

Load combination: not set

Seismic design: No

Anchors subjected to sustained tension: Not applicable

Apply entire shear load at front row: No

Anchors only resisting wind and/or seismic loads: No

Strength level loads:

$N_{ua}$  [lb]: 320

$V_{uax}$  [lb]: 0

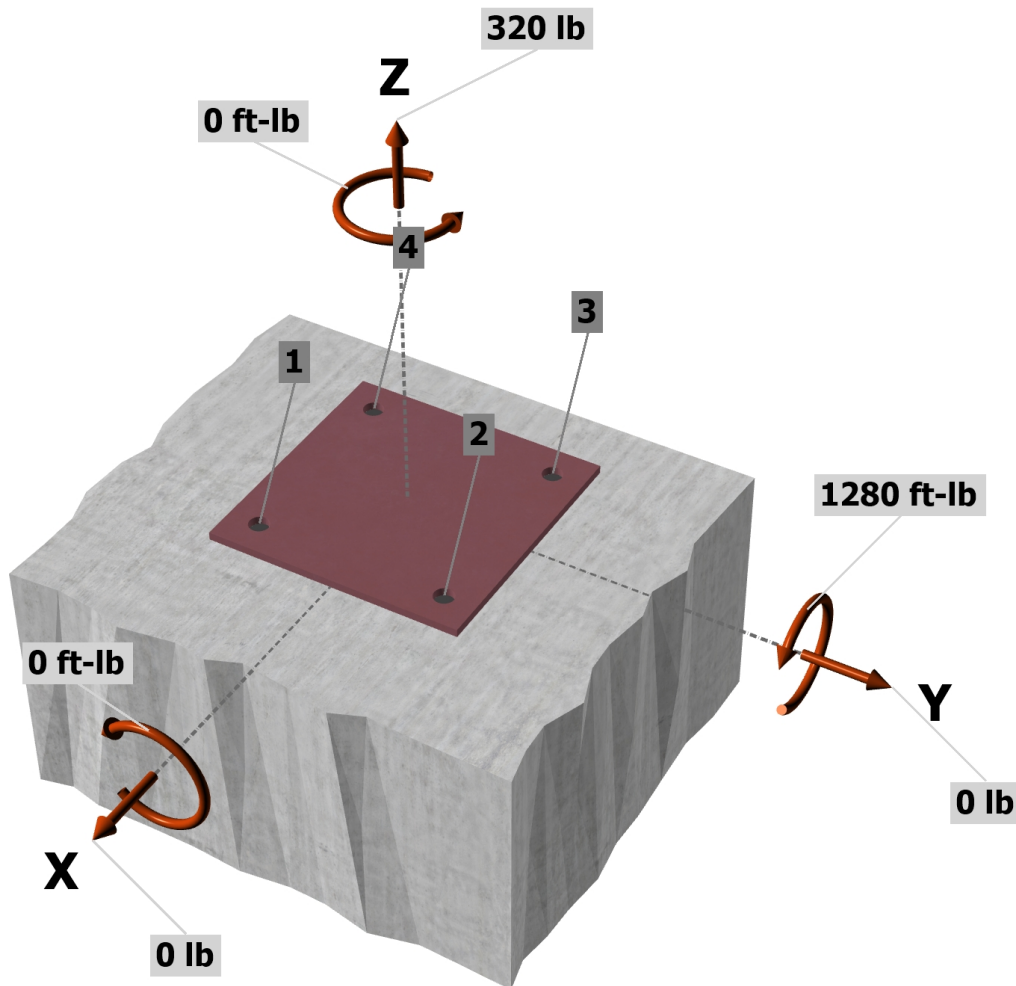
$V_{uay}$  [lb]: 0

$M_{ux}$  [ft-lb]: 0

$M_{uy}$  [ft-lb]: 1280

$M_{uz}$  [ft-lb]: 0

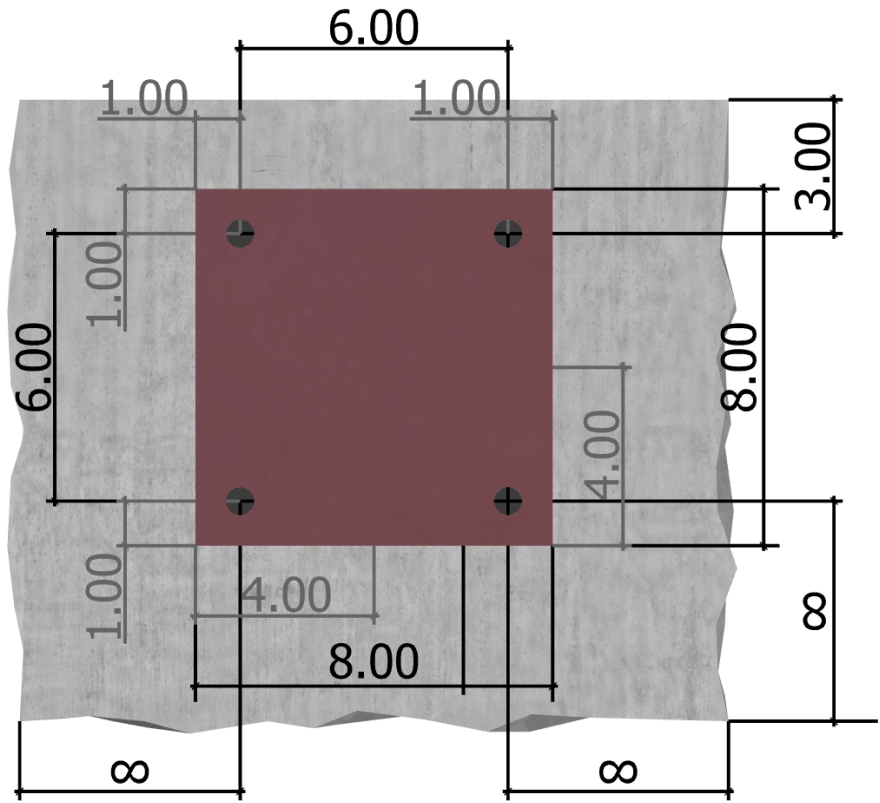
<Figure 1>





|           |                       |       |           |
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<Figure 2>







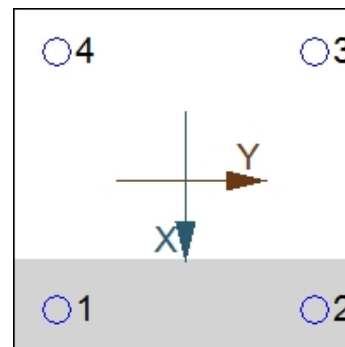
|           |                       |       |           |
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### 3. Resulting Anchor Forces

| Anchor | Tension load,<br>$N_{ua}$ (lb) | Shear load x,<br>$V_{uax}$ (lb) | Shear load y,<br>$V_{uay}$ (lb) | Shear load combined,<br>$\sqrt{(V_{uax})^2 + (V_{uay})^2}$ (lb) |
|--------|--------------------------------|---------------------------------|---------------------------------|-----------------------------------------------------------------|
| 1      | 0.0                            | 0.0                             | 0.0                             | 0.0                                                             |
| 2      | 0.0                            | 0.0                             | 0.0                             | 0.0                                                             |
| 3      | 1306.7                         | 0.0                             | 0.0                             | 0.0                                                             |
| 4      | 1306.7                         | 0.0                             | 0.0                             | 0.0                                                             |
| Sum    | 2613.4                         | 0.0                             | 0.0                             | 0.0                                                             |

Maximum concrete compression strain (%): 0.06  
Maximum concrete compression stress (psi): 264  
Resultant tension force (lb): 2613  
Resultant compression force (lb): 2293  
Eccentricity of resultant tension forces in x-axis,  $e'_{Nx}$  (inch): 0.00  
