# MYERS ENGINEERING

## Cantilever Retaining Walls


Digitally signed by Mark Myers
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**Project: RKK Spec Residence**
**4115 78th Avenue SE**
**Mercer Island, WA**

April 3, 2025

2021 INTERNATIONAL BUILDING CODE
100 MPH BASIC WIND, EXPOSURE C, $K_{zt}$ = 1.61
RISK CATEGORY II - SOIL SITE CLASS D
SEISMIC DESIGN CATEGORY D (IBC)

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Project Title: 4115 78th AVE SE
Engineer: Mark Myers, PE
Project ID:
Project Descr: SFR w/ Basement ADU

# Cantilevered Retaining Wall



LIC# : KW-06015659, Build:20.25.03.24 MYERS ENGINEERING 

**DESCRIPTION:** 10ft Stem at Basement w/ Slab

***Code Reference***

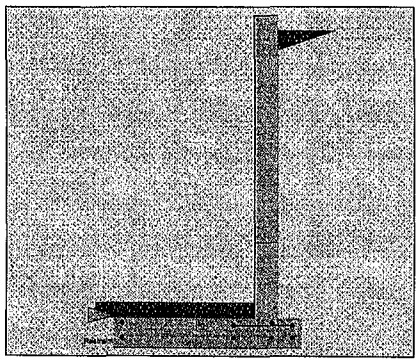
Calculations per IBC 2018, ACI 318-14, TMS 402-16

## Criteria

| | | |
|---|---|---|
| Retained Height | = | 9.50 ft |
| Wall height above soil | = | 0.50 ft |
| Slope Behind Wall | = | 0.00 |
| Height of Soil over Toe | = | 6.00 in |
| Water table above bottom of footing | = | 0.0 ft |

## Soil Data

| | | |
|---|---|---|
| Allow Soil Bearing | = | 2,500.0 psf |
| Equivalent Fluid Pressure Method | | |
| Active Heel Pressure | = | 35.0 psf/ft |
| | = | |
| Passive Pressure | = | 300.0 psf/ft |
| Soil Density, Heel | = | 110.00 pcf |
| Soil Density, Toe | = | 110.00 pcf |
| Footing\|\|Soil Friction | = | 0.400 |
| Soil height to ignore for passive pressure | = | 12.00 in |



## Surcharge Loads

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

## Axial Load Applied to Stem

| | | |
|---|---|---|
| Axial Dead Load | = | 150.0 lbs |
| Axial Live Load | = | 0.0 lbs |
| Axial Load Eccentricity | = | 1.3 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 |

Project Title: 4115 78th AVE SE
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**Cantilevered Retaining Wall** Project File: 4115 78th AVE SE.ec6

LIC# : KW-06015659, Build:20.25.03.24 MYERS ENGINEERING (c) ENERCALC, LLC 1982-2025

**DESCRIPTION:** 10ft Stem at Basement w/ Slab

## Design Summary

**Wall Stability Ratios**

| | | | |
|---|---|---|---|
| Overturning | = | 1.64 | OK |
| Slab Resists All Sliding ! | | | |
| Global Stability | = | 1.14 | |
| Total Bearing Load | = | 3,718 lbs | |
| ...resultant ecc. | = | 3.46 in | |
| Eccentricity within middle third | | | |
| Soil Pressure @ Toe | = | 923 psf | OK |
| Soil Pressure @ Heel | = | 471 psf | OK |
| Allowable | = | 2,500 psf | |
| Soil Pressure Less Than Allowable | | | |
| ACI Factored @ Toe | = | 996 psf | |
| ACI Factored @ Heel | = | 509 psf | |
| Footing Shear @ Toe | = | 18.6 psi | OK |
| Footing Shear @ Heel | = | 19.2 psi | OK |
| Allowable | = | 75.0 psi | |

**Sliding Calcs**

| | | |
|---|---|---|
| Lateral Sliding Force | = | 1,929.4 lbs |

Vertical component of active lateral soil pressure IS considered in the calculation of soil bearing pressures.

**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

| | | 2nd | Bottom | | |
|---|---|---|---|---|---|
| **Design Height Above Ftg** | ft = | Stem OK 2.50 | Stem OK 0.00 | | |
| Wall Material Above "Ht" | = | Concrete | Concrete | | |
| Design Method | = | SD | SD | SD | SD |
| Thickness | = | 8.00 | 8.00 | | |
| Rebar Size | = | # 4 | # 5 | | |
| Rebar Spacing | = | 10.00 | 5.00 | | |
| Rebar Placed at | = | 6 in | 6 in | | |
| **Design Data** | | | | | |
| fb/FB + fa/Fa | = | **0.515** | **0.465** | | |
| **Total Force @ Section** | | | | | |
| Service Level | lbs = | | | | |
| Strength Level | lbs = | 1,372.0 | 2,527.0 | | |
| **Moment....Actual** | | | | | |
| Service Level | ft-# = | | | | |
| Strength Level | ft-# = | 3,182.6 | 7,983.4 | | |
| Moment.....Allowable | ft-# = | 6,174.1 | 17,148.7 | | |
| **Shear.....Actual** | | | | | |
| Service Level | psi = | | | | |
| Strength Level | psi = | 19.1 | 35.1 | | |
| Shear.....Allowable | psi = | 75.0 | 75.0 | | |
| Anet (Masonry) | in2 = | | | | |
| Wall Weight | psf = | 100.0 | 100.0 | | |
| Rebar Depth 'd' | in = | 6.00 | 6.00 | | |

**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 | 2,500.0 |
| Fy | psi = | 60,000.0 | 60,000.0 |

Project Title: 4115 78th AVE SE
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Project ID:
Project Descr: SFR w/ Basement ADU

**Cantilevered Retaining Wall** Project File: 4115 78th AVE SE.ec6



**DESCRIPTION:** 10ft Stem at Basement w/ Slab

## Concrete Stem Rebar Area Details

| 2nd Stem | Vertical Reinforcing | Horizontal Reinforcing |
|---|---|---|
| As (based on applied moment) : | 0.1245 in2/ft | |
| (4/3) * As : | 0.166 in2/ft | Min Stem T&S Reinf Area 1.440 in2 |
| 200bd/fy : 200(12)(6)/60000 : | 0.24 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 : | 0.24 in2/ft | #5@ 19.38 in #5@ 38.75 in |
| Maximum Area : | 0.8128 in2/ft | #6@ 27.50 in #6@ 55.00 in |

| Bottom Stem | Vertical Reinforcing | Horizontal Reinforcing |
|---|---|---|
| As (based on applied moment) : | 0.3123 in2/ft | |
| (4/3) * As : | 0.4164 in2/ft | Min Stem T&S Reinf Area 0.480 in2 |
| 200bd/fy : 200(12)(6)/60000 : | 0.24 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 : | 0.3123 in2/ft | #4@ 12.50 in #4@ 25.00 in |
| Provided Area : | 0.744 in2/ft | #5@ 19.38 in #5@ 38.75 in |
| Maximum Area : | 0.8128 in2/ft | #6@ 27.50 in #6@ 55.00 in |

## Footing Data

| | | |
|---|---|---|
| Toe Width | = | 4.00 ft |
| Heel Width | = | 1.33 |
| Total Footing Width | = | 5.33 |
| Footing Thickness | = | 12.00 in |

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

## Footing Design Results

| | | Toe | Heel | |
|---|---|---|---|---|
| Factored Pressure | = | 996 | 509 | psf |
| Mu' : Upward | = | 6,995 | 117 | ft-# |
| Mu' : Downward | = | 1,968 | 1,226 | ft-# |
| Mu: Design | = | 5,027 | 1,109 | ft-# |
| φ Mn | = | 13,810 | 13,810 | ft-# |
| Actual 1-Way Shear | = | 18.65 | 19.21 | psi |
| Allow 1-Way Shear | = | 75.00 | 75.00 | psi |

Toe Reinforcing = # 5 @ 10.00 in
Heel Reinforcing = # 5 @ 10.00 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@ 9.25 in, #5@ 14.35 in, #6@ 18 in, #7@ 18 in, #8@ 18 in, #9@ 18 in, #10@ 18 in

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

Key: No key defined

| | | |
|---|---|---|
| Min footing T&S reinf Area | 1.38 | 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 | |

Project Title: 4115 78th AVE SE
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Project ID:
Project Descr: SFR w/ Basement ADU




**DESCRIPTION:** 10ft Stem at Basement w/ Slab

## 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) | | 1,929.4 | 3.50 | 6,752.8 | Soil Over HL (ab. water tbl) | 696.3 | 5.00 | 3,481.5 |
| HL Act Pres (be water tbl) | | | | | Soil Over HL (bel. water tbl) | | 5.00 | 3,481.5 |
| 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 | = | 150.0 | 4.44 | 665.6 |
| Added Lateral Load | = | | | | * Axial Live Load on Stem | = | | | |
| Load @ Stem Above Soil | = | | | | Soil Over Toe | = | 220.0 | 2.00 | 440.0 |
| | = | | | | Surcharge Over Toe | = | | | |
| | | | | | Stem Weight(s) | = | 1,000.0 | 4.33 | 4,333.3 |
| | | | | | Earth @ Stem Transitions | = | | | |
| | | | | | Footing Weight | = | 800.0 | 2.67 | 2,133.1 |
| | | | | | Key Weight | = | | | |
| | | | | | Vert. Component | = | | | |
| **Total** | = | 1,929.4 | **O.T.M.** = | 6,752.8 | **Total** = | | 2,866.3 lbs | **R.M.**= | 11,053.5 |

**Resisting/Overturning Ratio** = **1.64**
Vertical Loads used for Soil Pressure = 3,717.9 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) | 0.048 | 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.

**DESCRIPTION:** 10ft Stem at Basement w/ Slab

## Rebar Lap & Embedment Lengths Information

Stem Design Segment: 2nd
Stem Design Height: 2.50 ft above top of footing

| | |
|---|---|
| Lap Splice length for #4 bar specified in this stem design segment (25.4.2.3a) = | 18.72 in |
| Development length for #4 bar specified in this stem design segment = | 14.40 in |

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 (25.4.2.3a) = | 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 = | 6.00 in |
| As Provided = | 0.7440 in2/ft |
| As Required = | 0.3123 in2/ft |

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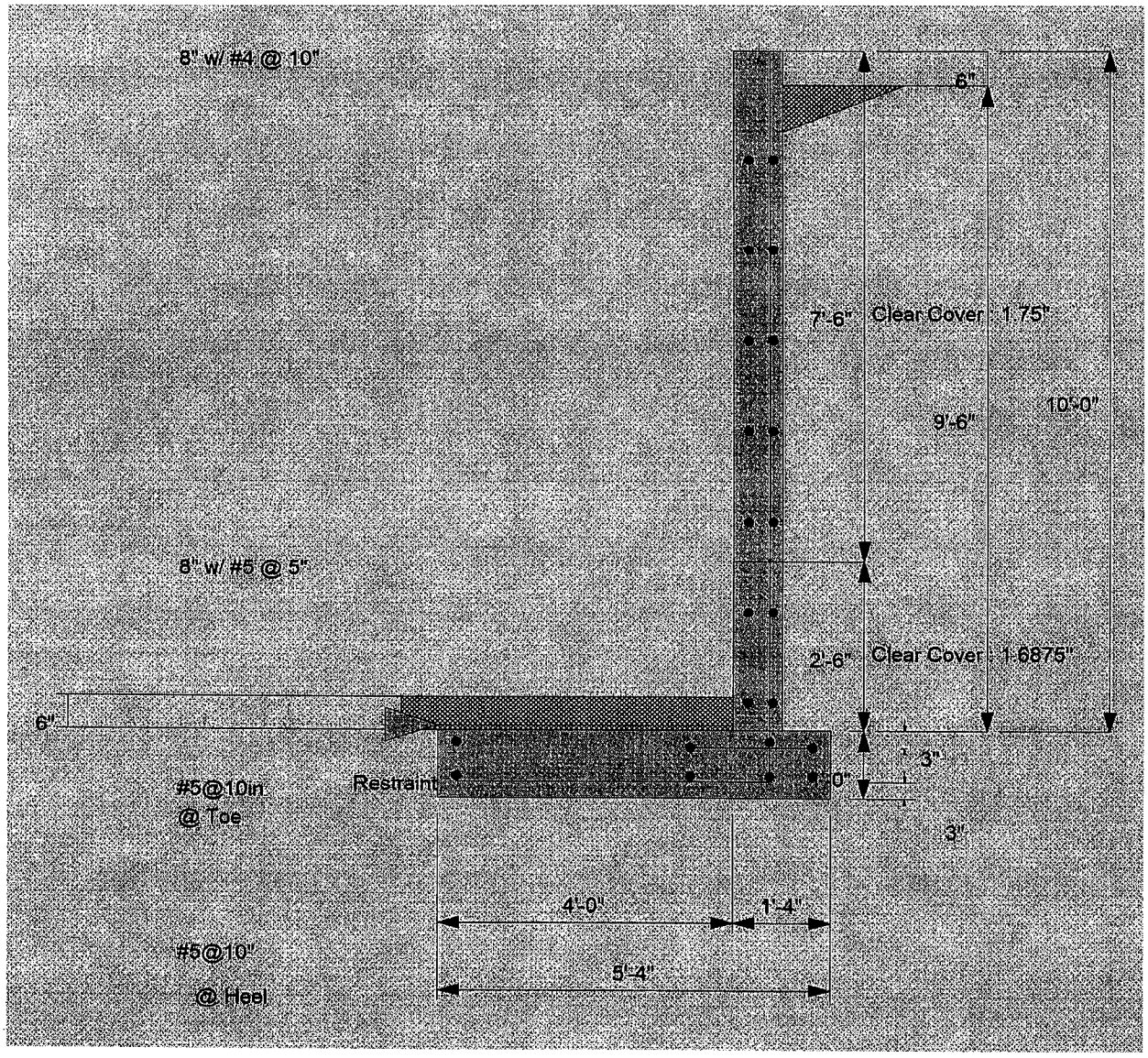
**Cantilevered Retaining Wall** Project File: 4115 78th AVE SE.ec6

