How to Use Concrete Wall Design in RISA

Presenter: Deborah Brisbin, P.E.
Concrete Wall Design Programs

RISAFloor 5.1

RISA-3D 9.1
What sections of the ACI apply to walls?

<table>
<thead>
<tr>
<th>Section</th>
<th>7.6</th>
<th>General Reinforcement Spacing Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>7.6.1</td>
<td>minimum spacing requirements</td>
</tr>
<tr>
<td></td>
<td>7.6.5</td>
<td>maximum spacing requirements</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Section</th>
<th>14.3</th>
<th>Wall Reinforcement Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>14.3.2 &amp; 14.3.3</td>
<td>minimum reinforcement ratios requirements</td>
</tr>
<tr>
<td></td>
<td>14.3.4</td>
<td>thickness requirements</td>
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<tr>
<td></td>
<td></td>
<td>proportioning and cover checks</td>
</tr>
<tr>
<td></td>
<td>14.3.5</td>
<td>maximum spacing requirements</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Section</th>
<th>11.9.8 and 11.9.9</th>
<th>Shear Reinforcement Requirements for Walls</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>11.9.8</td>
<td>if the $V_u$ exceeds $0.5*\phi*V_c$</td>
</tr>
<tr>
<td></td>
<td>11.9.9</td>
<td></td>
</tr>
</tbody>
</table>

ACI 08 CODE References
ACI Concrete Design Requires P-Delta

Per 10.10.2 “the design ... shall be based on factored forces and moments from second-order analysis satisfying 10.10.3, 10.10.4 OR 10.10.5”

- Nonlinear Second Order Analysis (10.10.3)
- Elastic Second Order Analysis (10.10.4)
- Moment Magnification (10.10.5 & 10.10.6)
What is P-Delta in RISA?

As the wall is loaded, it deflects.

The deflections induce secondary moments due to the fact that the wall is no longer co-linear.

Secondary Shears:

\[ V = P \text{ (Axial Force)} \times \frac{\Delta}{\text{Ht of Wall}} \]
Elastic Second Order Analysis (10.10.4)
Big P-Delta
\[ \Delta - \delta \]

- Turn on the PDelta Check for all Load Combination

Big P-Delta
Little P-Delta
Element Curvature Effects
\( \delta \) - delta

Only Required for Slender walls to account for:

- Influence of Axial Loads
- Presence of Cracked regions
- Effects of load duration
First Check Wall Slenderness

Slender \( \frac{kl_u}{r} \leq 22 \) \hspace{1cm} (Eq. 10-6)

\( l_u \) = full ht of wall or segments between diaphragms

Yes or No

Little P-Delta not required

Moment Magnification \hspace{1cm} (10.10.6)

\[ EI = 0.25E_cI_g \] From Commentary

Minimum Moment per 10.10.6.5 \((M2, \text{min})\)

Little P-Delta
Cracked Sections

- Deflection is based on the $I_g$ OR $I_{cr}$
- Global Parameters – Concrete Tab
  Check “Use Cracked Sections”

- Walls (10.10.4.1)
  In-Plane $I_{cr} = 0.7I_g$ (Un-cracked)
  Out-of-Plane $I_{cr} = 0.35I_g$ (Cracked)

Cracked Moment of Inertia
Modeling Walls in RISA
Types of Loading on Walls

- Point Loads
- Distributed Loads
- Surface Loads

In-Plane Loads

Out of Plane Loads
Concrete Wall Panel Cover Parameters

<table>
<thead>
<tr>
<th>Concrete Wall (Rebar)</th>
<th>Concrete Wall (Cover)</th>
<th>Masonry Wall</th>
<th>Wood Wall (Studs)</th>
<th>Wood Wall (Fasteners)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Label</strong></td>
<td><strong>Outer Bars</strong></td>
<td><strong>Location</strong></td>
<td><strong>Int Cover -z[in]</strong></td>
<td><strong>Ext Cover +z[in]</strong></td>
</tr>
<tr>
<td>1</td>
<td>Typical</td>
<td>Vertical</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td><strong>Each Face</strong></td>
<td></td>
<td></td>
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</tr>
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</table>

Outer bars orientation: (d measured from the vertical bars)

- **Vertical**
- **Horizontal**
- **Bars Centered**

Concrete Wall Design Rules
# Concrete Wall Design Rules

<table>
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<tr>
<th>Interior Cover –z (in)</th>
<th>Edge Cover</th>
<th>Exterior Cover +z (in)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
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<td>3</td>
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Bars are centered—here’s the extra

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**Concrete Wall Design Rules**

- **Interior Cover –z (in)**: 1 inch
- **Exterior Cover +z (in)**: 3 inches
- **Edge Cover**: 2 inches

**Note:** Bars are centered—here’s the extra cover.

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[Image of concrete wall design rules with tables and diagrams]
How does RISA calculate the “Extra”?

Wall length / Required spacing = Spacing + Remainder/2

Except very small walls:

If ONLY two bars are required and cannot fit at this spacing, one bar will be placed at each end of the wall.

Concrete Wall Design Rules
Concrete Walls are color coded in Rendered view so that you can determine your local axis and reinforcement.

Use ***New Modify Wall Panels- Flip Axis

- Interior = Light Grey
- Exterior = Dark Grey

Concrete Wall Design Rules
Let’s see RISA in action!

Concrete Walls in RISA
What’s Coming Soon?

- Openings in Concrete Walls
  (RISA-3D 10.0 & RISAFloor 6.0)
- Retaining Walls in RISAFoundation
  (RISAFoundation 4.0)
Questions?

Please let us know if you have questions.

We will answer as many questions as time permits during the webinar.

Once the webinar is closed, we will post all Q&A’s to our website: [www.risa.com](http://www.risa.com)

For further information, contact us at: webinar@risatech.com

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