Concrete Shear Walls in RISA

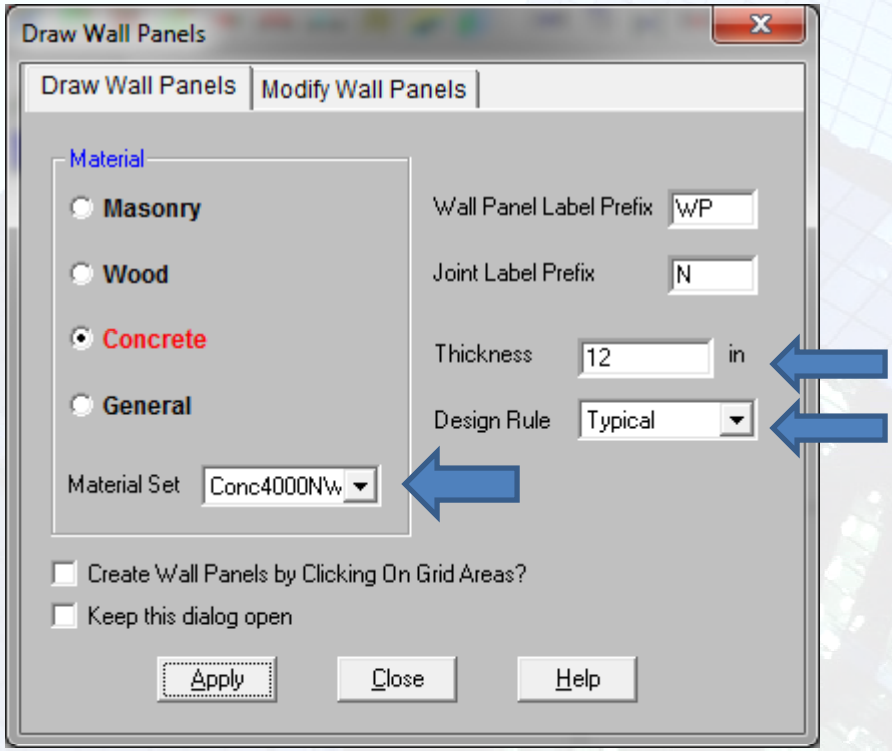
Presenter: Deborah Penko, P.E.

RISA TECHNOLOGIES

RISAFloor 6.0

RISA-3D 10.0

Concrete Wall Design Programs



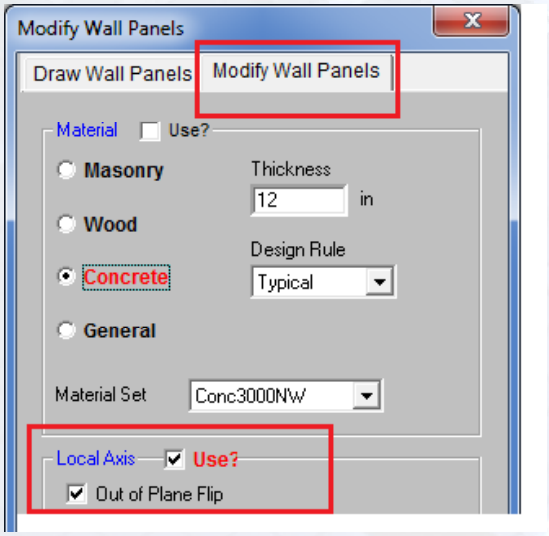
Modeling Walls in RISA

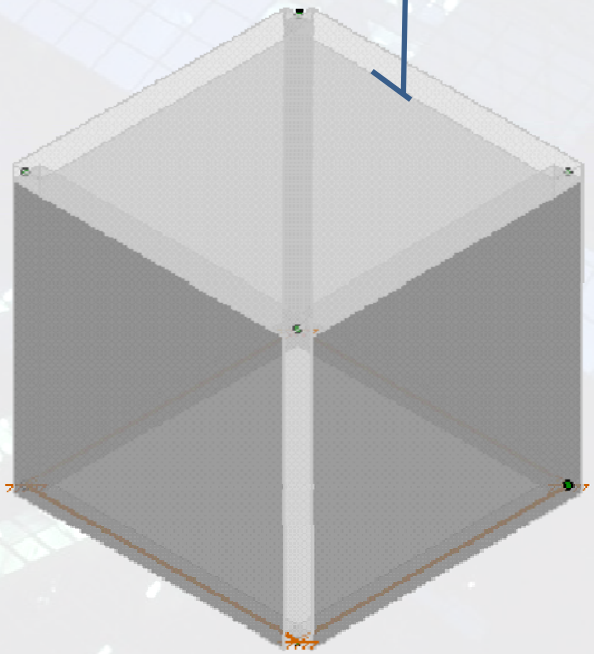
Color coded Rendered view:

