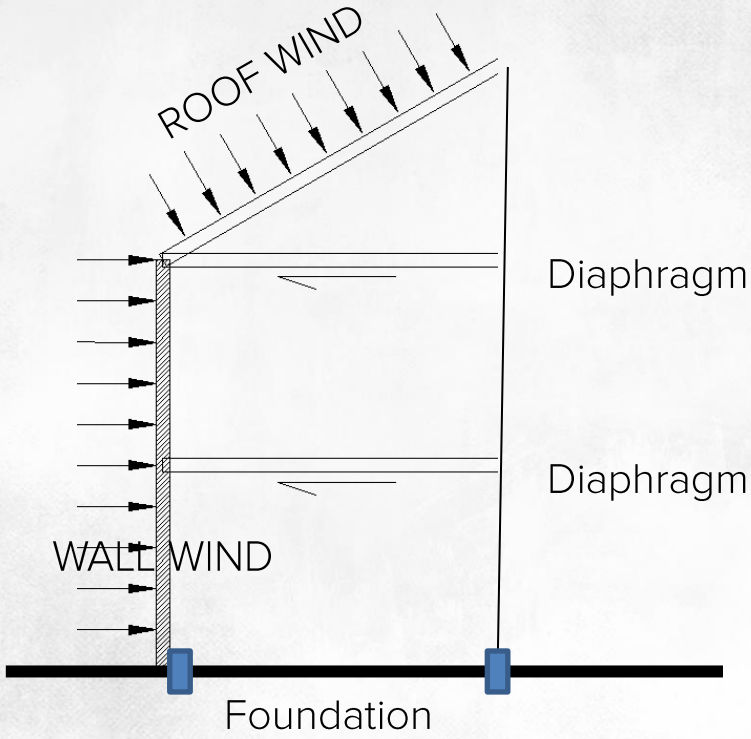
# SEMI-RIGID DIAPHRAGMS

Debbie Penko, P.E.