LIC# : KW-06015659, Build:20.25.03.24 MYERS ENGINEERING 

**DESCRIPTION:** 10ft Stem at Basement w/ Slab

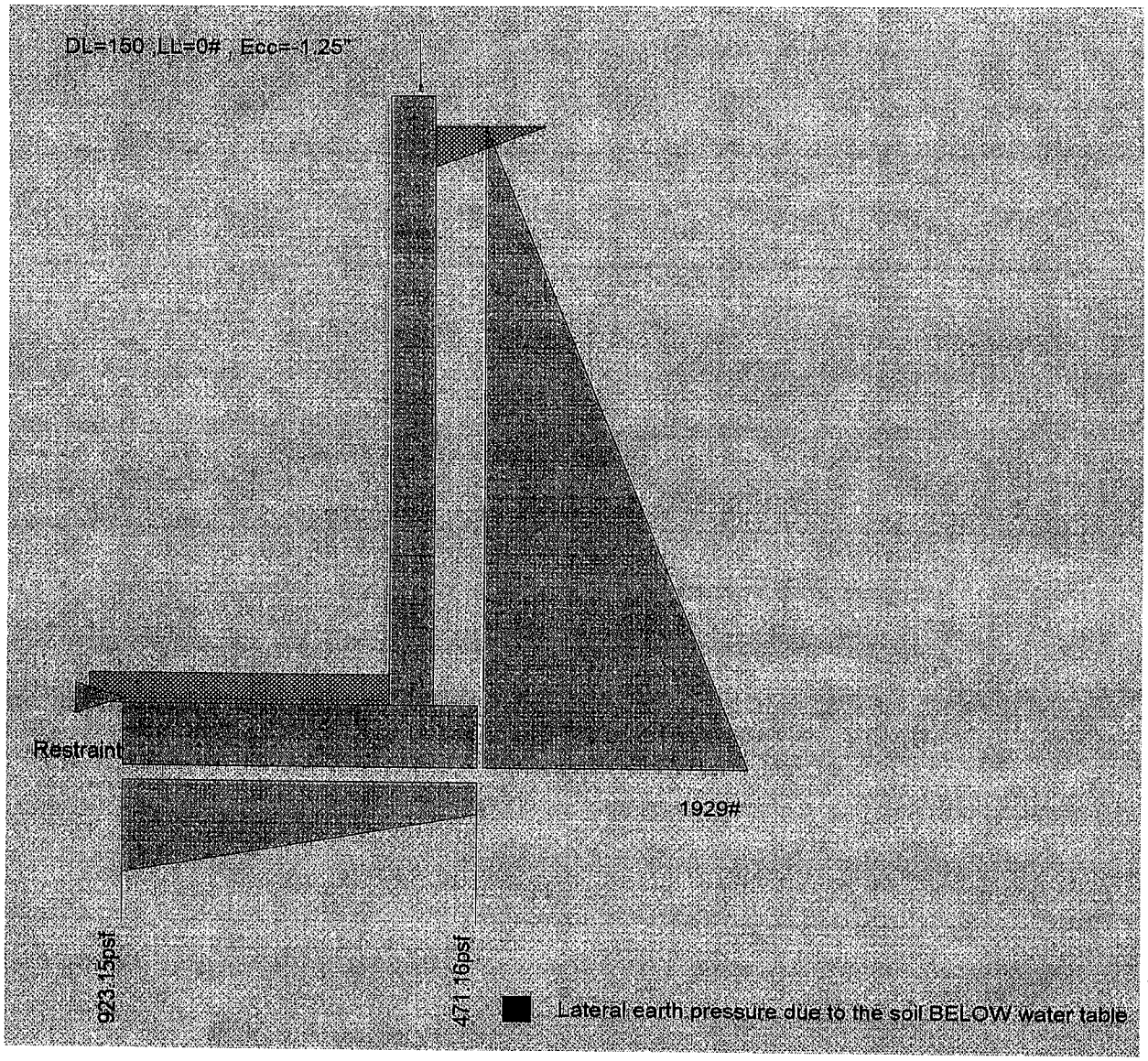


Project Title: 4115 78th AVE SE
Engineer: Mark Myers, PE
Project ID:
Project Descr: SFR w/ Basement ADU

**Cantilevered Retaining Wall** Project File: 4115 78th AVE SE.ecw

LIC# : KW-06015659, Build:20.25.03.24 MYERS ENGINEERING (c) ENERCALC, LLC 1982-2025

**DESCRIPTION:** 10ft Stem at Basement w/ Slab



Project Title: 4115 78th AVE SE
Engineer: Mark Myers, PE
Project ID:
Project Descr: SFR w/ Basement ADU




**DESCRIPTION:** 10ft Stem at Basement w/ Slab & Seismic

***Code Reference***

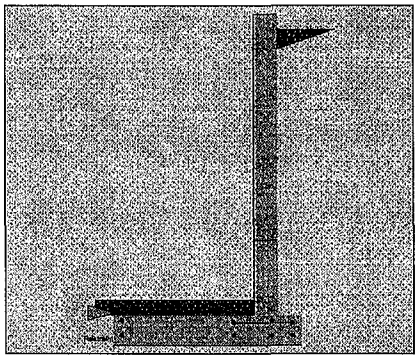
Calculations per IBC 2018, ACI 318-14, TMS 402-16

### Criteria

| | | |
|---|---|---|
| Retained Height | = | 9.50 ft |
| Wall height above soil | = | 0.50 ft |
| Slope Behind Wall | = | 0.00 |
| Height of Soil over Toe | = | 6.00 in |
| Water table above bottom of footing | = | 0.0 ft |

### Soil Data

| | | |
|---|---|---|
| Allow Soil Bearing | = | 2,500.0 psf |
| Equivalent Fluid Pressure Method | | |
| Active Heel Pressure | = | 35.0 psf/ft |
| | = | |
| Passive Pressure | = | 300.0 psf/ft |
| Soil Density, Heel | = | 110.00 pcf |
| Soil Density, Toe | = | 110.00 pcf |
| Footing\|\|Soil Friction | = | 0.400 |
| Soil height to ignore for passive pressure | = | 12.00 in |



### Surcharge Loads

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

### Lateral Load Applied to Stem

| | | |
|---|---|---|
| Lateral Load | = | 0.0 #/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 |

### Axial Load Applied to Stem

| | | |
|---|---|---|
| Axial Dead Load | = | 150.0 lbs |
| Axial Live Load | = | 0.0 lbs |
| Axial Load Eccentricity | = | 1.3 in |

### Earth Pressure Seismic Load

| | | |
|---|---|---|
| Method : Uniform | | |
| Multiplier Used | = | 8.000 |
| (Multiplier used on soil density) | | |

| | | |
|---|---|---|
| Uniform Seismic Force | = | 84.000 |
| Total Seismic Force | = | 882.000 |

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**DESCRIPTION:** 10ft Stem at Basement w/ Slab & Seismic

## Design Summary

**Wall Stability Ratios**

| | | | |
|---|---|---|---|
| Overturning | = | 1.11 | Ratio < 1.5! |
| Slab Resists All Sliding ! | | | |
| Global Stability | = | 1.14 | |
| Total Bearing Load | = | 3,718 lbs | |
| ...resultant ecc. | = | 13.92 in | |
| Eccentricity outside middle third | | | |
| Soil Pressure @ Toe | = | 1,645 psf | OK |
| Soil Pressure @ Heel | = | 0 psf | OK |
| Allowable | = | 2,500 psf | |
| Soil Pressure Less Than Allowable | | | |
| ACI Factored @ Toe | = | 1,776 psf | |
| ACI Factored @ Heel | = | 0 psf | |
| Footing Shear @ Toe | = | 27.8 psi | OK |
| Footing Shear @ Heel | = | 22.7 psi | OK |
| Allowable | = | 75.0 psi | |

**Sliding Calcs**

| | | |
|---|---|---|
| Lateral Sliding Force | = | 2,546.8 lbs |

Vertical component of active lateral soil pressure IS considered in the calculation of soil bearing pressures.

**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

| | | 2nd | Bottom | | |
|---|---|---|---|---|---|
| **Design Height Above Ftg** | ft = | Stem OK 2.50 | Stem OK 0.00 | | |
| Wall Material Above "Ht" | = | Concrete | Concrete | | |
| Design Method | = | SD | SD | SD | SD |
| Thickness | = | 8.00 | 8.00 | | |
| Rebar Size | = | # 4 | # 5 | | |
| Rebar Spacing | = | 10.00 | 5.00 | | |
| Rebar Placed at | = | 6 in | 6 in | | |
| **Design Data** | | | | | |
| fb/FB + fa/Fa | = | **0.848** | **0.686** | | |
| **Total Force @ Section** | | | | | |
| Service Level | lbs = | | | | |
| Strength Level | lbs = | 1,960.0 | 3,325.0 | | |
| **Moment....Actual** | | | | | |
| Service Level | ft-# = | | | | |
| Strength Level | ft-# = | 5,240.6 | 11,773.9 | | |
| Moment.....Allowable | ft-# = | 6,174.1 | 17,148.7 | | |
| **Shear.....Actual** | | | | | |
| Service Level | psi = | | | | |
| Strength Level | psi = | 27.2 | 46.2 | | |
| Shear.....Allowable | psi = | 75.0 | 75.0 | | |
| Anet (Masonry) | in2 = | | | | |
| Wall Weight | psf = | 100.0 | 100.0 | | |
| Rebar Depth 'd' | in = | 6.00 | 6.00 | | |

**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 | 2,500.0 |
| Fy | psi = | 60,000.0 | 60,000.0 |

Project Title: 4115 78th AVE SE
Engineer: Mark Myers, PE
Project ID:
Project Descr: SFR w/ Basement ADU




**DESCRIPTION:** 10ft Stem at Basement w/ Slab & Seismic

## Concrete Stem Rebar Area Details

| 2nd Stem | Vertical Reinforcing | Horizontal Reinforcing | |
|---|---|---|---|
| As (based on applied moment) : | 0.205 in2/ft | | |
| (4/3) * As : | 0.2733 in2/ft | Min Stem T&S Reinf Area 1.440 in2 | |
| 200bd/fy : 200(12)(6)/60000 : | 0.24 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 : | 0.24 in2/ft | #4@ 12.50 in | #4@ 25.00 in |
| Provided Area : | 0.24 in2/ft | #5@ 19.38 in | #5@ 38.75 in |
| Maximum Area : | 0.8128 in2/ft | #6@ 27.50 in | #6@ 55.00 in |

| Bottom Stem | Vertical Reinforcing | Horizontal Reinforcing | |
|---|---|---|---|
| As (based on applied moment) : | 0.4605 in2/ft | | |
| (4/3) * As : | 0.614 in2/ft | Min Stem T&S Reinf Area 0.480 in2 | |
| 200bd/fy : 200(12)(6)/60000 : | 0.24 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 : | 0.4605 in2/ft | #4@ 12.50 in | #4@ 25.00 in |
| Provided Area : | 0.744 in2/ft | #5@ 19.38 in | #5@ 38.75 in |
| Maximum Area : | 0.8128 in2/ft | #6@ 27.50 in | #6@ 55.00 in |

## Footing Data

| | | |
|---|---|---|
| Toe Width | = | 4.00 ft |
| Heel Width | = | 1.33 |
| Total Footing Width | = | 5.33 |
| Footing Thickness | = | 12.00 in |

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

## Footing Design Results

| | | Toe | Heel | |
|---|---|---|---|---|
| Factored Pressure | = | 1,776 | 0 | psf |
| Mu' : Upward | = | 10,015 | 0 | ft-# |
| Mu' : Downward | = | 1,968 | 1,226 | ft-# |
| Mu: Design | = | 8,047 | 1,226 | ft-# |
| φ Mn | = | 13,810 | 13,810 | ft-# |
| Actual 1-Way Shear | = | 27.79 | 22.73 | psi |
| Allow 1-Way Shear | = | 75.00 | 75.00 | psi |

Toe Reinforcing = # 5 @ 10.00 in
Heel Reinforcing = # 5 @ 10.00 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@ 8.23 in, #5@ 12.76 in, #6@ 18 in, #7@ 18 in, #8@ 18 in, #9@ 18 in, #10@ 18 in

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

Key: No key defined

| | | |
|---|---|---|
| Min footing T&S reinf Area | 1.38 | 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 |

Project Title: 4115 78th AVE SE
Engineer: Mark Myers, PE
Project ID:
Project Descr: SFR w/ Basement ADU





**DESCRIPTION:** 10ft Stem at Basement w/ Slab & 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) | | 1,929.4 | 3.50 | 6,752.8 | Soil Over HL (ab. water tbl) | 696.3 | 5.00 | 3,481.5 |
| HL Act Pres (be water tbl) | | | | | Soil Over HL (bel. water tbl) | | 5.00 | 3,481.5 |
| 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 | = 150.0 | 4.44 | 665.6 |
| Added Lateral Load | = | | | | * Axial Live Load on Stem | = | | |
| Load @ Stem Above Soil | = | | | | Soil Over Toe | = 220.0 | 2.00 | 440.0 |
| Seismic Earth Load | = | 617.4 | 5.25 | 3,241.4 | Surcharge Over Toe | = | | |
| | = | | | | Stem Weight(s) | = 1,000.0 | 4.33 | 4,333.3 |
| | | | | | Earth @ Stem Transitions | = | | |
| | | | | | Footing Weight | = 800.0 | 2.67 | 2,133.1 |
| | | | | | Key Weight | = | | |
| | | | | | Vert. Component | = | | |
| **Total** | = | 2,546.8 | **O.T.M.** = | 9,994.2 | **Total** = | 2,866.3 lbs | **R.M.**= | 11,053.5 |

**Resisting/Overturning Ratio** = **1.11**
Vertical Loads used for Soil Pressure = 3,717.9 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) | 0.086 | 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.

