STRUCTURAL ANALYSIS

of

790 Square Foot Residence
with 4” Thick ICF Walls
Subjected to 350 mph Tornado Winds
and
Maximum California Seismic Loads
STRUCTURAL DESIGN CRITERIA

   (Note: Equations and Tables are referenced from ASCE 7-05 & ACI 318-05)

2. Building Department and/or Regulatory Agencies Various

3. Type of Construction Concrete

4. Design Live Loads
   a. Roof Non-Snow
   b. Floor N/A

5. Structure
   a. Description of Vertical Load System Concrete slab and beam roof with concrete bearing walls
   b. Description of Lateral System Ordinary Reinforced Concrete Shearwalls

6. Residential Building (Assume Open)
   a. Occupancy Category II (ASCE 7-05 Table 1-1)
LATERAL DESIGN

a. SEISMIC [Maximum California Site]

\[
\begin{align*}
S_s &= 1.500 & \text{Site Class} &= D \text{ (Assumed)} & \text{Site Coordinates} \\
S_1 &= 0.749 & I &= 1.00 & \text{Latitude} & \text{Longitude} \\
F_a &= 1.0 & R &= 4.00 \\
F_v &= 1.5 & \square_o &= 2.50 \\
*S_{DS} &= 1.20 & C_d &= 4.00 & \text{Seismic Design Category} \\
S_{D1} &= 0.749 & T &= 0.150 \text{ (EQ 12.8-7)} & D
\end{align*}
\]

EQ 12.8-7 \quad T = Ta = C_t \times h_n^x = 0.02(1.0)^{0.75} = 0.150

EQ 12.8-2 \quad V = \frac{S_{DS}}{(R/I)} (W) = 0.300 \quad * W = E

EQ 12.8-3 \quad V = \frac{S_{D1}}{T (R/I)} (W) = 1.248 \quad * W \text{ (Need not exceed)}

EQ 12.8-6 \quad V = \frac{(0.5)S_1}{(R/I)} (W) = 0.094 \quad * W \text{ (Minimum when } S_1 \geq \text{ or } = 0.6)

\[
V = 0.300 \quad * W \text{ (Strength)}
\]

\[
V_{ASD} = 0.7 \text{(E)} \quad V_{ASD} = 0.210 \quad * W \text{ (Service)}
\]

*S_{DS} value assumed to consider maximum credible earthquake
b. Wind [350 mph Tornado Velocity]

**Main Wind-Force Resisting Systems**

Reference: ASCE 7-05

ASCE 7-05 Method 2

Enclosure Classification - Assume Open Building

\[
V = 350 \text{ mph} \quad I = 1 \quad \text{(Table 6-1)}
\]

Roof Angle = 26.56 degrees \quad \text{K}_d = 0.85 \quad \text{(Table 6-4)}

Exposure = C \quad \text{(6.5.6.3)} \quad \text{K}_{zt} = 1 \quad \text{(6.5.7.2)}

\[
h_r = 15 \text{ ft} \quad \text{K}_z = 0.85 \quad \text{(Table 6-3)}
\]

\[
h_w = 9 \text{ ft} \quad G = 0.85 \quad \text{(6.5.8.1)}
\]

L/B = 0.727 \quad 1.37 \quad \text{(Perp/Par)} \quad \text{GC}_{pi} = 0 \quad \text{(Figure 6-5)}

h/L = 0.63 \quad 0.36 \quad \text{(Perp/Par)} \quad q_h = 227 \text{ psf} \quad \text{(EQ 6-15)}

\[
q_h = q_z = 0.00256 K z K_{zt} K_d V^2 I = 227 \text{ psf}
\]

**Wind Pressure Perpendicular to Ridge**

\[
P = q(GC_{pi} - FC_{pi}) \quad \text{(6.5.12.2)}
\]

<table>
<thead>
<tr>
<th>Location</th>
<th>(C_p)</th>
<th>(P)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Windward</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wall</td>
<td>0.80</td>
<td>154  psf</td>
</tr>
<tr>
<td>Roof</td>
<td>0.1656</td>
<td>32.0 psf</td>
</tr>
<tr>
<td>Roof</td>
<td>-0.311</td>
<td>-60.0 psf</td>
</tr>
<tr>
<td>Leeward</td>
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<td></td>
</tr>
<tr>
<td>Wall</td>
<td>-0.5</td>
<td>-96.5 psf</td>
</tr>
<tr>
<td>Roof</td>
<td>-0.6</td>
<td>-116 psf</td>
</tr>
</tbody>
</table>

**Wind Force Parallel to Ridge**

<table>
<thead>
<tr>
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<th>(C_p)</th>
<th>(P)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Windward</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wall</td>
<td>0.80</td>
<td>154  psf</td>
</tr>
<tr>
<td>Roof</td>
<td>0-12'</td>
<td>-0.90</td>
</tr>
<tr>
<td>Roof</td>
<td>12-33'</td>
<td>-0.50</td>
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<tr>
<td>Leeward</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wall</td>
<td>-0.370</td>
<td>-71.4 psf</td>
</tr>
</tbody>
</table>
TRANSVERSE WIND
(Velocity = 350 mph)
IN-PLANE SHEAR DESIGN
Tornado (350 mph) Force

\[ P_u = 52.4^k \]

END WALLS (t=4"")
Horizontal Reinforcing = \#3 @ 12"oc (Min)
Vertical Reinforcing = \#5 @ 12"oc
IN-PLANE SHEAR DESIGN
Maximum California Seismic

\[ P_u = 11.6^k \]

END WALLS (t=4”)
Horizontal Reinforcing = #3 @ 12”oc (Min)
Vertical Reinforcing = #3 @ 12”oc (Min)
OUT-OF-PLANE WIND LOADS

Tornado (350 mph) Force

MAXIMUM DESIGN PRESSURE $P_u = 246$ psf

END WALLS ($t=4''$)

Horizontal Reinforcing = #5 @ 10"oc
Vertical Reinforcing = #5 @ 10"oc

Seismic $P_u = 24$ psf
Reinforcing = #3 @ 12"oc EW (Min)
IN-PLANE SHEAR DESIGN
Tornado (350 mph) Force

FRONT SHEAR WALL (t=4"")

Horizontal Reinforcing = #3 @ 12"oc (Min)
Vertical Reinforcing   = #5 @ 12"oc
IN–PLANE SHEAR DESIGN
Maximum California Seismic

FRONT SHEAR WALL (t=4”)

Horizontal Reinforcing = #3 @ 12”oc (Min)
Vertical Reinforcing = #3 @ 12”oc (Min)
OUT-OF-PLACE WIND LOADS

Tornado (350 mph) Force

MAXIMUM DESIGN PRESSURE $P_u = 246$psf

FRONT SHEAR WALL (t=4"

Horizontal Reinforcing = #3 @ 12"oc (Min)
Vertical Reinforcing = #5 @ 12"oc

Seismic $P_u = 24$psf
Reinforcing = #3 @ 12"oc EW (Min)