Interior = Light Grey

-z

Modify Wall Panels- Flip Axis

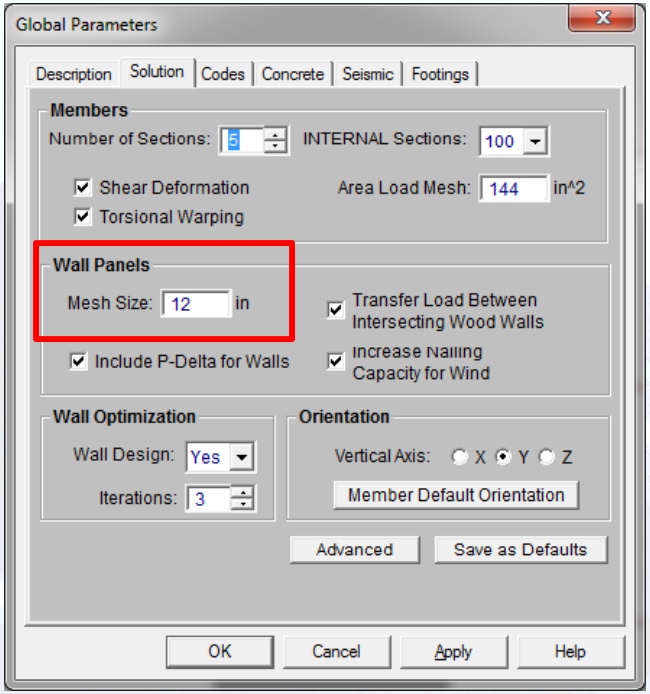


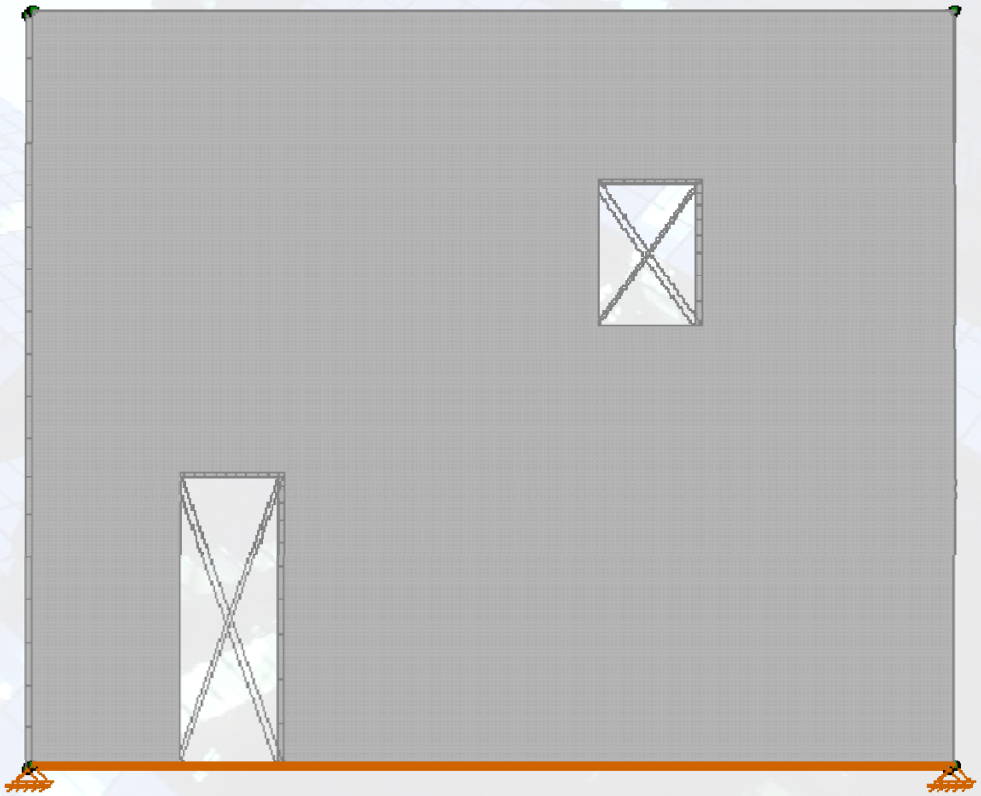


Exterior = Dark Grey

+z

Concrete Wall Modeling


Global Parameters
Description
Solution
Codes
Concrete
Seismic
Footings
Members
Number of Sections: 5
INTERNAL Sections: 100
Shear Deformation
Torsional Warping
Area Load Mesh: 144 in^2
Wall Panels
Mesh Size: 12 in
Transfer Load Between Intersecting Wood Walls
Include P-Delta for Walls
Increase Nailing Capacity for Wind
Wall Optimization
Wall Design: Yes
Iterations: 3
Orientation
Vertical Axis: X Y Z
Member Default Orientation
Advanced
Save as Defaults
OK
Cancel
Apply
Help



Wall FEA

Automatic Meshing

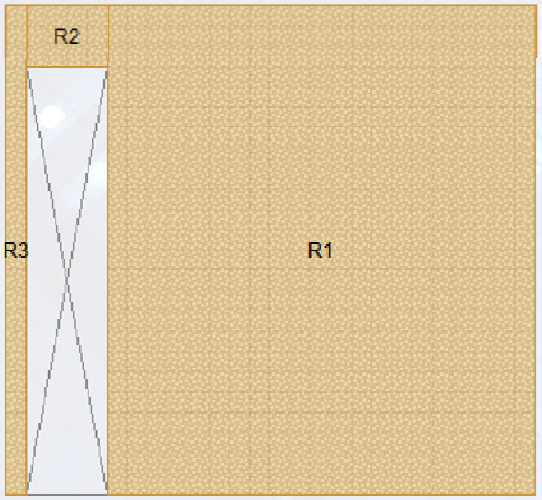
Line or point constraints created in the wall.

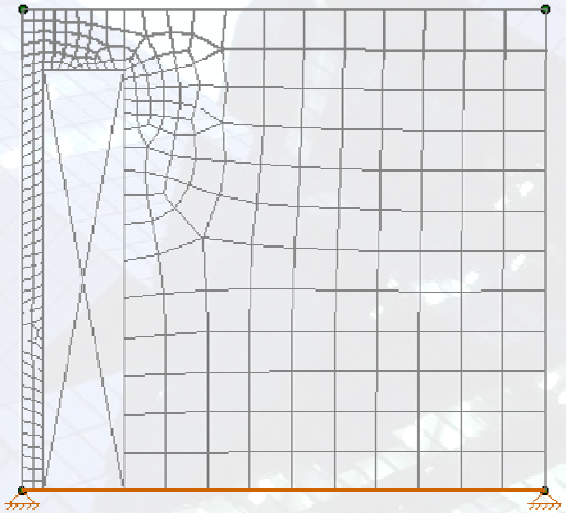
- Openings
- Loads
- Intersected by another wall panel
- Diaphragms
- Beams or plate elements
- Nodes

Wall Mesh

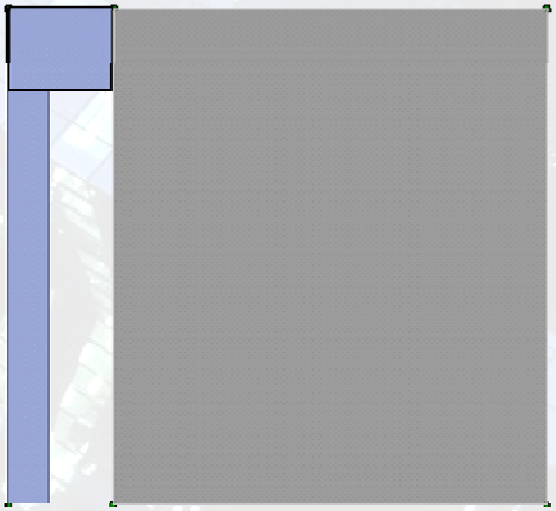
What to Avoid:

- Very narrow regions and openings



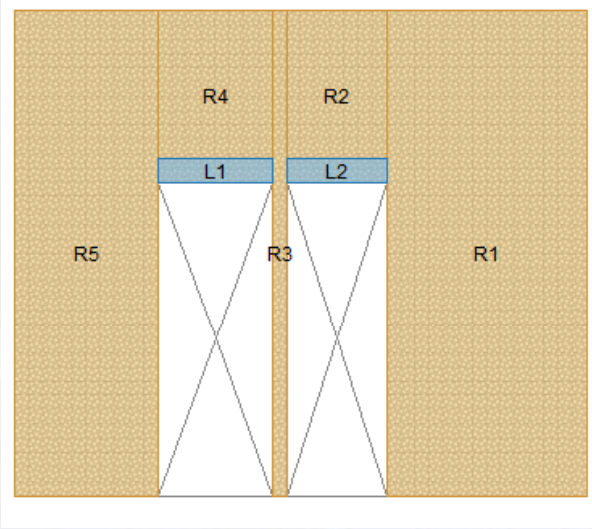


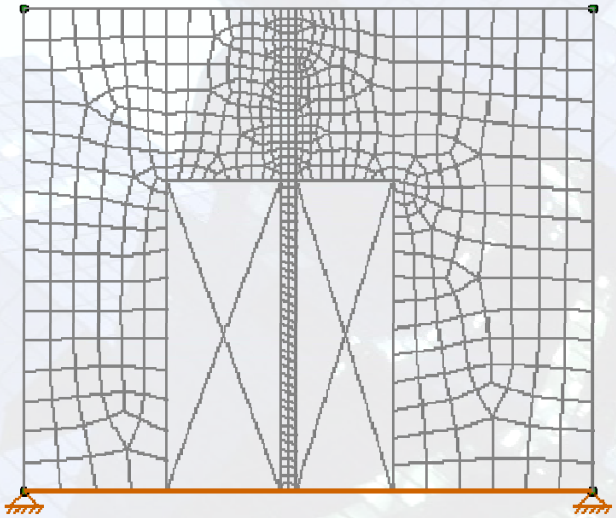
Possible Alternative:



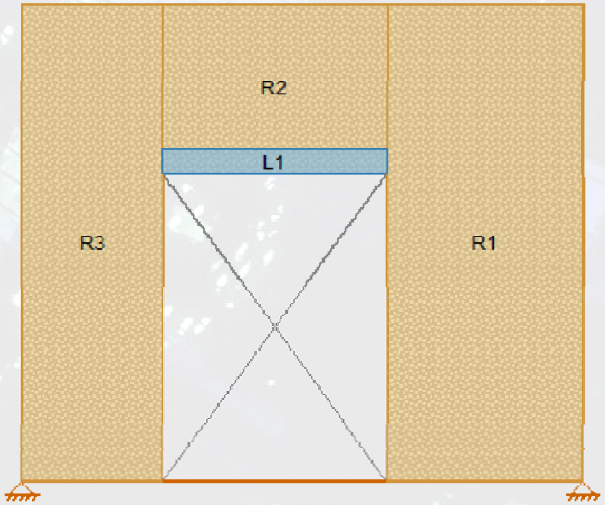
What to Avoid:

- Small offsets between opening edges → Combine the openings



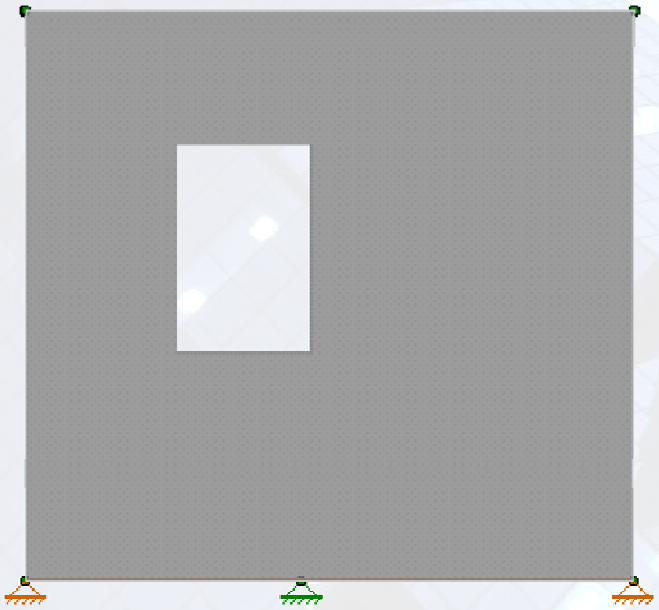


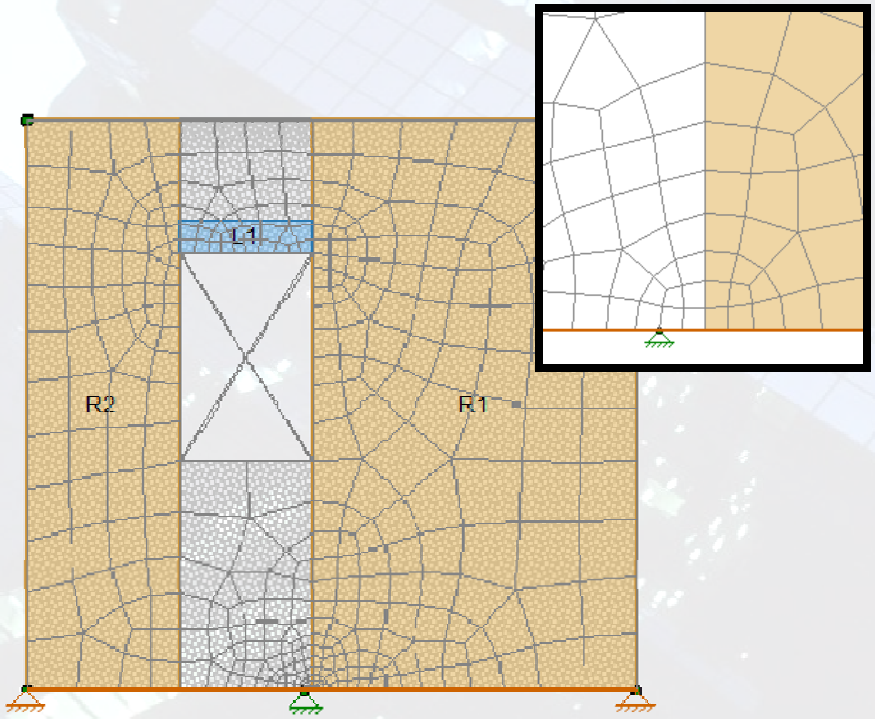
Alternative:



What to Avoid:

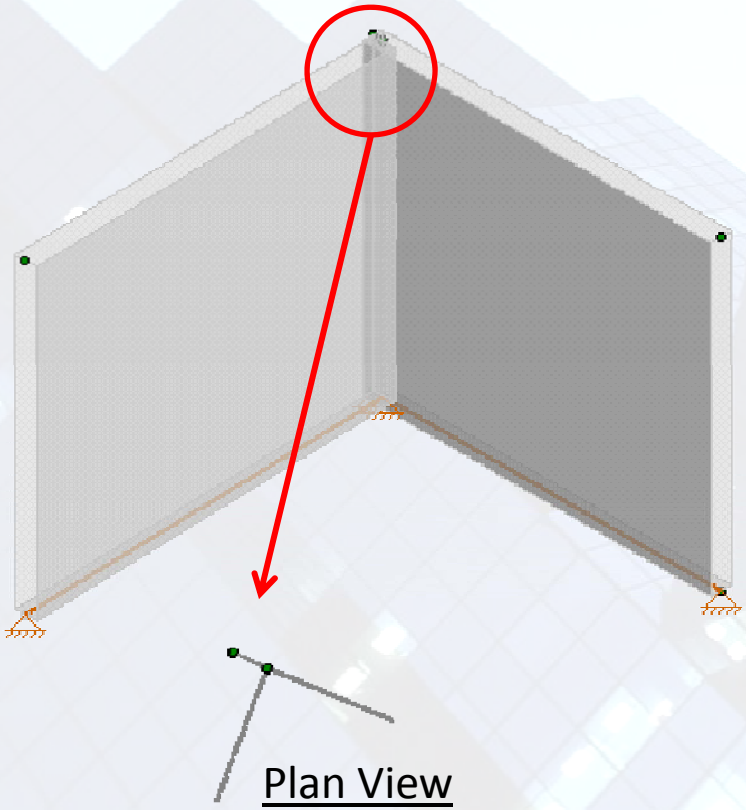
- Small offsets between Regions and External Boundaries conditions.