**DESCRIPTION:** 10ft Stem at Basement w/ Slab & Seismic

## Rebar Lap & Embedment Lengths Information

Stem Design Segment: 2nd
Stem Design Height: 2.50 ft above top of footing

| | |
|---|---|
| Lap Splice length for #4 bar specified in this stem design segment (25.4.2.3a) = | 18.72 in |
| Development length for #4 bar specified in this stem design segment = | 14.40 in |

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

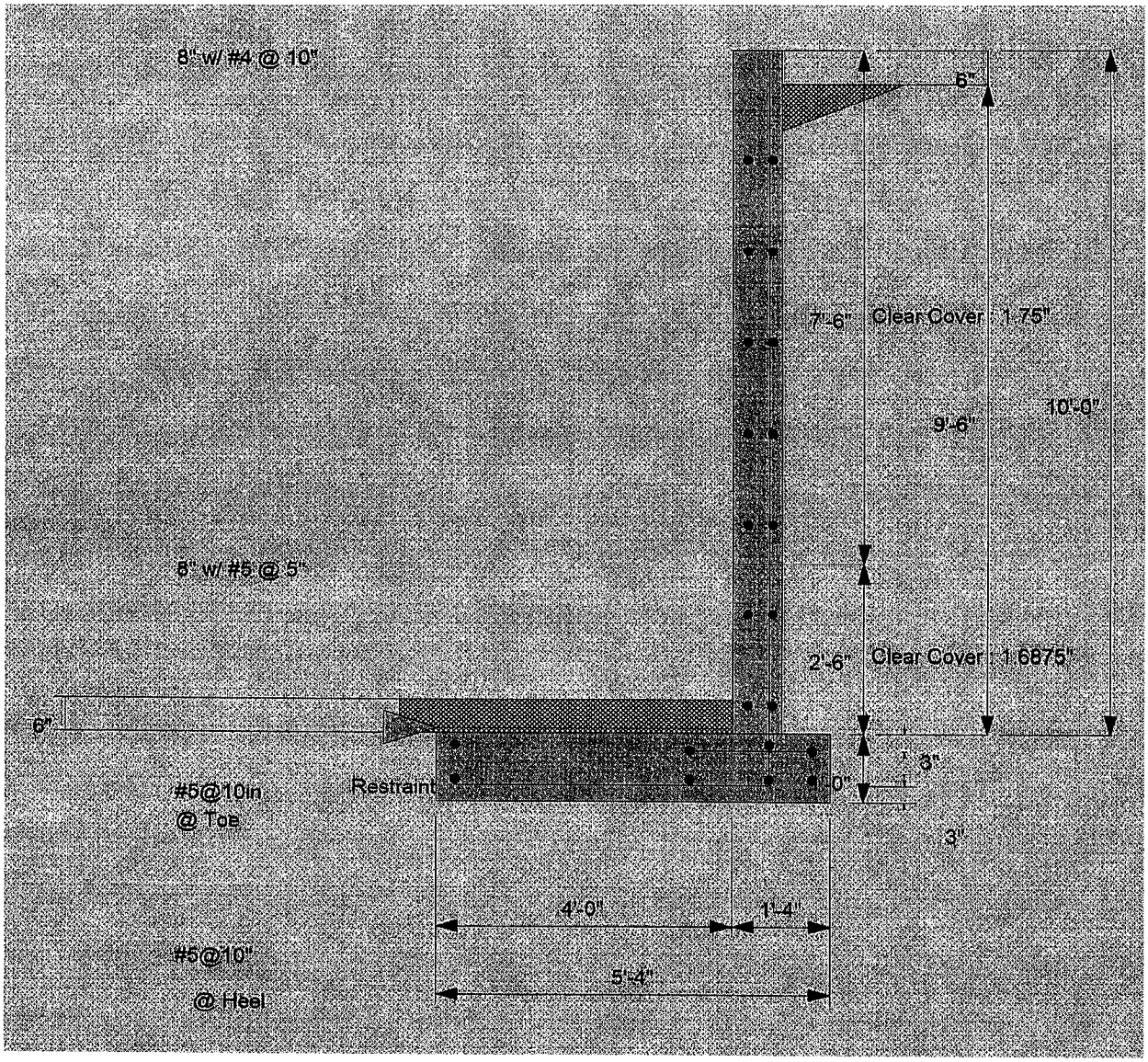
| | |
|---|---|
| Lap Splice length for #5 bar specified in this stem design segment (25.4.2.3a) = | 23.40 in |
| Development length for #5 bar specified in this stem design segment = | 18.00 in |
| Hooked embedment length into footing for #5 bar specified in this stem design segment = | 6.50 in |
| As Provided = | 0.7440 in2/ft |
| As Required = | 0.4605 in2/ft |

Project Title: 4115 78th AVE SE
Engineer: Mark Myers, PE
Project ID:
Project Descr: SFR w/ Basement ADU

**Cantilevered Retaining Wall** Project File: 4115 78th AVE SE.ec6

LIC# : KW-06015659, Build:20.25.03.24 MYERS ENGINEERING (c) ENERCALC, LLC 1982-2025

**DESCRIPTION:** 10ft Stem at Basement w/ Slab & Seismic

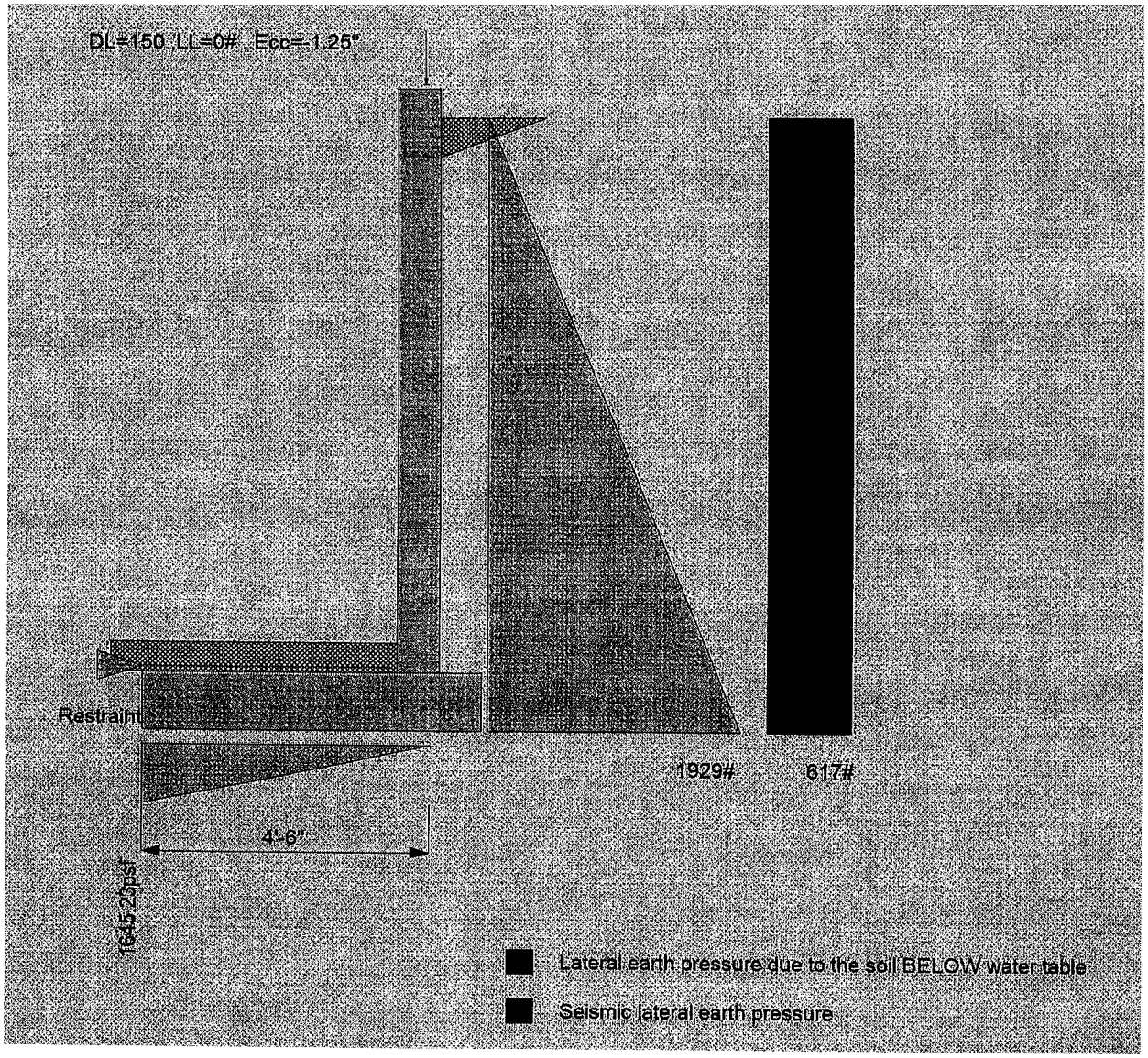


Project Title: 4115 78th AVE SE
Engineer: Mark Myers, PE
Project ID:
Project Descr: SFR w/ Basement ADU

**Cantilevered Retaining Wall** Project File: 4115 78th AVE SE.ec6

LIC# : KW-06015659, Build:20.25.03.24 MYERS ENGINEERING (c) ENERCALC, LLC 1982-2025

**DESCRIPTION:** 10ft Stem at Basement w/ Slab & Seismic



Project Title: 4115 78th AVE SE
Engineer: Mark Myers, PE
Project ID:
Project Descr: SFR w/ Basement ADU




**DESCRIPTION:** 8ft Stem at Basement w/ Slab

***Code Reference***

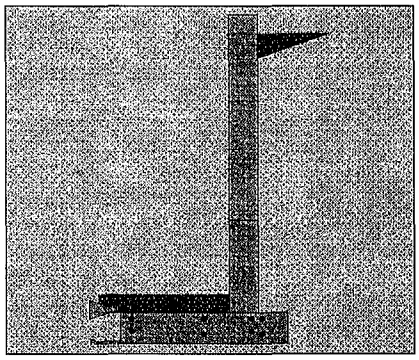
Calculations per IBC 2018, ACI 318-14, TMS 402-16

## Criteria

| | | |
|---|---|---|
| Retained Height | = | 7.50 ft |
| Wall height above soil | = | 0.50 ft |
| Slope Behind Wall | = | 0.00 |
| Height of Soil over Toe | = | 6.00 in |
| Water table above bottom of footing | = | 0.0 ft |

## Soil Data

| | | |
|---|---|---|
| Allow Soil Bearing | = | 2,500.0 psf |
| Equivalent Fluid Pressure Method | | |
| Active Heel Pressure | = | 35.0 psf/ft |
| | = | |
| Passive Pressure | = | 300.0 psf/ft |
| Soil Density, Heel | = | 110.00 pcf |
| Soil Density, Toe | = | 110.00 pcf |
| Footing\|\|Soil Friction | = | 0.400 |
| Soil height to ignore for passive pressure | = | 12.00 in |



## Surcharge Loads

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

## Axial Load Applied to Stem

| | | |
|---|---|---|
| Axial Dead Load | = | 150.0 lbs |
| Axial Live Load | = | 0.0 lbs |
| Axial Load Eccentricity | = | 1.3 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 |

Project Title: 4115 78th AVE SE
Engineer: Mark Myers, PE
Project ID:
Project Descr: SFR w/ Basement ADU

# Cantilevered Retaining Wall





**DESCRIPTION:** 8ft Stem at Basement w/ Slab

## Design Summary

**Wall Stability Ratios**

| | | | |
|---|---|---|---|
| Overturning | = | 1.69 | OK |
| Slab Resists All Sliding ! | | | |
| Global Stability | = | 1.35 | |
| Total Bearing Load | = | 2,653 lbs | |
| ...resultant ecc. | = | 3.09 in | |
| Eccentricity within middle third | | | |
| Soil Pressure @ Toe | = | 971 psf | OK |
| Soil Pressure @ Heel | = | 413 psf | OK |
| Allowable | = | 2,500 psf | |
| Soil Pressure Less Than Allowable | | | |
| ACI Factored @ Toe | = | 1,084 psf | |
| ACI Factored @ Heel | = | 462 psf | |
| Footing Shear @ Toe | = | 17.3 psi | OK |
| Footing Shear @ Heel | = | 42.5 psi | OK |
| Allowable | = | 75.0 psi | |

**Sliding Calcs**

| | | |
|---|---|---|
| Lateral Sliding Force | = | 1,215.3 lbs |

Vertical component of active lateral soil pressure IS considered in the calculation of soil bearing pressures.

**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

| | | 2nd | Bottom | | |
|---|---|---|---|---|---|
| | | Stem OK | Stem OK | | |
| **Design Height Above Ftg** | ft = | 2.50 | 0.00 | | |
| Wall Material Above "Ht" | = | Concrete | Concrete | | |
| Design Method | = | SD | SD | SD | SD |
| Thickness | = | 8.00 | 8.00 | | |
| Rebar Size | = | # 4 | # 4 | | |
| Rebar Spacing | = | 12.00 | 6.00 | | |
| Rebar Placed at | = | 6 in | 6 in | | |
| **Design Data** | | | | | |
| fb/FB + fa/Fa | = | **0.221** | **0.393** | | |
| **Total Force @ Section** | | | | | |
| Service Level | lbs = | | | | |
| Strength Level | lbs = | 700.0 | 1,575.0 | | |
| **Moment....Actual** | | | | | |
| Service Level | ft-# = | | | | |
| Strength Level | ft-# = | 1,147.9 | 3,918.8 | | |
| Moment.....Allowable | ft-# = | 5,187.6 | 9,950.4 | | |
| **Shear.....Actual** | | | | | |
| Service Level | psi = | | | | |
| Strength Level | psi = | 9.7 | 21.9 | | |
| Shear.....Allowable | psi = | 75.0 | 75.0 | | |
| Anet (Masonry) | in2 = | | | | |
| Wall Weight | psf = | 100.0 | 100.0 | | |
| Rebar Depth 'd' | in = | 6.00 | 6.00 | | |

**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 | 2,500.0 |
| Fy | psi = | 60,000.0 | 60,000.0 |

Project Title: 4115 78th AVE SE
Engineer: Mark Myers, PE
Project ID:
Project Descr: SFR w/ Basement ADU




**DESCRIPTION:** 8ft Stem at Basement w/ Slab

## Concrete Stem Rebar Area Details

| 2nd Stem | Vertical Reinforcing | Horizontal Reinforcing |
|---|---|---|
| As (based on applied moment) : | 0.0449 in2/ft | |
| (4/3) * As : | 0.0599 in2/ft | Min Stem T&S Reinf Area 1.056 in2 |
| 200bd/fy : 200(12)(6)/60000 : | 0.24 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 : | 0.8128 in2/ft | #6@ 27.50 in #6@ 55.00 in |

| Bottom Stem | Vertical Reinforcing | Horizontal Reinforcing |
|---|---|---|
| As (based on applied moment) : | 0.1533 in2/ft | |
| (4/3) * As : | 0.2044 in2/ft | Min Stem T&S Reinf Area 0.480 in2 |
| 200bd/fy : 200(12)(6)/60000 : | 0.24 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 : | 0.2044 in2/ft | #4@ 12.50 in #4@ 25.00 in |
| Provided Area : | 0.4 in2/ft | #5@ 19.38 in #5@ 38.75 in |
| Maximum Area : | 0.8128 in2/ft | #6@ 27.50 in #6@ 55.00 in |

## Footing Data

| | | |
|---|---|---|
| Toe Width | = | 2.50 ft |
| Heel Width | = | 1.33 |
| Total Footing Width | = | 3.83 |
| Footing Thickness | = | 10.00 in |

f'c = 2,500 psi Fy = 60,000 psi
Footing Concrete Density = 150.00 pcf
Min. As % = 0.0018
Cover @ Top 7.00 @ Btm.= 3.00 in

## Footing Design Results

| | | Toe | Heel | |
|---|---|---|---|---|
| Factored Pressure | = | 1,084 | 462 | psf |
| Mu' : Upward | = | 2,965 | 111 | ft-# |
| Mu' : Downward | = | 675 | 825 | ft-# |
| Mu: Design | = | 2,290 | 714 | ft-# |
| φ Mn | = | 6,985 | 2,665 | ft-# |
| Actual 1-Way Shear | = | 17.25 | 42.47 | psi |
| Allow 1-Way Shear | = | 75.00 | 75.00 | psi |

Toe Reinforcing = # 4 @ 10.00 in
Heel Reinforcing = # 4 @ 10.00 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@ 11.11 in, #5@ 17.22 in, #6@ 18 in, #7@ 18 in, #8@ 18 in, #9@ 18 in, #10@ 18 in

Heel: #4@ 11.11 in, #5@ 17.22 in, #6@ 18 in, #7@ 18 in, #8@ 18 in, #9@ 18 in, #10@ 18 in

Key: No key defined

| | | |
|---|---|---|
| Min footing T&S reinf Area | 0.83 | 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 |

Project Title: 4115 78th AVE SE
Engineer: Mark Myers, PE
Project ID:
Project Descr: SFR w/ Basement ADU




**DESCRIPTION:** 8ft Stem at Basement w/ Slab

## 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) | | 1,215.3 | 2.78 | 3,375.8 | Soil Over HL (ab. water tbl) | 549.7 | 3.50 | 1,923.9 |
| HL Act Pres (be water tbl) | | | | | Soil Over HL (bel. water tbl) | | 3.50 | 1,923.9 |
| 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 | = | 150.0 | 2.94 | 440.6 |
| Added Lateral Load | = | | | | * Axial Live Load on Stem | = | | | |
| Load @ Stem Above Soil | = | | | | Soil Over Toe | = | 137.5 | 1.25 | 171.9 |
| | = | | | | Surcharge Over Toe | = | | | |
| | | | | | Stem Weight(s) | = | 800.0 | 2.83 | 2,266.7 |
| | | | | | Earth @ Stem Transitions | = | | | |
| | | | | | Footing Weight | = | 479.1 | 1.92 | 918.2 |
| | | | | | Key Weight | = | | | |
| | | | | | Vert. Component | = | | | |
| **Total** | = | 1,215.3 | **O.T.M.** = | 3,375.8 | **Total** = | | 2,116.4 lbs | **R.M.=** | 5,721.4 |

**Resisting/Overturning Ratio** = **1.69**
Vertical Loads used for Soil Pressure = 2,652.8 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) | 0.056 | 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.