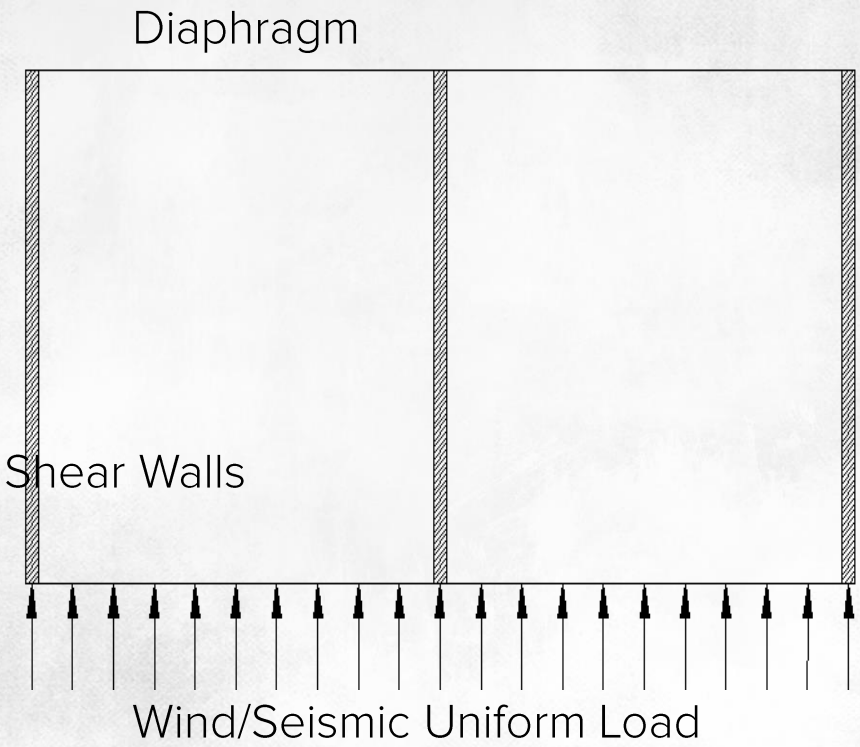
# OVERVIEW

- Lateral Load Path
- Diaphragm Behavior
- Diaphragms in RISA
- Example Models

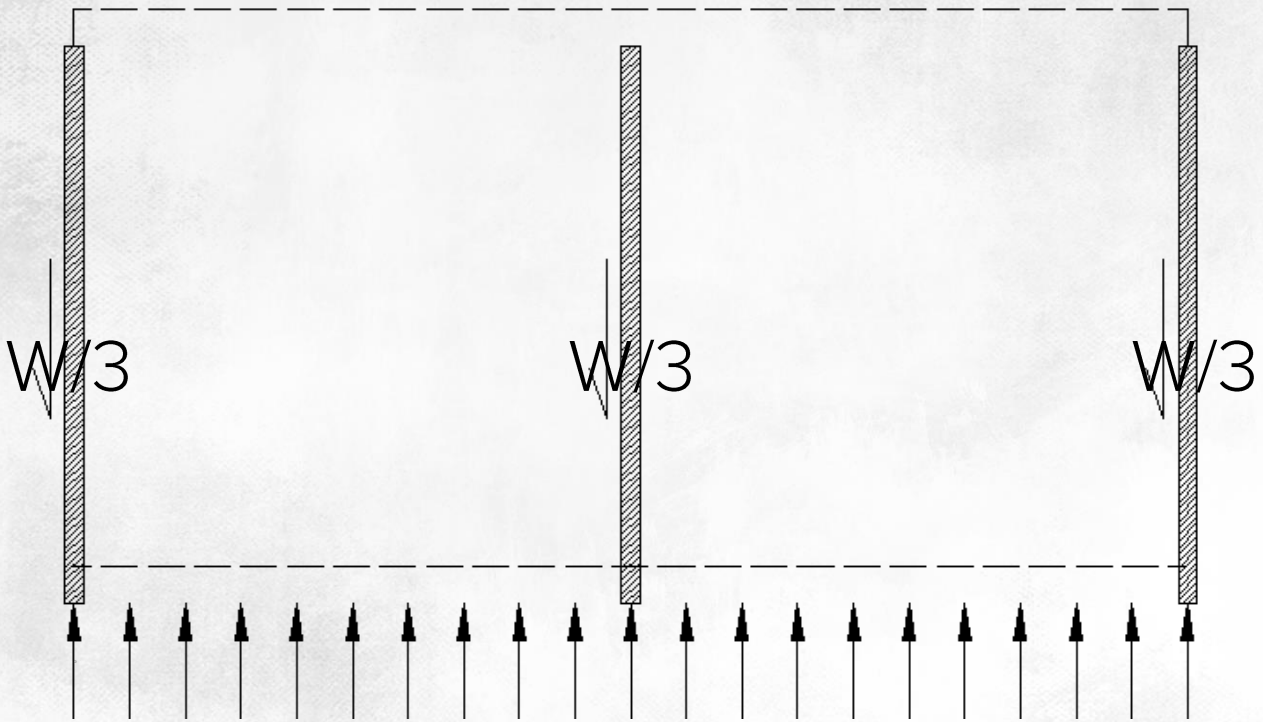
# LOAD PATH ILLUSTRATED



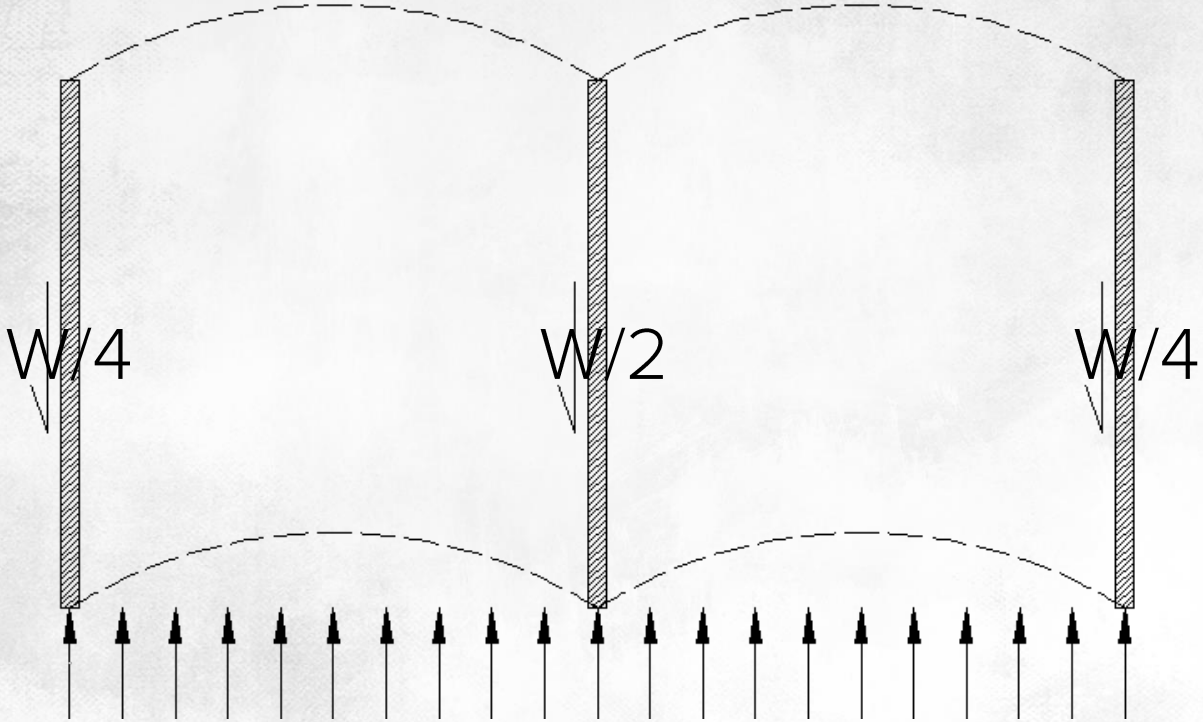
