

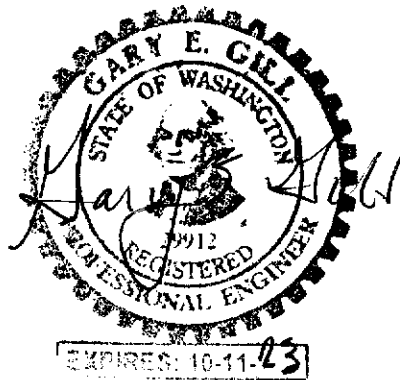
# Bird McDonald Residence

4304 East Mercer Way  
Mercer Island, WA 98040

## SUPPLEMENTAL STRUCTURAL CALCULATIONS

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Prepared by

Gary E. Gill, S.E.  
1125 NE 152<sup>nd</sup> Street  
Shoreline, Washington 98155  
(206) 992-2728  
gill26608@yahoo.com

**RW1 (H=9.8')**

$$A := 1 \quad Tw := .66 \quad B := 6 \quad Tf := 1.33 \quad H1 := .5 \quad H := 9.8$$

$$ECP := .035 \quad S := .008 \quad Sur := .0 \cdot H \quad SoilWt := .13$$

$$V_{ecp} := \frac{H^2}{2} \cdot ECP \quad V_{ecp} = 1.681 \quad V_s := S \cdot H^2 \quad V_s = 0.768 \quad V_{sur} := Sur \cdot H \quad V_{sur} = 0$$

$$Mot := V_{ecp} \cdot \left( \frac{H}{3} + H1 + Tf \right) + V_s \cdot \left( \frac{H}{2} + H1 + Tf \right) + V_{sur} \cdot \left( \frac{H}{2} + Tf + H1 \right)$$

$$Mot = 13.737$$

$$W_f := (A + Tw + B) \cdot (Tf + H1) \cdot .15 \quad W_w := (H + .5 + H1) \cdot Tw \cdot .15 \quad W_s := A \cdot (H + H1) \cdot SoilWt$$

$$W_f = 2.103$$

$$W_w = 1.069$$

$$W_s = 1.339$$

$$W := W_f + W_w + W_s \quad W = 4.511$$

$$Mr := W_f \cdot \frac{(A + Tw + B)}{2} + W_w \cdot \left( B + \frac{Tw}{2} \right) + W_s \cdot \left( B + Tw + \frac{A}{2} \right) \quad Mr = 24.409$$

$$FOS := \frac{Mr}{Mot}$$

$$FOS = 1.777$$

$$x_b := \frac{Mr - Mot}{W} \quad x_b = 2.366 \quad q_{max} := \frac{2 \cdot W}{3 \cdot x_b} \quad q_{max} = 1.271 \quad \text{OK with seismic}$$

**Sliding****Without Seismic**

$$V := V_{ecp} \quad V = 1.681 \quad V_{sl} := W \cdot \frac{.4}{1.5} \quad V_{sl} = 1.203 \quad \text{KeyDepth} := 1.0$$

$$V_{pass} := \frac{(Tf + \text{KeyDepth})^2}{2} \cdot \frac{.3}{1.5} \quad V_{pass} = 0.543 \quad V_{sl} + V_{pass} = 1.746 \quad \text{OK}$$

$$\text{Mukey} := \left( Tf \cdot .3 \cdot \frac{\text{KeyDepth}^2}{2} + \text{KeyDepth} \cdot .3 \cdot \frac{\text{KeyDepth}}{2} \cdot \text{KeyDepth} \cdot .66 \right) \cdot 1.6 \quad \text{Mukey} = 0.478$$

**With Seismic**

$$V := V_{ecp} + V_s \quad V = 2.449 \quad V_{sl} := W \cdot \frac{.4}{1.2} \quad V_{sl} = 1.504 \quad \text{KeyDepth} := 1.5$$

$$V_{pass} := \frac{(Tf + \text{KeyDepth})^2}{2} \cdot \frac{.3}{1.2} \quad V_{pass} = 1.001 \quad V_{sl} + V_{pass} = 2.505 \quad \text{OK}$$

$$\text{Mukey} := \left( Tf \cdot .3 \cdot \frac{\text{KeyDepth}^2}{2} + \text{KeyDepth} \cdot .3 \cdot \frac{\text{KeyDepth}}{2} \cdot \text{KeyDepth} \cdot .66 \right) \cdot 1.6 \quad \text{Mukey} = 1.253$$

$$d := 4 \quad A_s := .2 \quad a := A_s \cdot \frac{60}{.85 \cdot 2.5 \cdot 12} \quad a = 0.471$$

$$\text{PhiMc} := .9 \cdot A_s \cdot 60 \cdot \left( d - \frac{a}{2} \right) \cdot \frac{1}{12} \quad \text{PhiMc} = 3.388$$

Use: 1'-0"x8"W key with #4v @ 12"

Span = 11'

Try 6" slab w/#4t&b @ 12"

$$As := .2 \quad Asp := .2 \quad d := 4 \quad b := 12 \quad dp := 2$$

$$fc := 2500 \quad D := 6 \quad Ig := b \cdot \frac{D^3}{12} \quad Ig = 216 \quad wd := \frac{D}{12 \cdot 150} + 10 \quad wl := 40$$

$$Span := 11 \quad wc := 150 \quad Ec := 33 \cdot (wc^3 \cdot fc)^{.5} \quad Ec = 3031243.56 \quad Es := 29000000$$

$$n := \frac{Es}{Ec} \quad n = 9.57$$

$$B := \frac{b}{n \cdot As} \quad r := (n - 1) \cdot \frac{Asp}{n \cdot As}$$

$$Ma := (wd + wl) \cdot \frac{Span^2}{8} \quad Ma = 756.3$$

$$fr := 7.5 \cdot fc^{.5} \quad fr = 375 \quad Mcr := fr \cdot \frac{Ig}{\frac{D}{2}} \quad Mcr = 27000$$

$$kd := \frac{\left[ 2 \cdot d \cdot B \cdot \left( 1 + r \cdot \frac{dp}{d} \right) + (1 + r)^2 \right]^{.5} - (1 + r)}{B}$$

$$kd = 1.09$$

$$Icr := b \cdot \frac{kd^3}{3} + n \cdot As \cdot (d - kd)^2 + (n - 1) \cdot Asp \cdot (kd - dp)^2 \quad Icr = 22.8$$

$$Ie := \frac{Mcr^3}{Ma^3} \cdot Ig + \left[ 1 - \left( \frac{Mcr}{Ma} \right)^3 \right] \cdot Icr \quad Ie = 8790473.05 \quad Ie := \text{if}[(Ie > Ig), Ig, Ie]$$

$$Ie = 216$$

$$K := 1$$

$$ai := \frac{K \cdot \frac{5}{48} \cdot Ma \cdot Span^2 \cdot 144}{Ec \cdot Ie} \quad ai = 0.0021 \quad rp := \frac{Asp}{D \cdot b}$$

$$lam := \frac{2}{1 + 50 \cdot rp} \quad acpsh := lam \cdot ai \quad acpsh = 0.0037 \quad \text{OK}$$

$$Mu := (wd \cdot 1.4 + wl \cdot 1.6) \cdot \frac{Span^2}{8} \quad Mu = 1179.82 \quad a := \frac{As \cdot 60000}{.85 \cdot b \cdot fc} \quad a = 0.47$$

$$PhiMc := .9 \cdot 60000 \cdot As \cdot \left( d - \frac{a}{2} \right) \cdot \frac{1}{12} \quad PhiMc = 3388.24 \quad \text{OK}$$