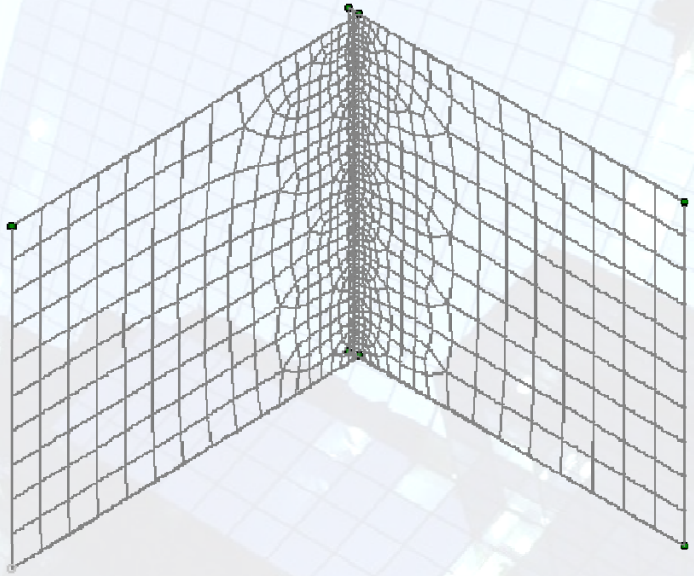




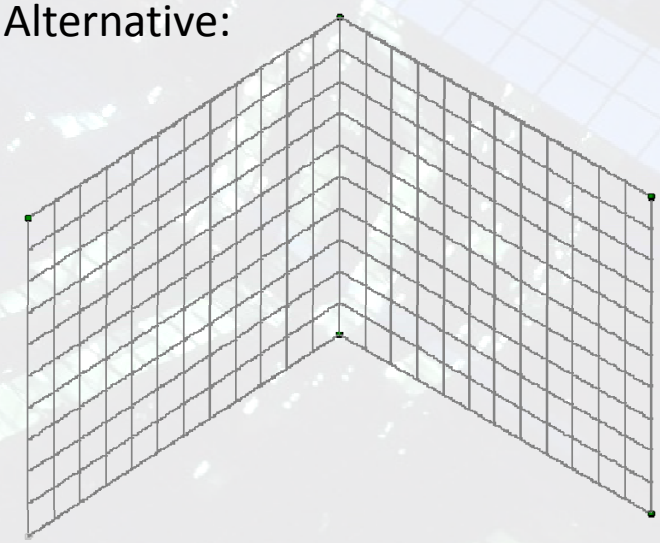
What to Avoid:

- Intersecting wall with very little overlap

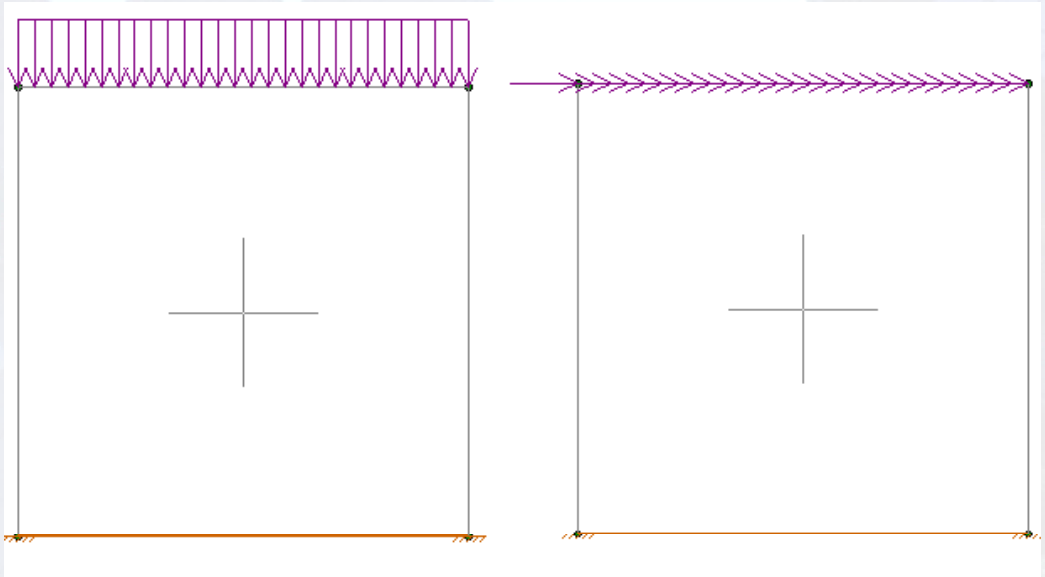




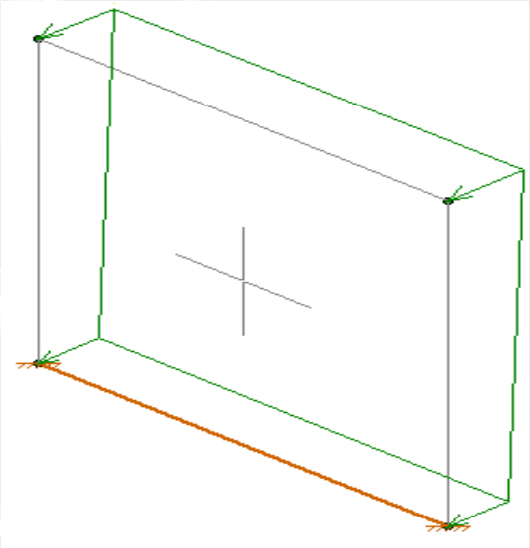
Alternative:



In-Plane:



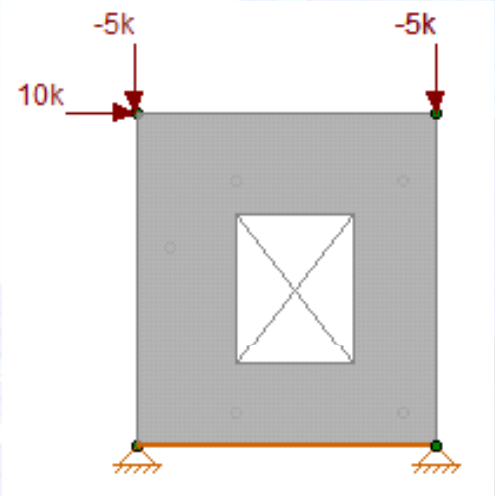
Out of Plane:

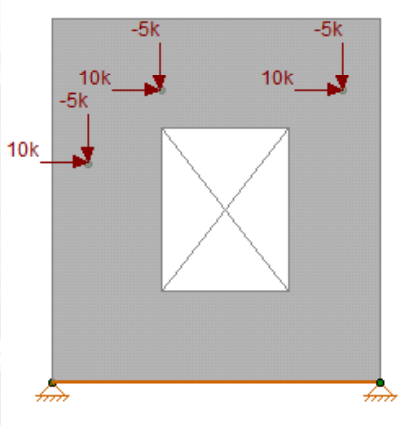


Loads On Walls

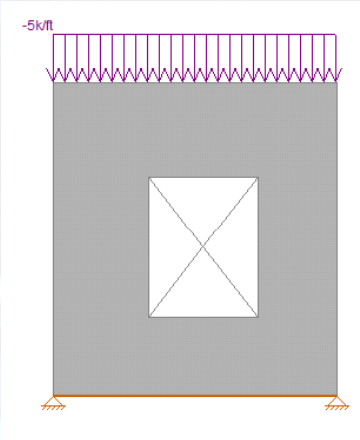
Types of Loading on Walls

- Point Loads





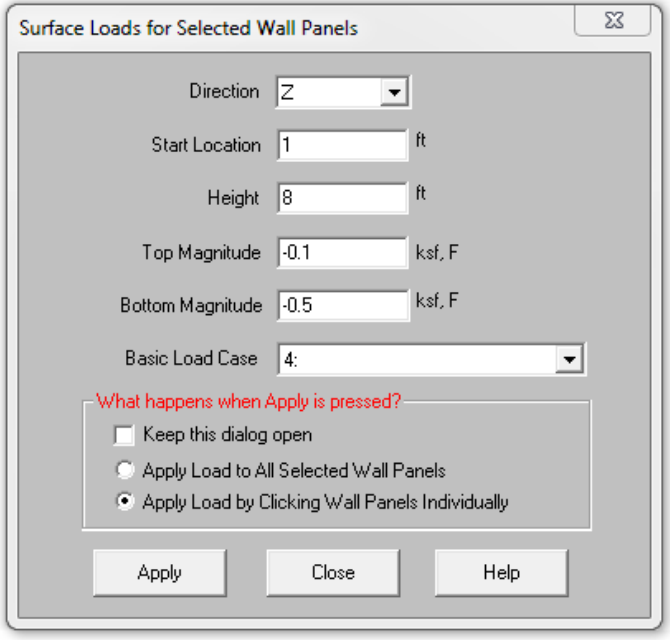
- Distributed Loads

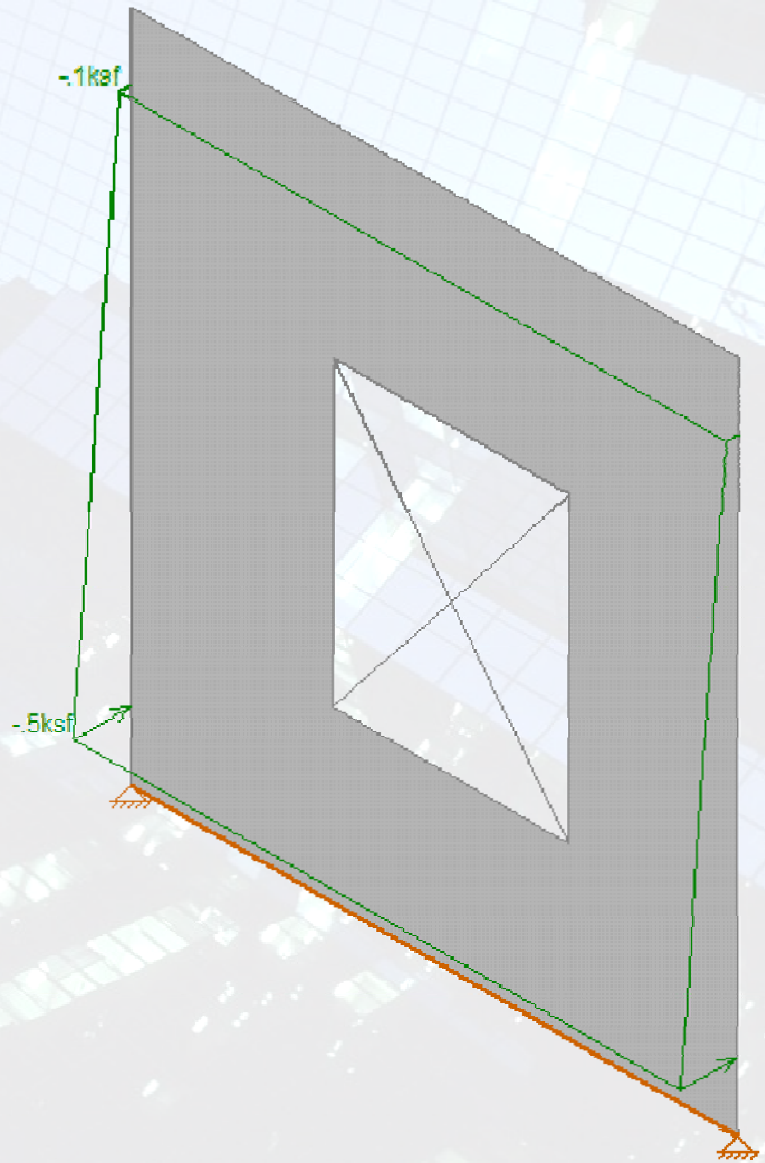


Loads On Walls

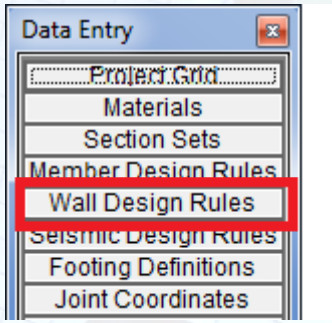
Types of Loading on Walls

- Surface Loads 





Loads On Walls

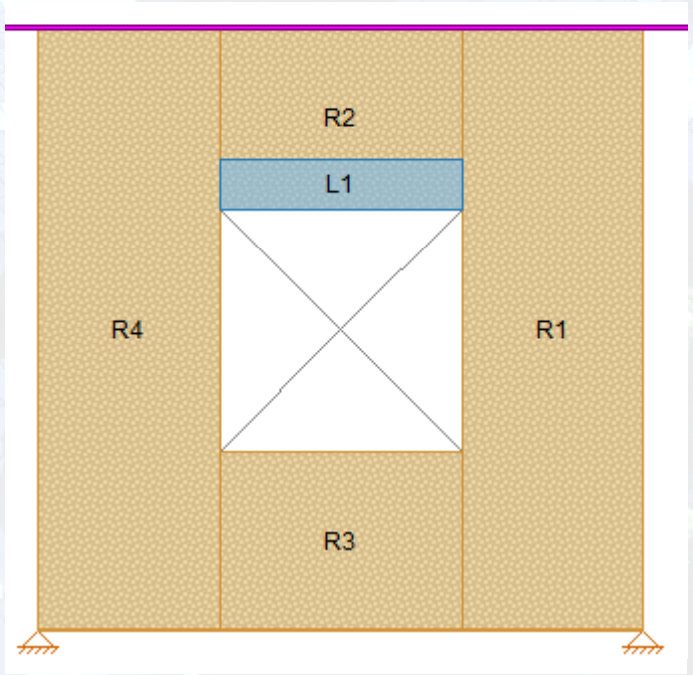


Wall Design Rules

- Rule for ENTIRE wall
- Design = Reinforcement

Regions

- Similar to Design Strips
- Regions missing?

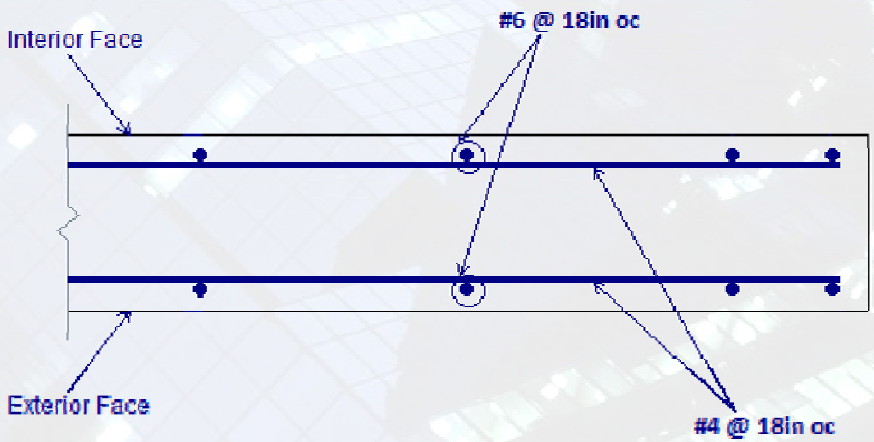


Concrete Wall Design Rules

Concrete Wall Panel Rebar Parameters

Unity Check | Concrete Wall (Rebar) | Concrete Wall (Misc) | Masonry Wall | Masonry In | Masonry Out | Masonry Lintel | Wood Wall (Studs) | Wood Wall (Fasteners)