**DESCRIPTION:** 8ft Stem at Basement w/ Slab

## Rebar Lap & Embedment Lengths Information

Stem Design Segment: 2nd
Stem Design Height: 2.50 ft above top of footing

| | |
|---|---|
| Lap Splice length for #4 bar specified in this stem design segment (25.4.2.3a) = | 18.72 in |
| Development length for #4 bar specified in this stem design segment = | 14.40 in |

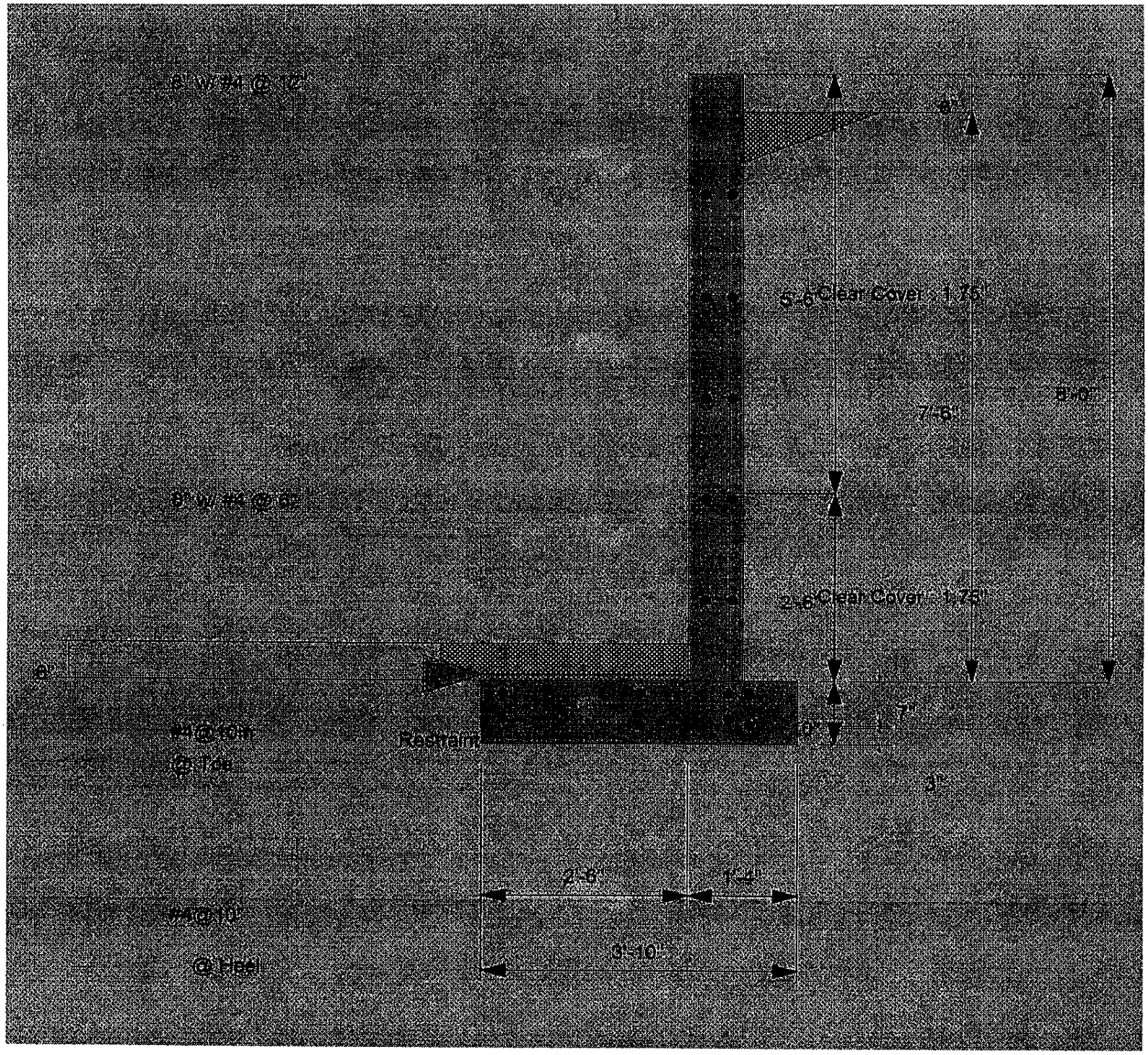
Stem Design Segment: Bottom
Stem Design Height: 0.00 ft above top of footing

| | |
|---|---|
| Lap Splice length for #4 bar specified in this stem design segment (25.4.2.3a) = | 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 = | 6.00 in |
| As Provided = | 0.4000 in2/ft |
| As Required = | 0.2044 in2/ft |

Project Title: 4115 78th AVE SE
Engineer: Mark Myers, PE
Project ID:
Project Descr: SFR w/ Basement ADU



**DESCRIPTION:** 8ft Stem at Basement w/ Slab



Project Title: 4115 78th AVE SE
Engineer: Mark Myers, PE
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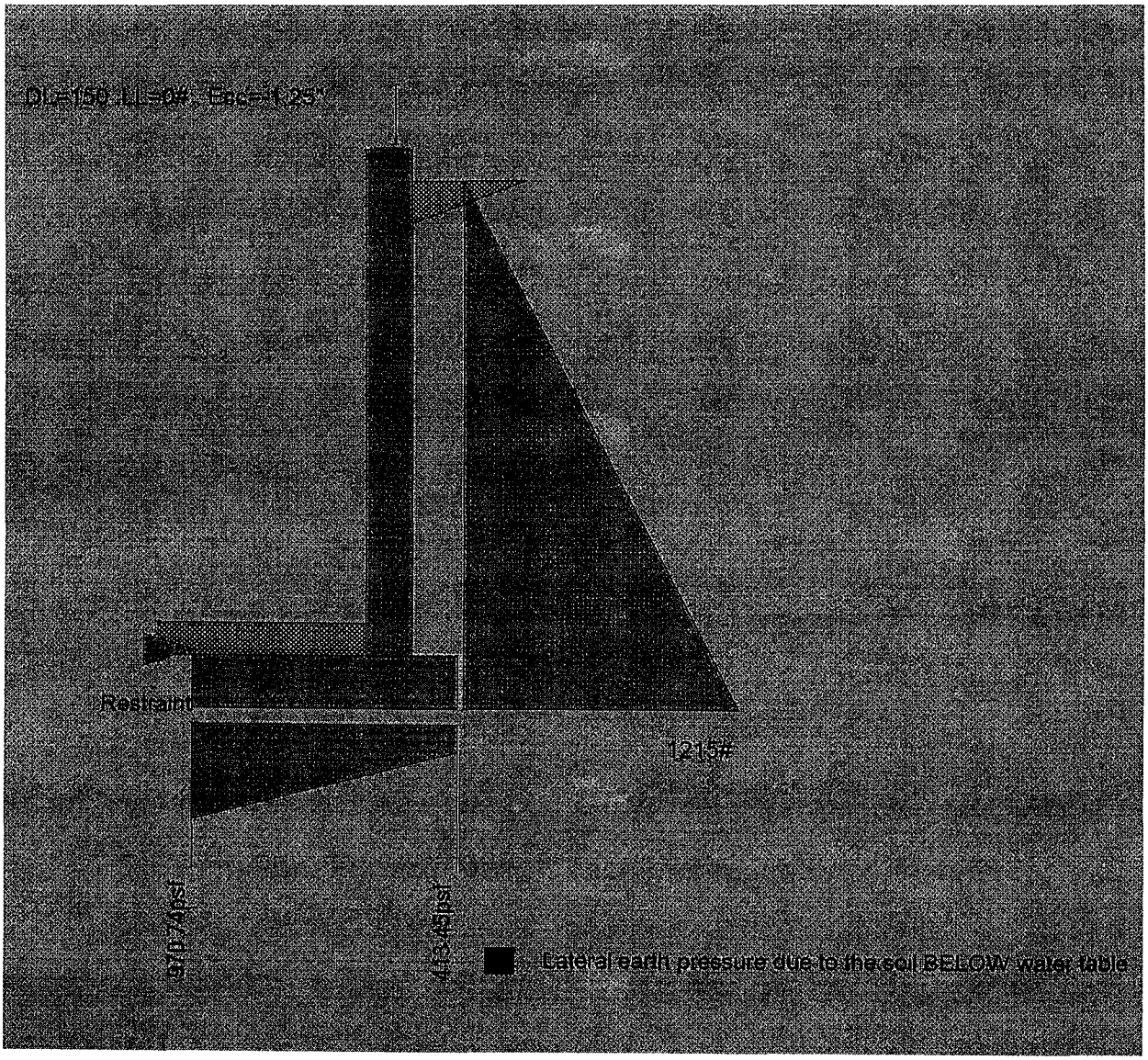
**DESCRIPTION:** 8ft Stem at Basement w/ Slab



Project Title: 4115 78th AVE SE
Engineer: Mark Myers, PE
Project ID:
Project Descr: SFR w/ Basement ADU



**DESCRIPTION:** 8ft Stem at Basement w/ Slab & Seismic

***Code Reference:***

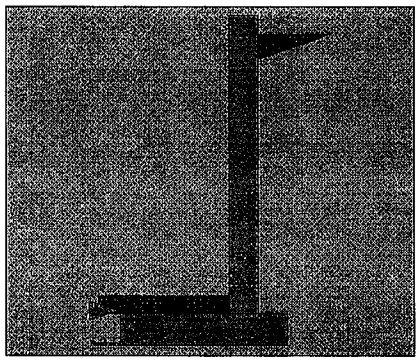
Calculations per IBC 2018, ACI 318-14, TMS 402-16

## Criteria

| | | |
|---|---|---|
| Retained Height | = | 7.50 ft |
| Wall height above soil | = | 0.50 ft |
| Slope Behind Wall | = | 0.00 |
| Height of Soil over Toe | = | 6.00 in |
| Water table above bottom of footing | = | 0.0 ft |

## Soil Data

| | | |
|---|---|---|
| Allow Soil Bearing | = | 2,500.0 psf |
| Equivalent Fluid Pressure Method | | |
| Active Heel Pressure | = | 35.0 psf/ft |
| | = | |
| Passive Pressure | = | 300.0 psf/ft |
| Soil Density, Heel | = | 110.00 pcf |
| Soil Density, Toe | = | 110.00 pcf |
| Footing\|\|Soil Friction | = | 0.400 |
| Soil height to ignore for passive pressure | = | 12.00 in |



## Surcharge Loads

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

## Lateral Load Applied to Stem

| | | |
|---|---|---|
| Lateral Load | = | 0.0 #/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 |

## Axial Load Applied to Stem

| | | |
|---|---|---|
| Axial Dead Load | = | 150.0 lbs |
| Axial Live Load | = | 0.0 lbs |
| Axial Load Eccentricity | = | 1.3 in |

## Earth Pressure Seismic Load

Method : Uniform

| | | |
|---|---|---|
| Multiplier Used | = | 8.000 |
| (Multiplier used on soil density) | | |

| | | |
|---|---|---|
| Uniform Seismic Force | = | 66.667 |
| Total Seismic Force | = | 555.556 |

Project Title: 4115 78th AVE SE
Engineer: Mark Myers, PE
Project ID:
Project Descr: SFR w/ Basement ADU



**DESCRIPTION:** 8ft Stem at Basement w/ Slab & Seismic

## Design Summary

**Wall Stability Ratios**

| | | | |
|---|---|---|---|
| Overturning | = | 1.15 | Ratio < 1.5! |
| Slab Resists All Sliding ! | | | |
| Global Stability | = | 1.35 | |
| Total Bearing Load | = | 2,653 lbs | |
| ...resultant ecc. | = | 10.42 in | |
| Eccentricity outside middle third | | | |
| Soil Pressure @ Toe | = | 1,687 psf | OK |
| Soil Pressure @ Heel | = | 0 psf | OK |
| Allowable | = | 2,500 psf | |
| Soil Pressure Less Than Allowable | | | |
| ACI Factored @ Toe | = | 1,884 psf | |
| ACI Factored @ Heel | = | 0 psf | |
| Footing Shear @ Toe | = | 26.6 psi | OK |
| Footing Shear @ Heel | = | 53.9 psi | OK |
| Allowable | = | 75.0 psi | |

**Sliding Calcs**

| | | |
|---|---|---|
| Lateral Sliding Force | = | 1,604.2 lbs |

Vertical component of active lateral soil pressure IS considered in the calculation of soil bearing pressures.