# DIAPHRAGM EXAMPLE



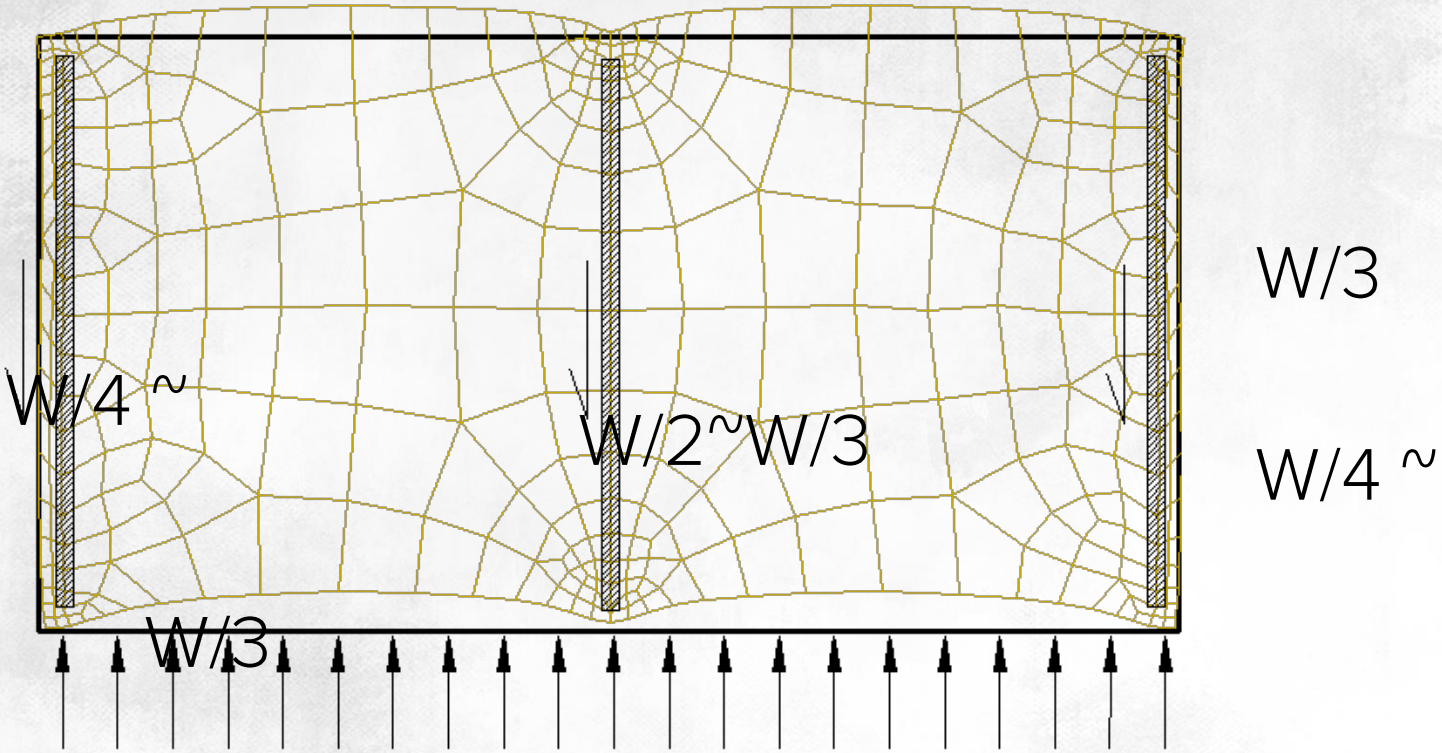
# RIGID DIAPHRAGM



# FLEXIBLE DIAPHRAGM

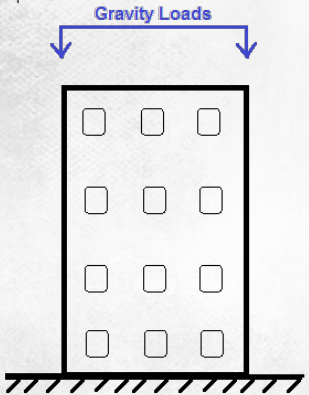


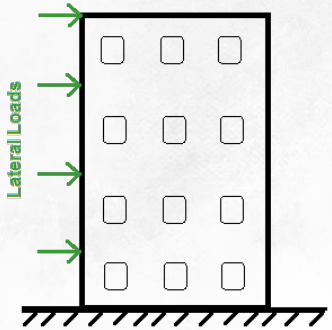
# SEMI-RIGID DIAPHRAGM



# HOW DOES RISA SYSTEM WORK?

FL | RISAFloor → RISA Calculates Lateral Loads → 3D | RISA-3D