	Label	Vert Bar Size	Max Vert Bar Spac...	Min Vert Bar Spac...	Vert Bar Inc[in]	Horz Bar Size	Max Horz Bar Spa...	Min Horz Bar Spa...	Horz Bar Inc[in]	Group Wall
1	Typical	#6	18	4	2	#4	18	4	2	☐



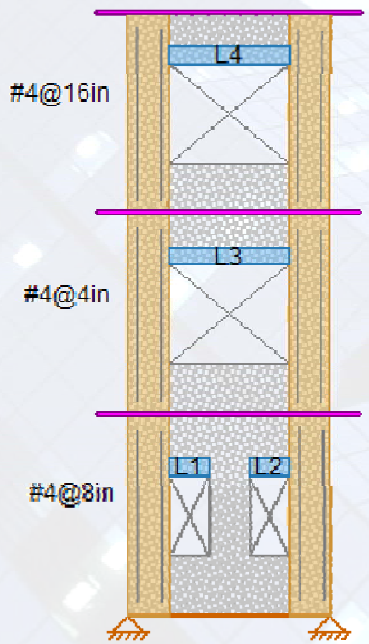
Reinforcement

Concrete Wall Design Rules

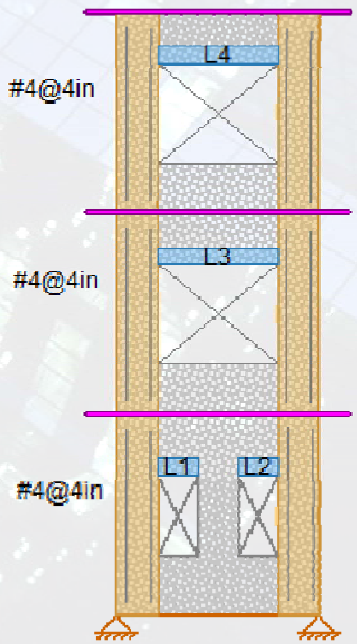
Concrete Wall Panel Rebar Parameters

Unity Check | Concrete Wall (Rebar) | Concrete Wall (Misc) | Masonry Wall | Masonry In | Masonry Out | Masonry Lintel | Wood Wall (Studs) | Wood Wall (Fasteners)

	Label	Vert Bar Size	Max Vert Bar Spac...	Min Vert Bar Spac...	Vert Bar Inc[in]	Horz Bar Size	Max Horz Bar Spa...	Min Horz Bar Spa...	Horz Bar Inc[in]	Group Wall
1	Typical	#6	18	4	2	#4	18	4	2	☑

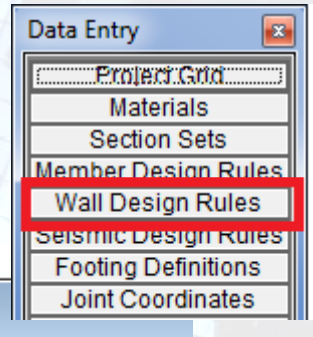


Group Wall → OFF



Group Wall → ON

Concrete Wall Design Rules



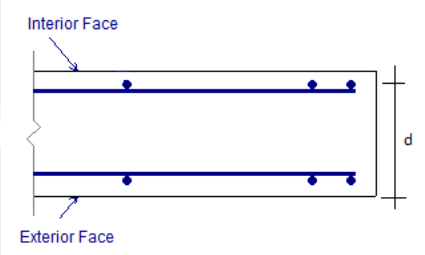
Concrete Wall Panel Cover Parameters

Unity Check | Concrete Wall (Rebar) | Concrete Wall (Misc) | Masonry Wall | Masonry In | Masonry Out | Masonry Lintel | Wood Wall (Studs)

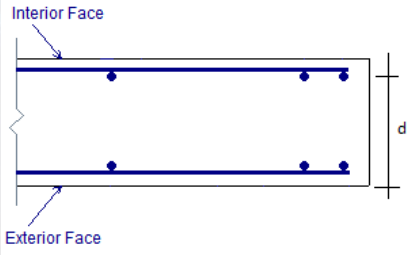
	Label	Outer Bars	Location	In	Cover -z[in]	Ext Cover +z[...	Edge Cover[...	Transfer In	Transfer Out
1	Typical	Vertical	Each Face		1	1	2	☐	☐

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

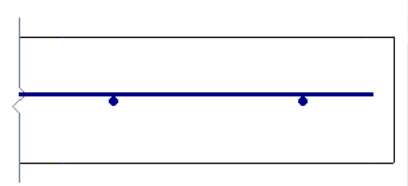
Vertical



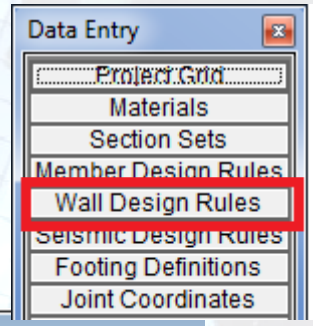
Horizontal

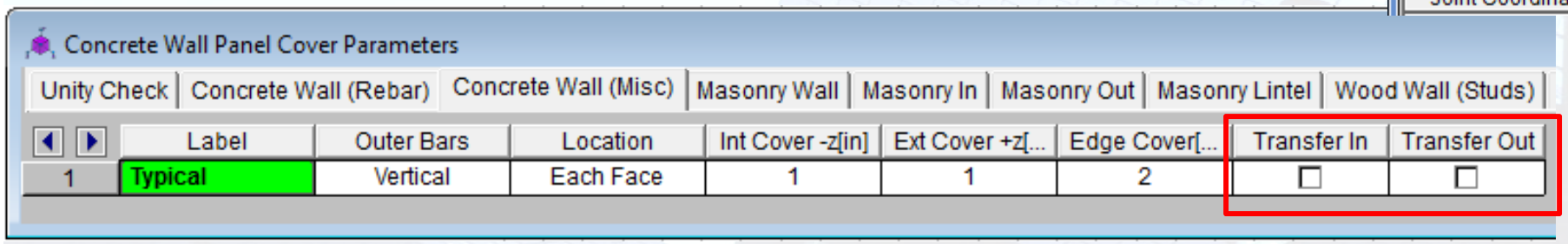


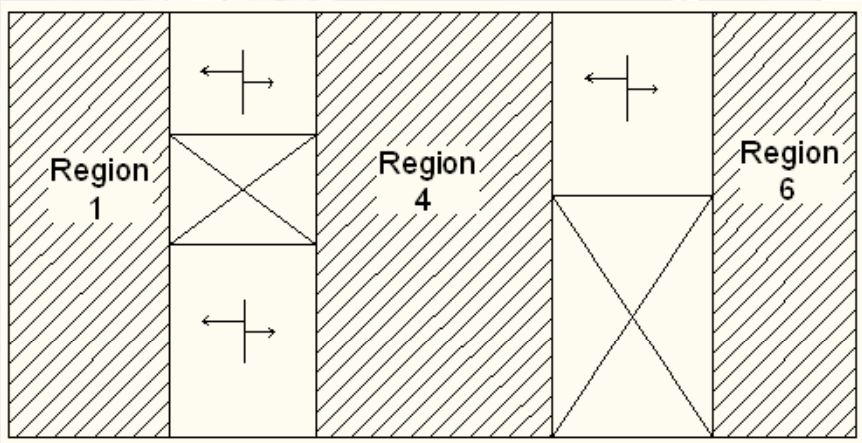
Centered



Concrete Wall Design Rules







Transfer Turned On

Concrete Wall Design Rules

What sections of the ACI apply to walls?