**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

| | | 2nd | Bottom | | |
|---|---|---|---|---|---|
| | | Stem OK | Stem OK | | |
| **Design Height Above Ftg** | ft = | 2.50 | 0.00 | | |
| Wall Material Above "Ht" | = | Concrete | Concrete | | |
| Design Method | = | SD | SD | SD | SD |
| Thickness | = | 8.00 | 8.00 | | |
| Rebar Size | = | # 4 | # 4 | | |
| Rebar Spacing | = | 12.00 | 6.00 | | |
| Rebar Placed at | = | 6 in | 6 in | | |
| **Design Data** | | | | | |
| fb/FB + fa/Fa | = | **0.381** | **0.582** | | |
| **Total Force @ Section** | | | | | |
| Service Level | lbs = | | | | |
| Strength Level | lbs = | 1,033.3 | 2,075.0 | | |
| **Moment....Actual** | | | | | |
| Service Level | ft-# = | | | | |
| Strength Level | ft-# = | 1,981.3 | 5,793.8 | | |
| Moment.....Allowable | ft-# = | 5,187.6 | 9,950.4 | | |
| **Shear.....Actual** | | | | | |
| Service Level | psi = | | | | |
| Strength Level | psi = | 14.4 | 28.8 | | |
| Shear.....Allowable | psi = | 75.0 | 75.0 | | |
| Anet (Masonry) | in2 = | | | | |
| Wall Weight | psf = | 100.0 | 100.0 | | |
| Rebar Depth 'd' | in = | 6.00 | 6.00 | | |

**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 | 2,500.0 |
| Fy | psi = | 60,000.0 | 60,000.0 |

Project Title: 4115 78th AVE SE
Engineer: Mark Myers, PE
Project ID:
Project Descr: SFR w/ Basement ADU



**DESCRIPTION:** 8ft Stem at Basement w/ Slab & Seismic

## Concrete Stem Rebar Area Details

| 2nd Stem | Vertical Reinforcing | Horizontal Reinforcing | |
|---|---|---|---|
| As (based on applied moment) : | 0.0775 in2/ft | | |
| (4/3) * As : | 0.1033 in2/ft | Min Stem T&S Reinf Area 1.056 in2 | |
| 200bd/fy : 200(12)(6)/60000 : | 0.24 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 : | 0.8128 in2/ft | #6@ 27.50 in | #6@ 55.00 in |

| Bottom Stem | Vertical Reinforcing | Horizontal Reinforcing | |
|---|---|---|---|
| As (based on applied moment) : | 0.2266 in2/ft | | |
| (4/3) * As : | 0.3022 in2/ft | Min Stem T&S Reinf Area 0.480 in2 | |
| 200bd/fy : 200(12)(6)/60000 : | 0.24 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 : | 0.24 in2/ft | #4@ 12.50 in | #4@ 25.00 in |
| Provided Area : | 0.4 in2/ft | #5@ 19.38 in | #5@ 38.75 in |
| Maximum Area : | 0.8128 in2/ft | #6@ 27.50 in | #6@ 55.00 in |

## Footing Data

| | | |
|---|---|---|
| Toe Width | = | 2.50 ft |
| Heel Width | = | 1.33 |
| Total Footing Width | = | 3.83 |
| Footing Thickness | = | 10.00 in |

f'c = 2,500 psi Fy = 60,000 psi
Footing Concrete Density = 150.00 pcf
Min. As % = 0.0018
Cover @ Top 7.00 @ Btm.= 3.00 in

## Footing Design Results

| | | Toe | Heel | |
|---|---|---|---|---|
| Factored Pressure | = | 1,884 | 0 | psf |
| Mu' : Upward | = | 4,328 | 0 | ft-# |
| Mu' : Downward | = | 675 | 825 | ft-# |
| Mu: Design | = | 3,653 | 825 | ft-# |
| φ Mn | = | 6,985 | 2,665 | ft-# |
| Actual 1-Way Shear | = | 26.60 | 53.93 | psi |
| Allow 1-Way Shear | = | 75.00 | 75.00 | psi |

Toe Reinforcing = # 4 @ 10.00 in
Heel Reinforcing = # 4 @ 10.00 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@ 11.11 in, #5@ 17.22 in, #6@ 18 in, #7@ 18 in, #8@ 18 in, #9@ 18 in, #10@ 18 in

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

Key: No key defined

Min footing T&S reinf Area 0.83 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 |

Project Title: 4115 78th AVE SE
Engineer: Mark Myers, PE
Project ID:
Project Descr: SFR w/ Basement ADU



**DESCRIPTION:** 8ft Stem at Basement w/ Slab & 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) | | 1,215.3 | 2.78 | 3,375.8 | Soil Over HL (ab. water tbl) | 549.7 | 3.50 | 1,923.9 |
| HL Act Pres (be water tbl) | | | | | Soil Over HL (bel. water tbl) | | 3.50 | 1,923.9 |
| 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 | = 150.0 | 2.94 | 440.6 |
| Added Lateral Load | = | | | | * Axial Live Load on Stem | = | | |
| Load @ Stem Above Soil | = | | | | Soil Over Toe | = 137.5 | 1.25 | 171.9 |
| Seismic Earth Load | = | 388.9 | 4.17 | 1,620.4 | Surcharge Over Toe | = | | |
| | = | | | | Stem Weight(s) | = 800.0 | 2.83 | 2,266.7 |
| | | | | | Earth @ Stem Transitions | = | | |
| | | | | | Footing Weight | = 479.1 | 1.92 | 918.2 |
| | | | | | Key Weight | = | | |
| | | | | | Vert. Component | = | | |
| **Total** | = | 1,604.2 | **O.T.M.** = | 4,996.1 | **Total** = | 2,116.4 lbs | **R.M.**= | 5,721.4 |

**Resisting/Overturning Ratio** = **1.15**
Vertical Loads used for Soil Pressure = 2,652.8 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) | 0.098 | 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.

**DESCRIPTION:** 8ft Stem at Basement w/ Slab & Seismic

## Rebar Lap & Embedment Lengths Information

Stem Design Segment: 2nd
Stem Design Height: 2.50 ft above top of footing

| | |
|---|---|
| Lap Splice length for #4 bar specified in this stem design segment (25.4.2.3a) = | 18.72 in |
| Development length for #4 bar specified in this stem design segment = | 14.40 in |

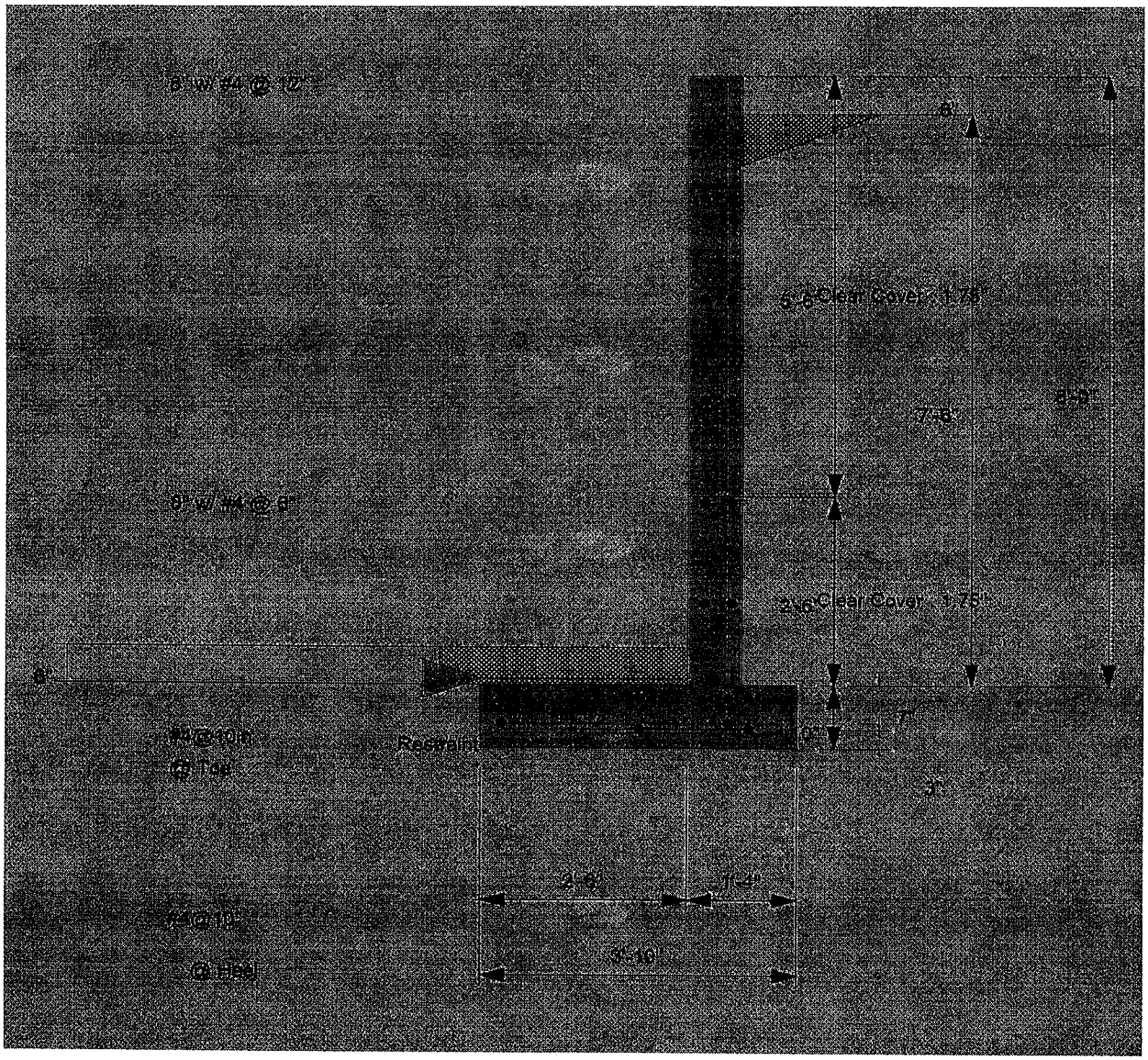
Stem Design Segment: Bottom
Stem Design Height: 0.00 ft above top of footing

| | |
|---|---|
| Lap Splice length for #4 bar specified in this stem design segment (25.4.2.3a) = | 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 = | 6.00 in |
| As Provided = | 0.4000 in2/ft |
| As Required = | 0.2400 in2/ft |

Project Title: 4115 78th AVE SE
Engineer: Mark Myers, PE
Project ID:
Project Descr: SFR w/ Basement ADU



**DESCRIPTION:** 8ft Stem at Basement w/ Slab & Seismic



Project Title: 4115 78th AVE SE
Engineer: Mark Myers, PE
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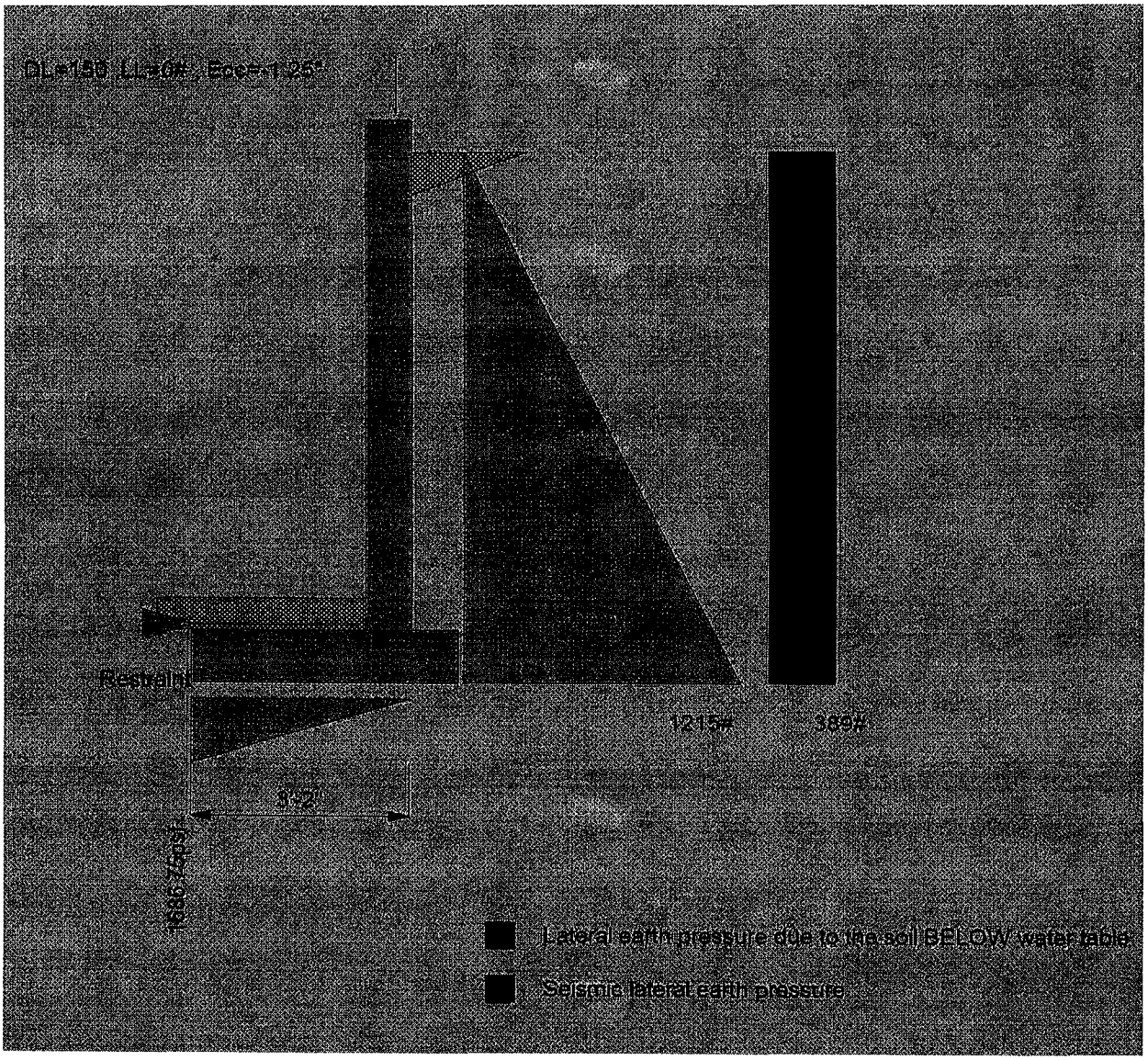
Project Descr: SFR w/ Basement ADU



**DESCRIPTION:** 8ft Stem at Basement w/ Slab & Seismic



Project Title: 4115 78th AVE SE
Engineer: Mark Myers, PE
Project ID:
Project Descr: SFR w/ Basement ADU



**DESCRIPTION:** 6ft Stem at Basement w/ Slab

***Code Reference***

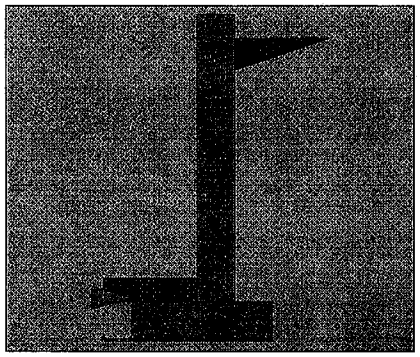
Calculations per IBC 2018, ACI 318-14, TMS 402-16

## Criteria

| | | |
|---|---|---|
| Retained Height | = | 5.50 ft |
| Wall height above soil | = | 0.50 ft |
| Slope Behind Wall | = | 0.00 |
| Height of Soil over Toe | = | 6.00 in |
| Water table above bottom of footing | = | 0.0 ft |

## Soil Data

| | | |
|---|---|---|
| Allow Soil Bearing | = | 2,500.0 psf |
| Equivalent Fluid Pressure Method | | |
| Active Heel Pressure | = | 35.0 psf/ft |
| | = | |
| Passive Pressure | = | 300.0 psf/ft |
| Soil Density, Heel | = | 110.00 pcf |
| Soil Density, Toe | = | 110.00 pcf |
| Footing\|\|Soil Friction | = | 0.400 |
| Soil height to ignore for passive pressure | = | 12.00 in |



## Surcharge Loads

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

## Axial Load Applied to Stem

| | | |
|---|---|---|
| Axial Dead Load | = | 150.0 lbs |
| Axial Live Load | = | 0.0 lbs |
| Axial Load Eccentricity | = | 1.3 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 |

Project Title: 4115 78th AVE SE
Engineer: Mark Myers, PE
Project ID:
Project Descr: SFR w/ Basement ADU



**DESCRIPTION:** 6ft Stem at Basement w/ Slab

## Design Summary

**Wall Stability Ratios**

| | | | |
|---|---|---|---|
| Overturning | = | 1.65 | OK |
| Slab Resists All Sliding ! | | | |
| Global Stability | = | 1.76 | |
| Total Bearing Load | = | 1,840 | lbs |
| ...resultant ecc. | = | 3.68 | in |
| Eccentricity within middle third | | | |
| Soil Pressure @ Toe | = | 1,278 | psf OK |
| Soil Pressure @ Heel | = | 194 | psf OK |
| Allowable | = | 2,500 | psf |
| Soil Pressure Less Than Allowable | | | |
| ACI Factored @ Toe | = | 1,487 | psf |
| ACI Factored @ Heel | = | 226 | psf |
| Footing Shear @ Toe | = | 8.8 | psi OK |
| Footing Shear @ Heel | = | 27.2 | psi OK |
| Allowable | = | 75.0 | psi |

**Sliding Calcs**

| | | |
|---|---|---|
| Lateral Sliding Force | = | 701.9 lbs |

Vertical component of active lateral soil pressure IS considered in the calculation of soil bearing pressures.