Eccentricity of resultant tension forces in y-axis,  $e'_{Ny}$  (inch): 0.00

<Figure 3>



### 4. Steel Strength of Anchor in Tension (Sec. 17.6.1)

| $N_{sa}$ (lb) | $\phi$ | $\phi N_{sa}$ (lb) |
|---------------|--------|--------------------|
| 28723         | 0.75   | 21542              |

### 5. Concrete Breakout Strength of Anchor in Tension (Sec. 17.6.2)

$$N_b = k_c \lambda_a \sqrt{f'_c} h_{ef}^{1.5} \text{ (Eq. 17.6.2.2.1)}$$

| $k_c$ | $\lambda_a$ | $f'_c$ (psi) | $h_{ef}$ (in) | $N_b$ (lb) |
|-------|-------------|--------------|---------------|------------|
| 17.0  | 1.00        | 4000         | 2.950         | 5448       |

$$\phi N_{cbg} = \phi (A_{Nc} / A_{Nco}) \Psi_{ec,N} \Psi_{ed,N} \Psi_{c,N} \Psi_{cp,N} N_b \text{ (Sec. 17.5.1.2 \& Eq. 17.6.2.1a)}$$

| $A_{Nc}$ (in <sup>2</sup> ) | $A_{Nco}$ (in <sup>2</sup> ) | $c_{a,min}$ (in) | $\Psi_{ec,N}$ | $\Psi_{ed,N}$ | $\Psi_{c,N}$ | $\Psi_{cp,N}$ | $N_b$ (lb) | $\phi$ | $\phi N_{cbg}$ (lb) |
|-----------------------------|------------------------------|------------------|---------------|---------------|--------------|---------------|------------|--------|---------------------|
| 110.26                      | 78.32                        | 3.00             | 1.000         | 0.903         | 1.00         | 1.000         | 5448       | 0.65   | 4503                |

## 11. Results

### Interaction of Tensile and Shear Forces (Sec. 17.8)

| Tension           | Factored Load, $N_{ua}$ (lb) | Design Strength, $\phi N_n$ (lb) | Ratio | Status         |
|-------------------|------------------------------|----------------------------------|-------|----------------|
| Steel             | 1307                         | 21542                            | 0.06  | Pass           |
| Concrete breakout | 2613                         | 4503                             | 0.58  | Pass (Governs) |



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**5/8"Ø SS Titen HD, hnom:4.75" (121mm) meets the selected design criteria.**

#### **12. Warnings**

- Designer must exercise own judgement to determine if this design is suitable.
- Refer to manufacturer's product literature for hole cleaning and installation instructions.