Section 7.6 General Reinforcement Spacing Requirements

7.6.1 minimum spacing requirements

7.6.5 maximum spacing requirements

Section 14.3 Wall Reinforcement Requirements

14.3.2 &.3 minimum reinforcement ratios requirements

14.3.4 thickness requirements

proportioning and cover checks

14.3.5 maximum spacing requirements

Section 11.9.8 and 11.9.9 Shear Reinforcement Requirements for Walls

11.9.8 if the Vu exceeds 0.5*ϕ*Vc

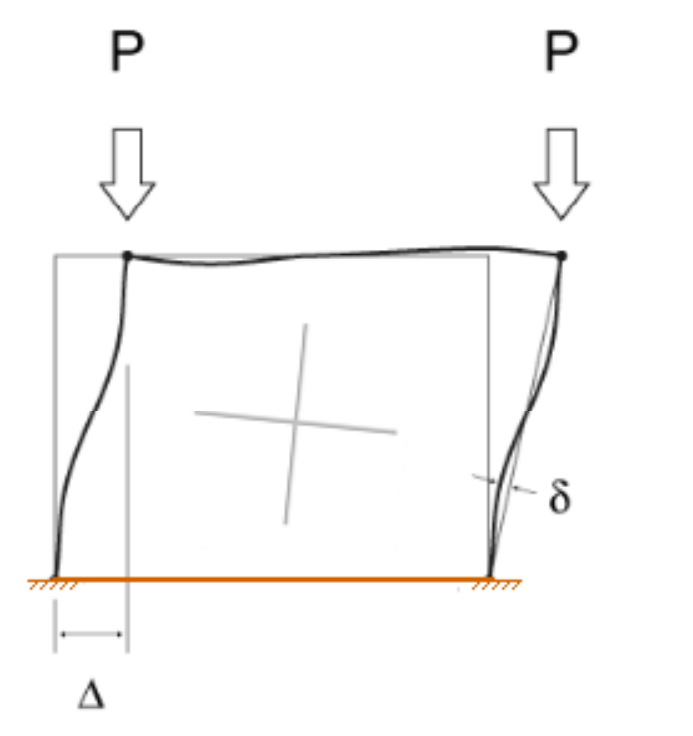
11.9.9

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)

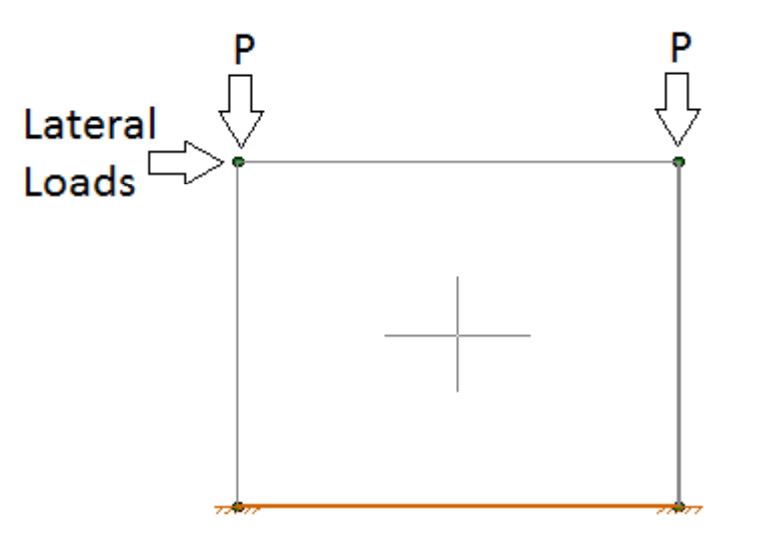


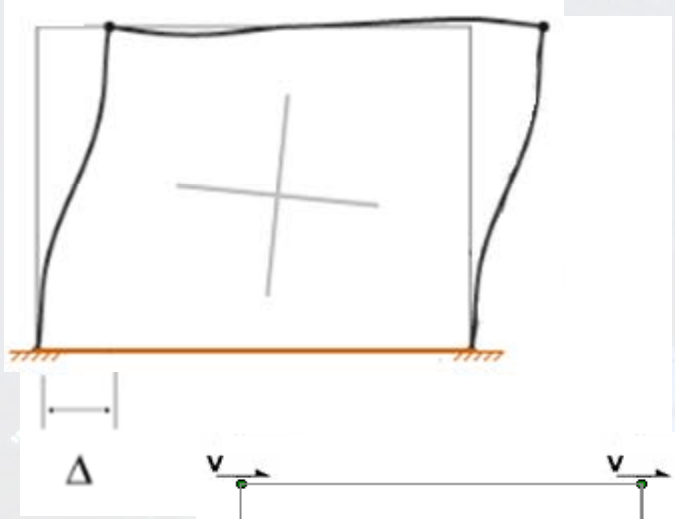
P-Delta

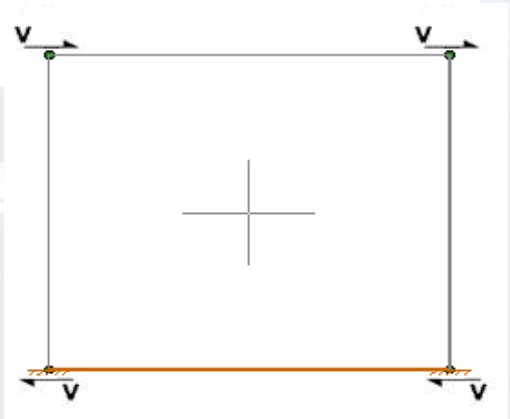
What is P-Delta in RISA?

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

As the wall is loaded, it deflects.







Secondary Shears:

$$V = \frac{P\ (\text{Axial Force}) \times \Delta}{\text{Ht of Wall}}$$

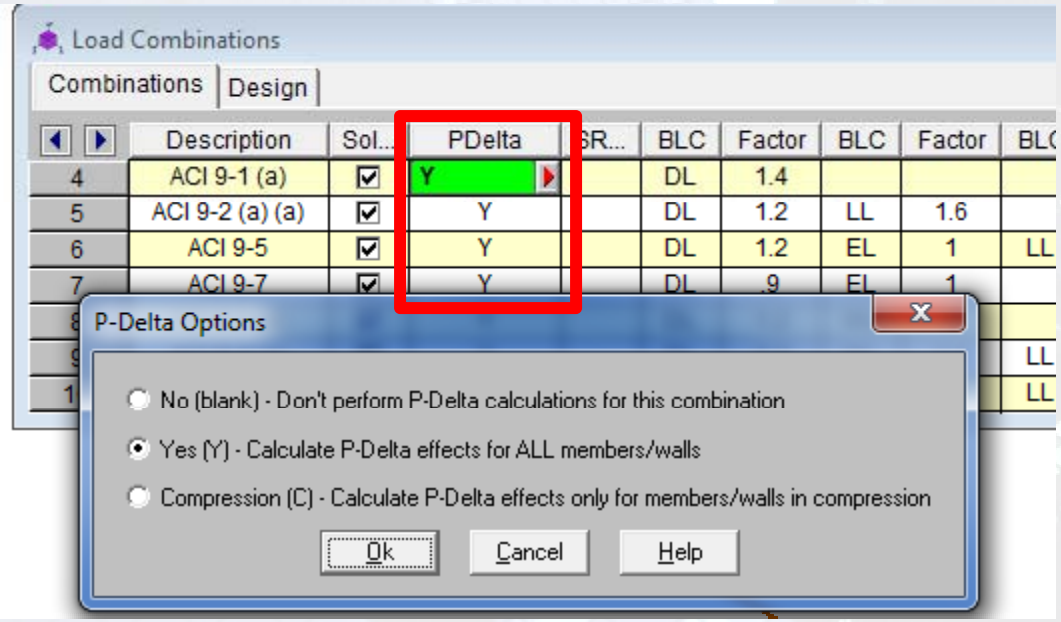
P-Delta

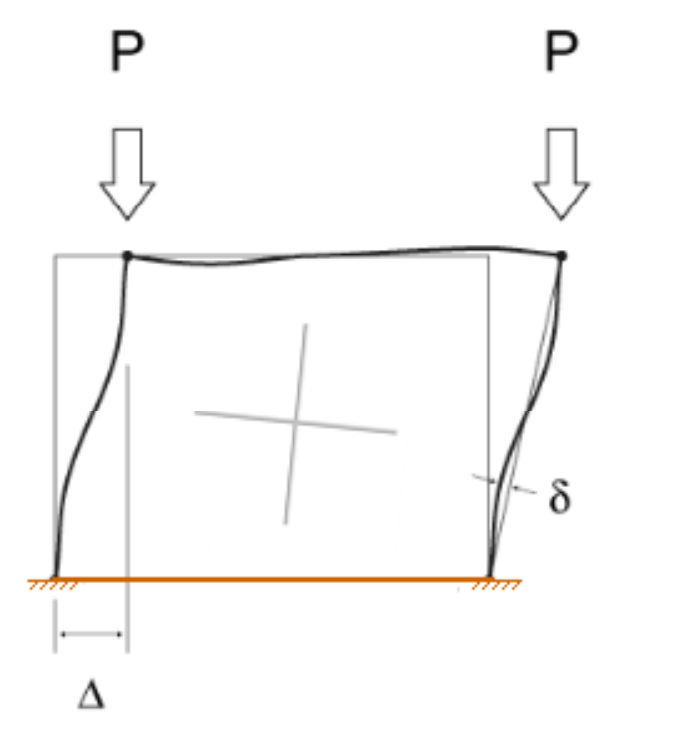
Wall P-Delta

Δ - delta

δ - delta

➢ Turn on the PDelta Check for all Load Combinations



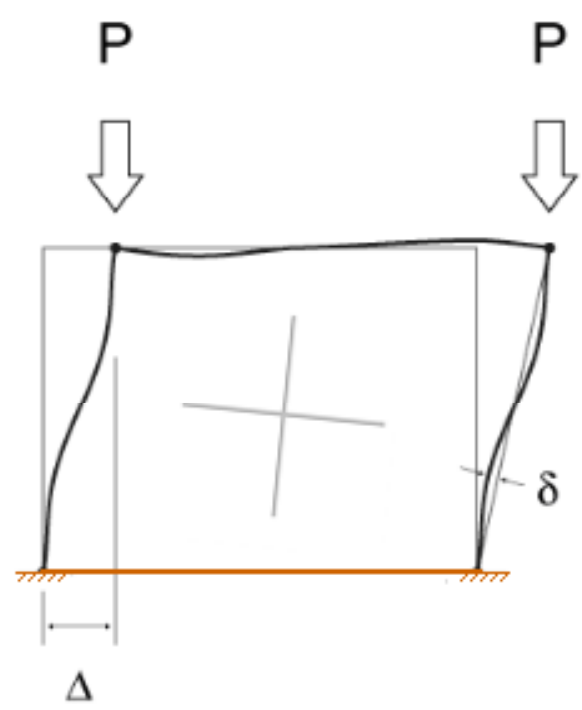


Big P-Delta

Little P-Delta

Element Curvature Effects

δ - delta



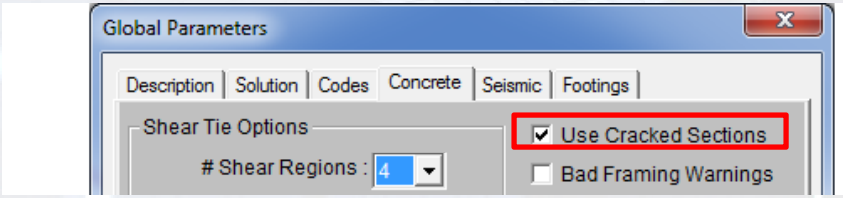
Only Required for Slender walls to account for:

- Influence of Axial Loads
- Presence of Cracked regions
- Effects of load duration

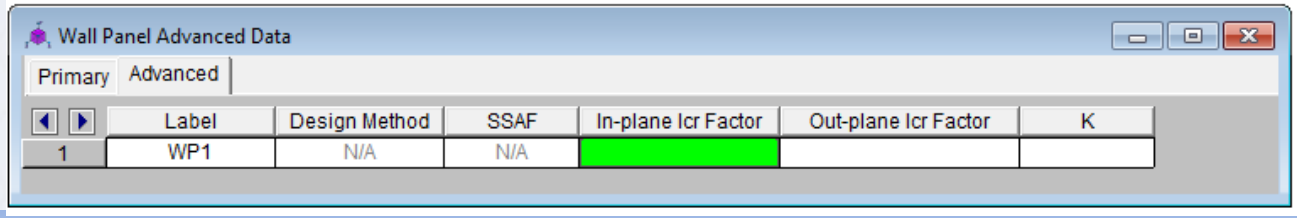
Little P-Delta

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

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

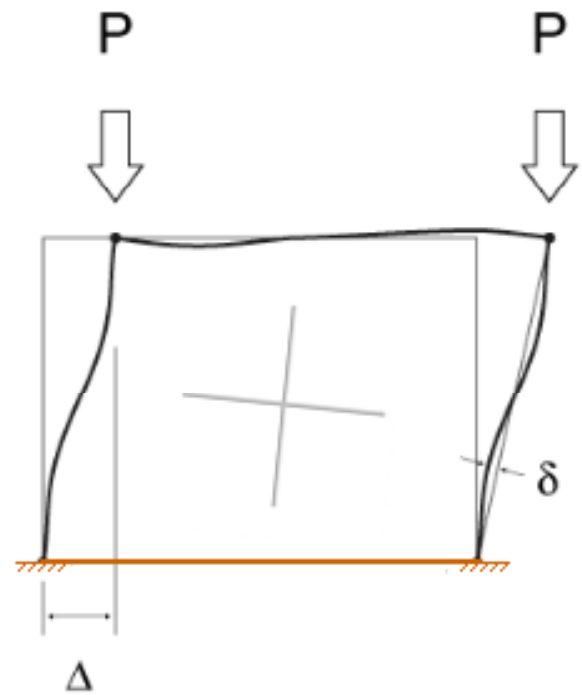
For further information, contact us at: webinar@risatech.com

Presenter: Deborah Brisbin, P.E.

First Check Wall Slenderness

Slender $\frac{kl_u}{r} \leq 22$ **(Eq. 10-6)**

l_u = full ht of wall or segments between diaphragms



Yes or **No** → **Little P-Delta not required**

Moment Magnification (10.10.6)

$EI = 0.25E_cI_g$ From Commentary

Minimum Moment per 10.10.6.5 (M2,min)

Little P-Delta