**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

| | | 2nd | Bottom | | |
|---|---|---|---|---|---|
| | | Stem OK | Stem OK | | |
| **Design Height Above Ftg** | ft = | 2.50 | 0.00 | | |
| Wall Material Above "Ht" | = | Concrete | Concrete | | |
| Design Method | = | SD | SD | SD | SD |
| Thickness | = | 8.00 | 8.00 | | |
| Rebar Size | = | # 4 | # 4 | | |
| Rebar Spacing | = | 10.00 | 10.00 | | |
| Rebar Placed at | = | 6 in | 6 in | | |
| **Design Data** | | | | | |
| fb/FB + fa/Fa | = | **0.037** | **0.248** | | |
| **Total Force @ Section** | | | | | |
| Service Level | lbs = | | | | |
| Strength Level | lbs = | 252.0 | 847.0 | | |
| **Moment....Actual** | | | | | |
| Service Level | ft-# = | | | | |
| Strength Level | ft-# = | 233.3 | 1,534.1 | | |
| Moment.....Allowable | ft-# = | 6,174.1 | 6,174.1 | | |
| **Shear.....Actual** | | | | | |
| Service Level | psi = | | | | |
| Strength Level | psi = | 3.5 | 11.8 | | |
| Shear.....Allowable | psi = | 75.0 | 75.0 | | |
| Anet (Masonry) | in2 = | | | | |
| Wall Weight | psf = | 100.0 | 100.0 | | |
| Rebar Depth 'd' | in = | 6.00 | 6.00 | | |
| **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 | 2,500.0 | | |
| Fy | psi = | 60,000.0 | 60,000.0 | | |

Project Title: 4115 78th AVE SE
Engineer: Mark Myers, PE
Project ID:
Project Descr: SFR w/ Basement ADU



**DESCRIPTION:** 6ft Stem at Basement w/ Slab

## Concrete Stem Rebar Area Details

| 2nd Stem | Vertical Reinforcing | Horizontal Reinforcing | |
|---|---|---|---|
| As (based on applied moment) : | 0.0091 in2/ft | | |
| (4/3) * As : | 0.0122 in2/ft | Min Stem T&S Reinf Area 0.672 in2 | |
| 200bd/fy : 200(12)(6)/60000 : | 0.24 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 : | 0.24 in2/ft | #5@ 19.38 in | #5@ 38.75 in |
| Maximum Area : | 0.8128 in2/ft | #6@ 27.50 in | #6@ 55.00 in |

| Bottom Stem | Vertical Reinforcing | Horizontal Reinforcing | |
|---|---|---|---|
| As (based on applied moment) : | 0.06 in2/ft | | |
| (4/3) * As : | 0.08 in2/ft | Min Stem T&S Reinf Area 0.480 in2 | |
| 200bd/fy : 200(12)(6)/60000 : | 0.24 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 : | 0.24 in2/ft | #5@ 19.38 in | #5@ 38.75 in |
| Maximum Area : | 0.8128 in2/ft | #6@ 27.50 in | #6@ 55.00 in |

## Footing Data

| | | |
|---|---|---|
| Toe Width | = | 1.17 ft |
| Heel Width | = | 1.33 |
| Total Footing Width | = | 2.50 |
| Footing Thickness | = | 10.00 in |

f'c = 2,500 psi Fy = 60,000 psi
Footing Concrete Density = 150.00 pcf
Min. As % = 0.0018
Cover @ Top 7.00 @ Btm.= 3.00 in

## Footing Design Results

| | | Toe | Heel | |
|---|---|---|---|---|
| Factored Pressure | = | 1,487 | 226 | psf |
| Mu' : Upward | = | 879 | 75 | ft-# |
| Mu' : Downward | = | 147 | 525 | ft-# |
| Mu: Design | = | 732 | 450 | ft-# |
| φ Mn | = | 6,985 | 2,665 | ft-# |
| Actual 1-Way Shear | = | 8.75 | 27.23 | psi |
| Allow 1-Way Shear | = | 75.00 | 75.00 | psi |

Toe Reinforcing = # 4 @ 10.00 in
Heel Reinforcing = # 4 @ 10.00 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@ 11.11 in, #5@ 17.22 in, #6@ 18 in, #7@ 18 in, #8@ 18 in, #9@ 18 in, #10@ 18 in

Heel: #4@ 11.11 in, #5@ 17.22 in, #6@ 18 in, #7@ 18 in, #8@ 18 in, #9@ 18 in, #10@ 18 in

Key: No key defined

| | | |
|---|---|---|
| Min footing T&S reinf Area | 0.54 | 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 |

Project Title: 4115 78th AVE SE
Engineer: Mark Myers, PE
Project ID:
Project Descr: SFR w/ Basement ADU



**DESCRIPTION:** 6ft Stem at Basement w/ Slab

## 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) | | 701.9 | 2.11 | 1,481.9 | Soil Over HL (ab. water tbl) | 403.1 | 2.17 | 873.5 |
| HL Act Pres (be water tbl) | | | | | Soil Over HL (bel. water tbl) | | 2.17 | 873.5 |
| 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 | = 150.0 | 1.60 | 240.7 |
| Added Lateral Load | = | | | | * Axial Live Load on Stem | = | | |
| Load @ Stem Above Soil | = | | | | Soil Over Toe | = 64.2 | 0.58 | 37.5 |
| | = | | | | Surcharge Over Toe | = | | |
| | | | | | Stem Weight(s) | = 600.0 | 1.50 | 900.2 |
| | | | | | Earth @ Stem Transitions | = | | |
| | | | | | Footing Weight | = 312.5 | 1.25 | 390.6 |
| | | | | | Key Weight | = | | |
| | | | | | Vert. Component | = | | |
| **Total** | = | 701.9 | **O.T.M.** = | 1,481.9 | **Total** = | 1,529.8 lbs | **R.M.=** | 2,442.5 |

**Resisting/Overturning Ratio** = **1.65**
Vertical Loads used for Soil Pressure = 1,839.7 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) | 0.085 | 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.

**DESCRIPTION:** 6ft Stem at Basement w/ Slab

## Rebar Lap & Embedment Lengths Information

Stem Design Segment: 2nd
Stem Design Height: 2.50 ft above top of footing

| | |
|---|---|
| Lap Splice length for #4 bar specified in this stem design segment (25.4.2.3a) = | 18.72 in |
| Development length for #4 bar specified in this stem design segment = | 14.40 in |

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 (25.4.2.3a) = | 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 = | 6.05 in |
| As Provided = | 0.2400 in2/ft |
| As Required = | 0.1728 in2/ft |

Project Title: 4115 78th AVE SE
Engineer: Mark Myers, PE
Project ID:
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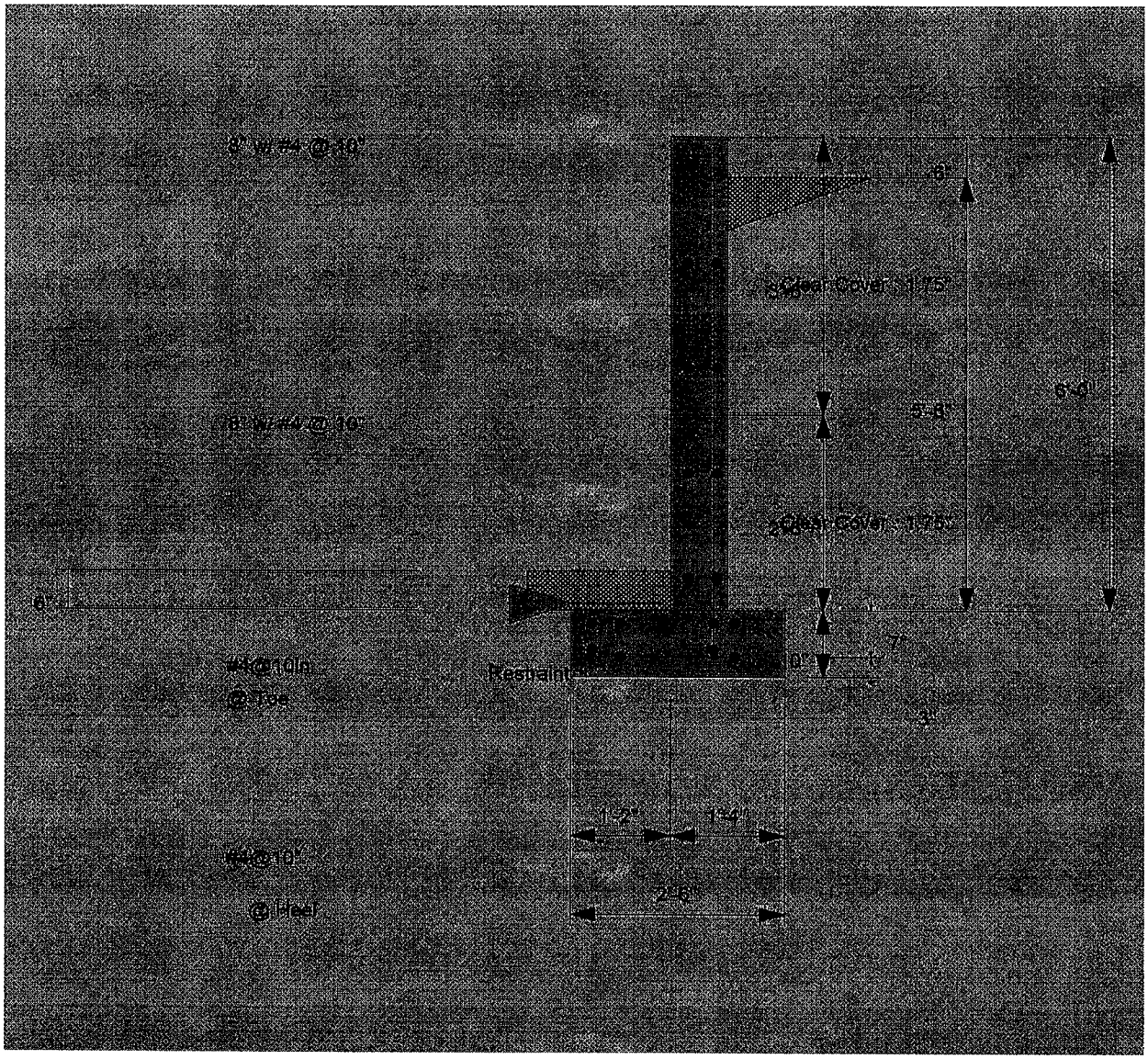
**DESCRIPTION:** 6ft Stem at Basement w/ Slab



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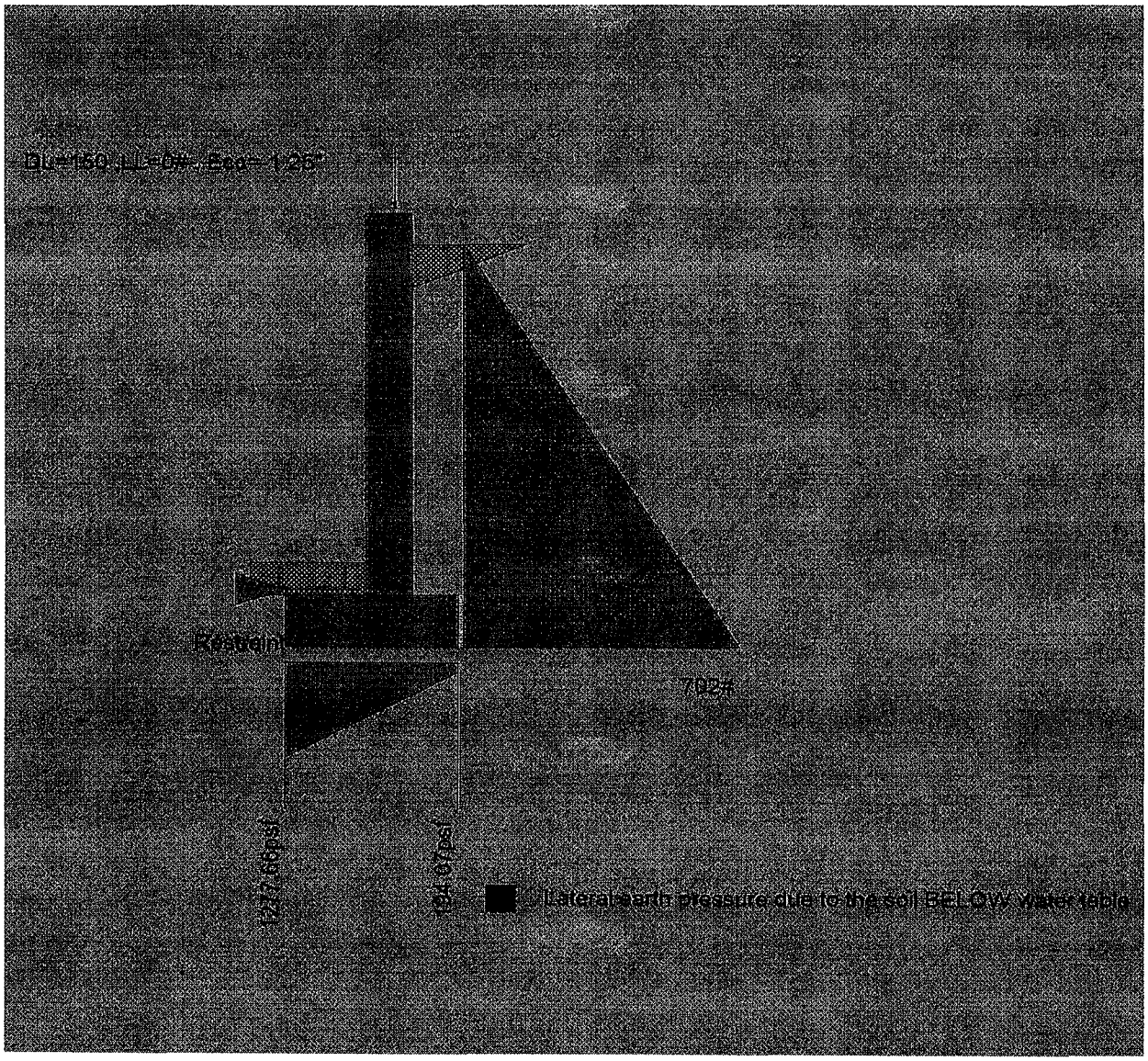
Project Descr: SFR w/ Basement ADU



**DESCRIPTION:** 6ft Stem at Basement w/ Slab



Project Title: 4115 78th AVE SE
Engineer: Mark Myers, PE
Project ID:
Project Descr: SFR w/ Basement ADU



**DESCRIPTION:** 6ft Stem at Basement w/ Slab & Seismic

***Code Reference:***

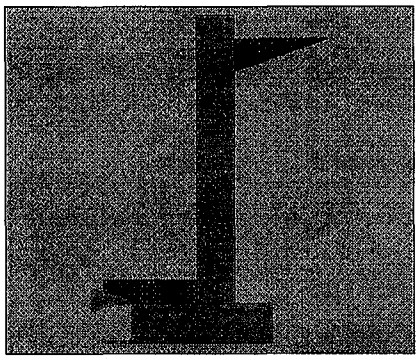
Calculations per IBC 2018, ACI 318-14, TMS 402-16

## Criteria

| | | |
|---|---|---|
| Retained Height | = | 5.50 ft |
| Wall height above soil | = | 0.50 ft |
| Slope Behind Wall | = | 0.00 |
| Height of Soil over Toe | = | 6.00 in |
| Water table above bottom of footing | = | 0.0 ft |

## Soil Data

| | | |
|---|---|---|
| Allow Soil Bearing | = | 2,500.0 psf |
| Equivalent Fluid Pressure Method | | |
| Active Heel Pressure | = | 35.0 psf/ft |
| | = | |
| Passive Pressure | = | 300.0 psf/ft |
| Soil Density, Heel | = | 110.00 pcf |
| Soil Density, Toe | = | 110.00 pcf |
| Footing\|\|Soil Friction | = | 0.400 |
| Soil height to ignore for passive pressure | = | 12.00 in |



## Surcharge Loads

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

## Axial Load Applied to Stem

| | | |
|---|---|---|
| Axial Dead Load | = | 150.0 lbs |
| Axial Live Load | = | 0.0 lbs |
| Axial Load Eccentricity | = | 1.3 in |

## Earth Pressure Seismic Load

Method : Uniform

| | | |
|---|---|---|
| Multiplier Used | = | 8.000 |
| (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 | = | 50.667 |
| Total Seismic Force | = | 320.889 |

## 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 |

Project Title: 4115 78th AVE SE
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**DESCRIPTION:** 6ft Stem at Basement w/ Slab & Seismic

## Design Summary

**Wall Stability Ratios**

| | | | |
|---|---|---|---|
| Overturning | = | 1.11 | Ratio < 1.5! |
| Slab Resists All Sliding ! | | | |
| Global Stability | = | 1.76 | |
| Total Bearing Load | = | 1,840 lbs | |
| ...resultant ecc. | = | 8.32 in | |
| Eccentricity outside middle third | | | |
| Soil Pressure @ Toe | = | 2,204 psf | OK |
| Soil Pressure @ Heel | = | 0 psf | OK |
| Allowable | = | 2,500 psf | |
| Soil Pressure Less Than Allowable | | | |
| ACI Factored @ Toe | = | 2,565 psf | |
| ACI Factored @ Heel | = | 0 psf | |
| Footing Shear @ Toe | = | 14.8 psi | OK |
| Footing Shear @ Heel | = | 36.0 psi | OK |
| Allowable | = | 75.0 psi | |

**Sliding Calcs**

| | | |
|---|---|---|
| Lateral Sliding Force | = | 926.6 lbs |

Vertical component of active lateral soil pressure IS considered in the calculation of soil bearing pressures.

**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

| | | 2nd | Bottom | | |
|---|---|---|---|---|---|
| **Design Height Above Ftg** | ft = | Stem OK 2.50 | Stem OK 0.00 | | |
| Wall Material Above "Ht" | = | Concrete | Concrete | | |
| Design Method | = | SD | SD | SD | SD |
| Thickness | = | 8.00 | 8.00 | | |
| Rebar Size | = | # 4 | # 4 | | |
| Rebar Spacing | = | 10.00 | 10.00 | | |
| Rebar Placed at | = | 6 in | 6 in | | |
| **Design Data** | | | | | |
| fb/FB + fa/Fa | = | **0.074** | **0.372** | | |
| **Total Force @ Section** | | | | | |
| Service Level | lbs = | | | | |
| Strength Level | lbs = | 404.0 | 1,125.7 | | |
| **Moment....Actual** | | | | | |
| Service Level | ft-# = | | | | |
| Strength Level | ft-# = | 461.3 | 2,300.4 | | |
| Moment.....Allowable | ft-# = | 6,174.1 | 6,174.1 | | |
| **Shear.....Actual** | | | | | |
| Service Level | psi = | | | | |
| Strength Level | psi = | 5.6 | 15.6 | | |
| Shear.....Allowable | psi = | 75.0 | 75.0 | | |
| Anet (Masonry) | in2 = | | | | |
| Wall Weight | psf = | 100.0 | 100.0 | | |
| Rebar Depth 'd' | in = | 6.00 | 6.00 | | |

**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 | 2,500.0 |
| Fy | psi = | 60,000.0 | 60,000.0 |

Project Title: 4115 78th AVE SE
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**DESCRIPTION:** 6ft Stem at Basement w/ Slab & Seismic

## Concrete Stem Rebar Area Details

| 2nd Stem | Vertical Reinforcing | Horizontal Reinforcing | |
|---|---|---|---|
| As (based on applied moment) : | 0.018 in2/ft | | |
| (4/3) * As : | 0.0241 in2/ft | Min Stem T&S Reinf Area 0.672 in2 | |
| 200bd/fy : 200(12)(6)/60000 : | 0.24 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 : | 0.24 in2/ft | #5@ 19.38 in | #5@ 38.75 in |
| Maximum Area : | 0.8128 in2/ft | #6@ 27.50 in | #6@ 55.00 in |

| Bottom Stem | Vertical Reinforcing | Horizontal Reinforcing | |
|---|---|---|---|
| As (based on applied moment) : | 0.09 in2/ft | | |
| (4/3) * As : | 0.12 in2/ft | Min Stem T&S Reinf Area 0.480 in2 | |
| 200bd/fy : 200(12)(6)/60000 : | 0.24 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 : | 0.24 in2/ft | #5@ 19.38 in | #5@ 38.75 in |
| Maximum Area : | 0.8128 in2/ft | #6@ 27.50 in | #6@ 55.00 in |

## Footing Data

| | | |
|---|---|---|
| Toe Width | = | 1.17 ft |
| Heel Width | = | 1.33 |
| Total Footing Width | = | 2.50 |
| Footing Thickness | = | 10.00 in |

f'c = 2,500 psi Fy = 60,000 psi
Footing Concrete Density = 150.00 pcf
Min. As % = 0.0018
Cover @ Top 7.00 @ Btm.= 3.00 in

## Footing Design Results

| | | Toe | Heel | |
|---|---|---|---|---|
| Factored Pressure | = | 2,565 | 0 | psf |
| Mu' : Upward | = | 1,340 | 0 | ft-# |
| Mu' : Downward | = | 147 | 525 | ft-# |
| Mu: Design | = | 1,193 | 525 | ft-# |
| φ Mn | = | 6,985 | 2,665 | ft-# |
| Actual 1-Way Shear | = | 14.81 | 35.98 | psi |
| Allow 1-Way Shear | = | 75.00 | 75.00 | psi |

Toe Reinforcing = # 4 @ 10.00 in
Heel Reinforcing = # 4 @ 10.00 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@ 11.11 in, #5@ 17.22 in, #6@ 18 in, #7@ 18 in, #8@ 18 in, #9@ 18 in, #10@ 18 in

Heel: #4@ 11.11 in, #5@ 17.22 in, #6@ 18 in, #7@ 18 in, #8@ 18 in, #9@ 18 in, #10@ 18 in

Key: No key defined

Min footing T&S reinf Area 0.54 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 |

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**DESCRIPTION:** 6ft Stem at Basement w/ Slab & 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) | | 701.9 | 2.11 | 1,481.9 | Soil Over HL (ab. water tbl) | 403.1 | 2.17 | 873.5 |
| HL Act Pres (be water tbl) | | | | | Soil Over HL (bel. water tbl) | | 2.17 | 873.5 |
| 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 | = | 150.0 | 1.60 | 240.7 |
| Added Lateral Load | = | | | | * Axial Live Load on Stem | = | | | |
| Load @ Stem Above Soil | = | | | | Soil Over Toe | = | 64.2 | 0.58 | 37.5 |
| Seismic Earth Load | = | 224.6 | 3.17 | 711.3 | Surcharge Over Toe | = | | | |
| | = | | | | Stem Weight(s) | = | 600.0 | 1.50 | 900.2 |
| | | | | | Earth @ Stem Transitions | = | | | |
| | | | | | Footing Weight | = | 312.5 | 1.25 | 390.6 |
| | | | | | Key Weight | = | | | |
| | | | | | Vert. Component | = | | | |
| **Total** | = | 926.6 | **O.T.M.** = | 2,193.2 | **Total** = | 1,529.8 lbs | **R.M.** = | 2,442.5 |

**Resisting/Overturning Ratio** = **1.11**
Vertical Loads used for Soil Pressure = 1,839.7 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) | 0.147 | 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.

**DESCRIPTION:** 6ft Stem at Basement w/ Slab & Seismic

## Rebar Lap & Embedment Lengths Information

Stem Design Segment: 2nd
Stem Design Height: 2.50 ft above top of footing

| | |
|---|---|
| Lap Splice length for #4 bar specified in this stem design segment (25.4.2.3a) = | 18.72 in |
| Development length for #4 bar specified in this stem design segment = | 14.40 in |

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 (25.4.2.3a) = | 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 = | 6.05 in |
| As Provided = | 0.2400 in2/ft |
| As Required = | 0.1728 in2/ft |

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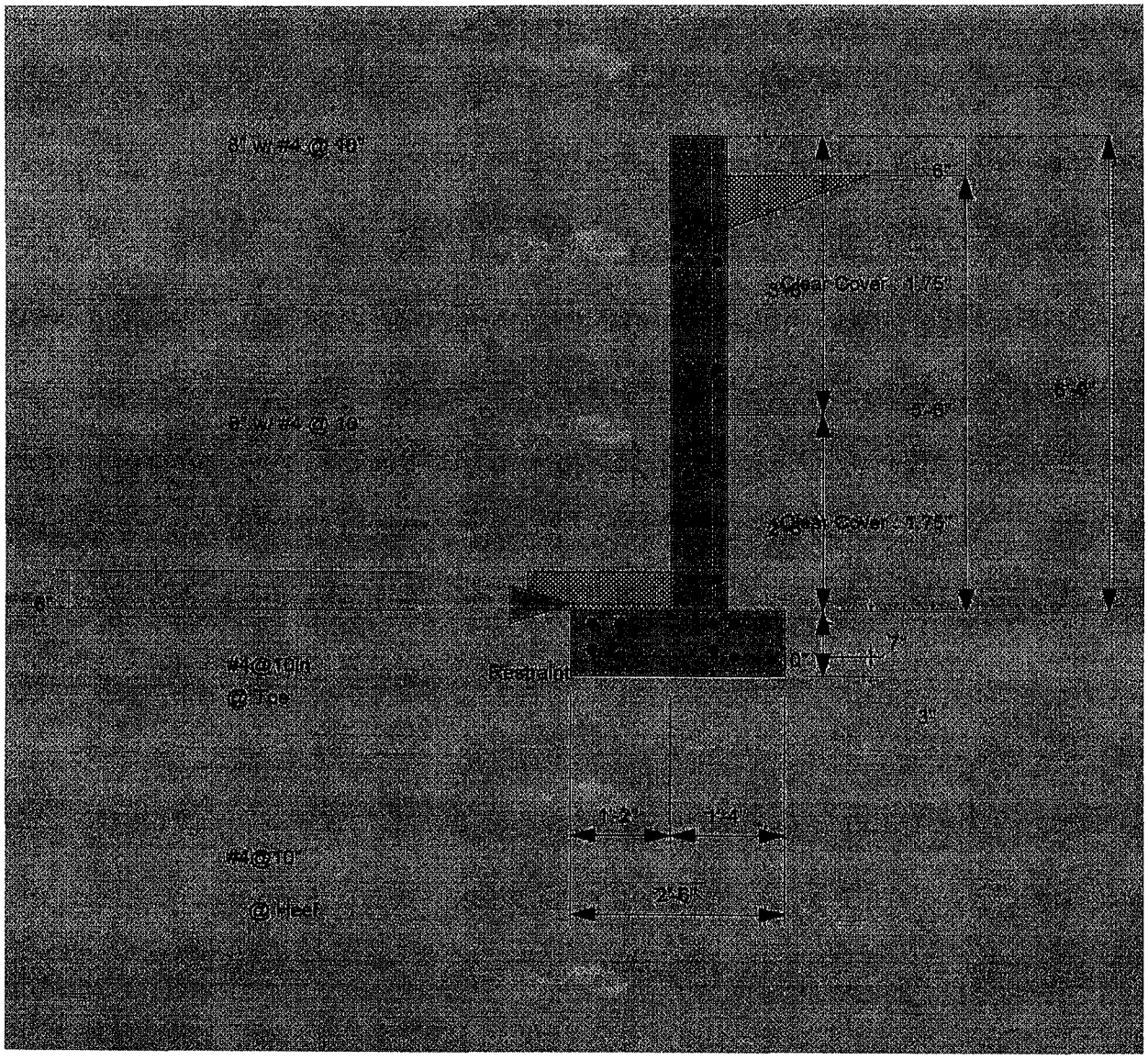
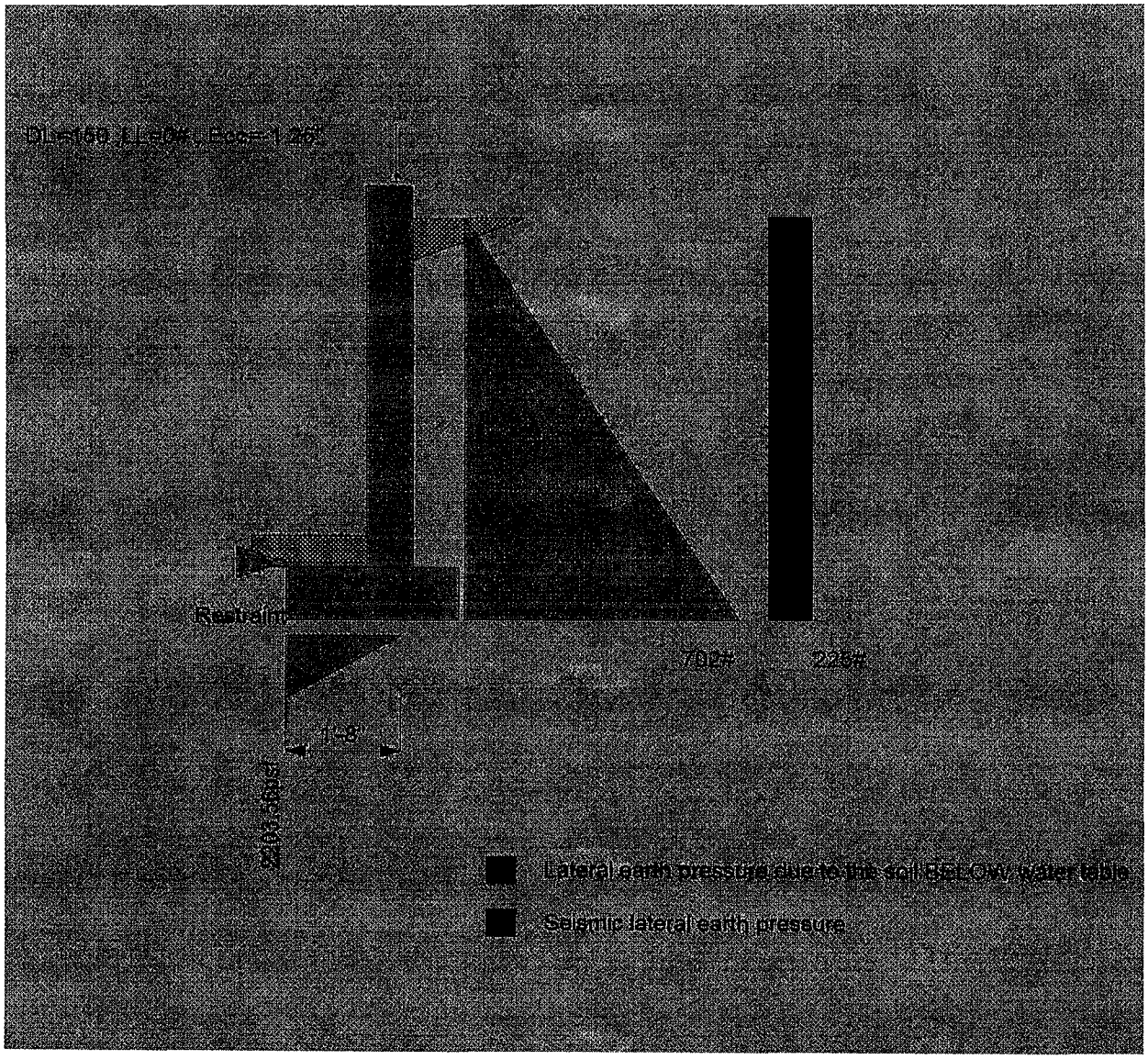


**DESCRIPTION:** 6ft Stem at Basement w/ Slab & Seismic



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**DESCRIPTION:** 4ft Stem at Basement w/ Slab

***Code Reference***

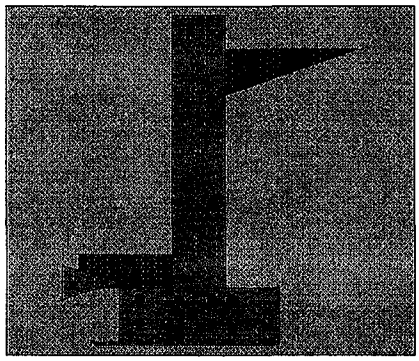
Calculations per IBC 2018, ACI 318-14, TMS 402-16

## Criteria

| | | |
|---|---|---|
| Retained Height | = | 3.50 ft |
| Wall height above soil | = | 0.50 ft |
| Slope Behind Wall | = | 0.00 |
| Height of Soil over Toe | = | 6.00 in |
| Water table above bottom of footing | = | 0.0 ft |

## Soil Data

| | | |
|---|---|---|
| Allow Soil Bearing | = | 2,500.0 psf |
| Equivalent Fluid Pressure Method | | |
| Active Heel Pressure | = | 35.0 psf/ft |
| | = | |
| Passive Pressure | = | 300.0 psf/ft |
| Soil Density, Heel | = | 110.00 pcf |
| Soil Density, Toe | = | 110.00 pcf |
| Footing\|\|Soil Friction | = | 0.400 |
| Soil height to ignore for passive pressure | = | 12.00 in |



## Surcharge Loads

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

## Axial Load Applied to Stem

| | | |
|---|---|---|
| Axial Dead Load | = | 150.0 lbs |
| Axial Live Load | = | 0.0 lbs |
| Axial Load Eccentricity | = | 1.3 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 |

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**DESCRIPTION:** 4ft Stem at Basement w/ Slab

## Design Summary

**Wall Stability Ratios**

| | | | |
|---|---|---|---|
| Overturning | = | 2.64 | OK |
| Slab Resists All Sliding ! | | | |
| Global Stability | = | 2.53 | |
| Total Bearing Load | = | 1,238 lbs | |
| ...resultant ecc. | = | 1.62 in | |
| Eccentricity within middle third | | | |
| Soil Pressure @ Toe | = | 870 psf | OK |
| Soil Pressure @ Heel | = | 368 psf | OK |
| Allowable | = | 2,500 psf | |
| Soil Pressure Less Than Allowable | | | |
| ACI Factored @ Toe | = | 1,076 psf | |
| ACI Factored @ Heel | = | 455 psf | |
| Footing Shear @ Toe | = | 1.3 psi | OK |
| Footing Shear @ Heel | = | 8.9 psi | OK |
| Allowable | = | 75.0 psi | |

**Sliding Calcs**

| | | |
|---|---|---|
| Lateral Sliding Force | = | 328.6 lbs |

Vertical component of active lateral soil pressure IS considered in the calculation of soil bearing pressures.

**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 |
| Thickness | = | 8.00 | | | |
| Rebar Size | = | # 4 | | | |
| Rebar Spacing | = | 10.00 | | | |
| Rebar Placed at | = | 6 in | | | |
| **Design Data** | | | | | |
| fb/FB + fa/Fa | = | **0.061** | | | |
| **Total Force @ Section** | | | | | |
| Service Level | lbs = | | | | |
| Strength Level | lbs = | 343.0 | | | |
| **Moment....Actual** | | | | | |
| Service Level | ft-# = | | | | |
| Strength Level | ft-# = | 381.4 | | | |
| Moment.....Allowable | = | 6,174.1 | | | |
| **Shear.....Actual** | | | | | |
| Service Level | psi = | | | | |
| Strength Level | psi = | 4.8 | | | |
| Shear.....Allowable | psi = | 75.0 | | | |
| Anet (Masonry) | in2 = | | | | |
| Wall Weight | psf = | 100.0 | | | |
| Rebar Depth 'd' | in = | 6.00 | | | |
| **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 | | | |

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## Concrete Stem Rebar Area Details

| Bottom Stem | Vertical Reinforcing | Horizontal Reinforcing |
|---|---|---|
| As (based on applied moment) : | 0.0149 in2/ft | |
| (4/3) * As : | 0.0199 in2/ft | Min Stem T&S Reinf Area 0.768 in2 |
| 200bd/fy : 200(12)(6)/60000 : | 0.24 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 : | 0.24 in2/ft | #5@ 19.38 in #5@ 38.75 in |
| Maximum Area : | 0.8128 in2/ft | #6@ 27.50 in #6@ 55.00 in |

## Footing Data

| | | |
|---|---|---|
| Toe Width | = | 0.67 ft |
| Heel Width | = | 1.33 |
| Total Footing Width | = | 2.00 |
| Footing Thickness | = | 10.00 in |

f'c = 2,500 psi Fy = 60,000 psi
Footing Concrete Density = 150.00 pcf
Min. As % = 0.0018
Cover @ Top 7.00 @ Btm.= 3.00 in

## Footing Design Results

| | | Toe | Heel | |
|---|---|---|---|---|
| Factored Pressure | = | 1,076 | 455 | psf |
| Mu' : Upward | = | 224 | 116 | ft-# |
| Mu' : Downward | = | 48 | 291 | ft-# |
| Mu: Design | = | 176 | 174 | ft-# |
| φ Mn | = | 6,985 | 2,665 | ft-# |
| Actual 1-Way Shear | = | 1.31 | 8.93 | psi |
| Allow 1-Way Shear | = | 75.00 | 75.00 | psi |

Toe Reinforcing = # 4 @ 10.00 in
Heel Reinforcing = # 4 @ 10.00 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@ 11.11 in, #5@ 17.22 in, #6@ 18 in, #7@ 18 in, #8@ 18 in, #9@ 18 in, #10@ 18 in

Heel: #4@ 11.11 in, #5@ 17.22 in, #6@ 18 in, #7@ 18 in, #8@ 18 in, #9@ 18 in, #10@ 18 in

Key: No key defined

Min footing T&S reinf Area 0.43 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 |

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**DESCRIPTION:** 4ft Stem at Basement w/ Slab

## 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) | | 328.6 | 1.44 | 474.7 | Soil Over HL (ab. water tbl) | 256.5 | 1.67 | 427.5 |
| HL Act Pres (be water tbl) | | | | | Soil Over HL (bel. water tbl) | | 1.67 | 427.5 |
| 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 | = | 150.0 | 1.10 | 165.6 |
| Added Lateral Load | = | | | | * Axial Live Load on Stem | = | | | |
| Load @ Stem Above Soil | = | | | | Soil Over Toe | = | 36.7 | 0.33 | 12.2 |
| | = | | | | Surcharge Over Toe | = | | | |
| | | | | | Stem Weight(s) | = | 400.0 | 1.00 | 400.0 |
| | | | | | Earth @ Stem Transitions | = | | | |
| **Total** | = | 328.6 | **O.T.M.** = | 474.7 | Footing Weight | = | 250.0 | 1.00 | 249.9 |
| | | | | | Key Weight | = | | | |
| | | | | | Vert. Component | = | | | |
| | | | | | **Total =** | | 1,093.2 lbs | **R.M.=** | 1,255.3 |

**Resisting/Overturning Ratio** = **2.64**
Vertical Loads used for Soil Pressure = 1,238.2 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 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) | 0.048 | 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.

**DESCRIPTION:** 4ft Stem at Basement w/ Slab

## Rebar Lap & Embedment Lengths Information

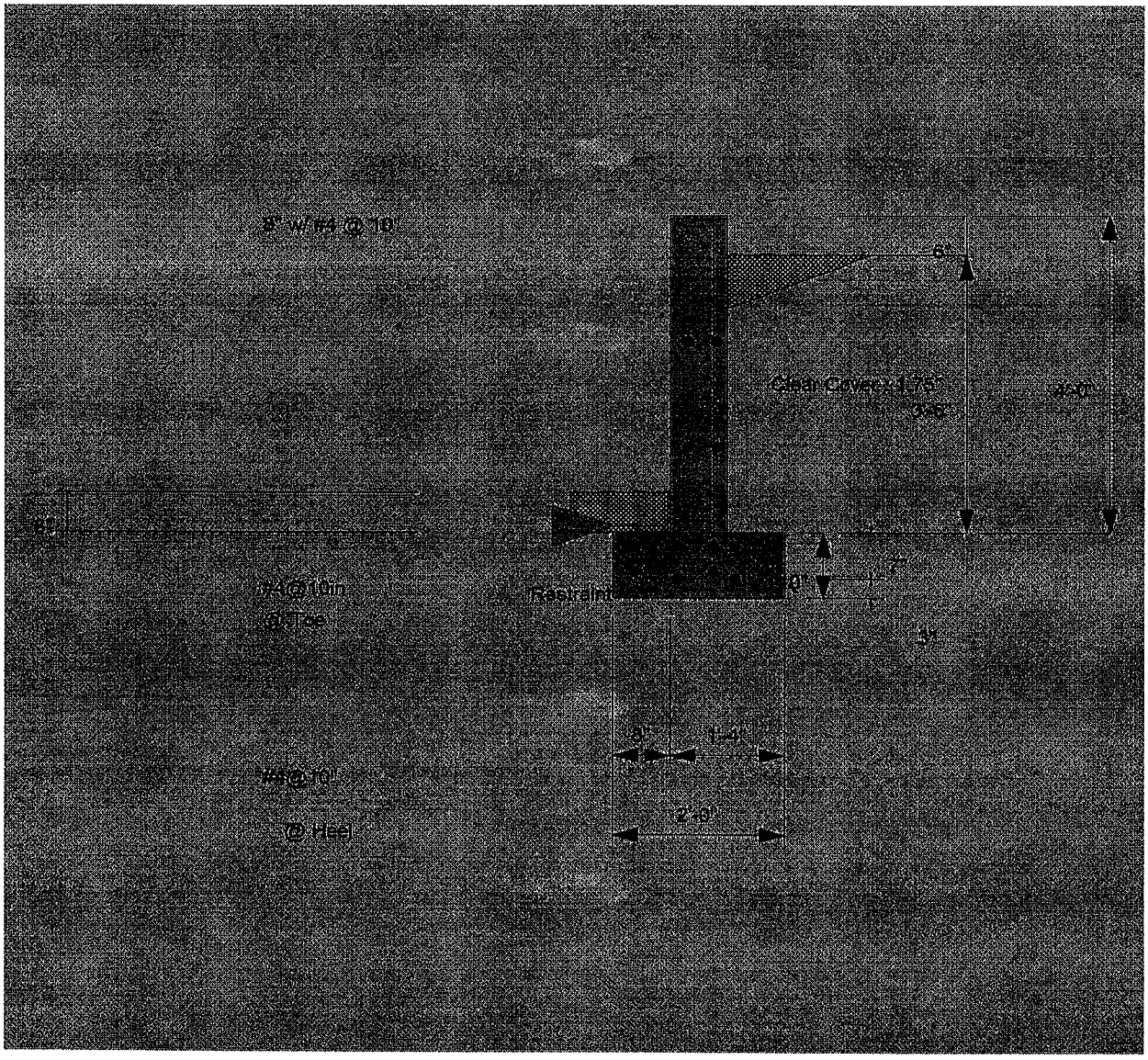
Stem Design Segment: Bottom
Stem Design Height: 0.00 ft above top of footing

| | |
|---|---|
| Lap Splice length for #4 bar specified in this stem design segment (25.4.2.3a) = | 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 = | 6.05 in |
| As Provided = | 0.2400 in2/ft |
| As Required = | 0.1728 in2/ft |

Project Title: 4115 78th AVE SE
Engineer: Mark Myers, PE
Project ID:
Project Descr: SFR w/ Basement ADU



**DESCRIPTION:** 4ft Stem at Basement w/ Slab



**DESCRIPTION:** 4ft Stem at Basement w/ Slab