Automated Diaphragms:

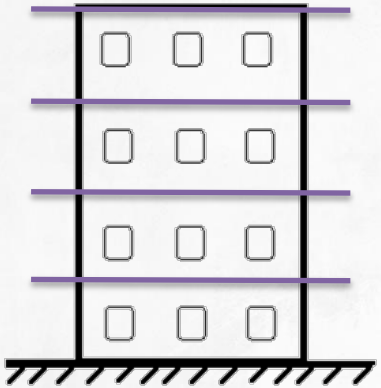
Semi-Rigid: Concrete Floor

Flexible: Beam Supported

Rigid: Beam Supported, Concrete Floor

# HOW DOES RISA SYSTEM WORK?

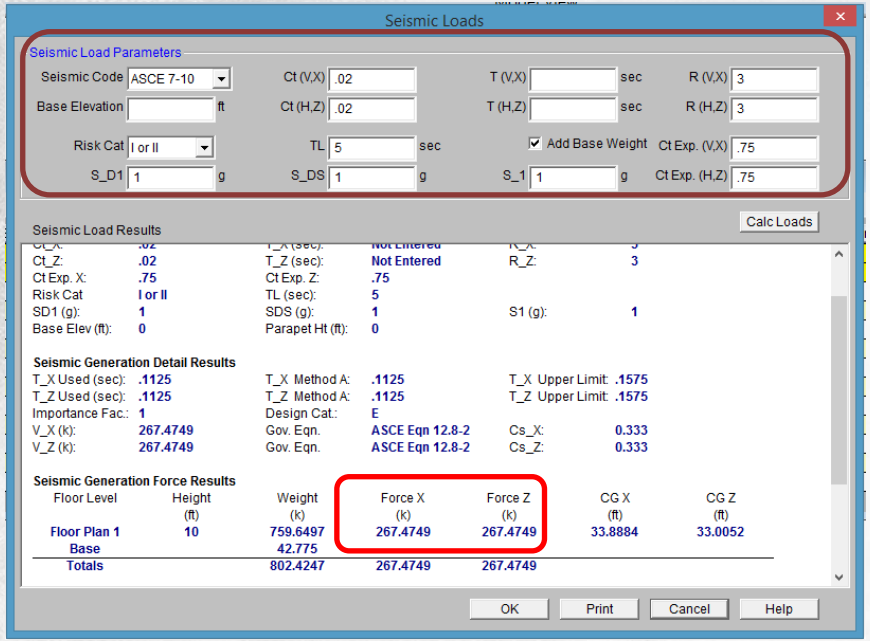
RISA-3D

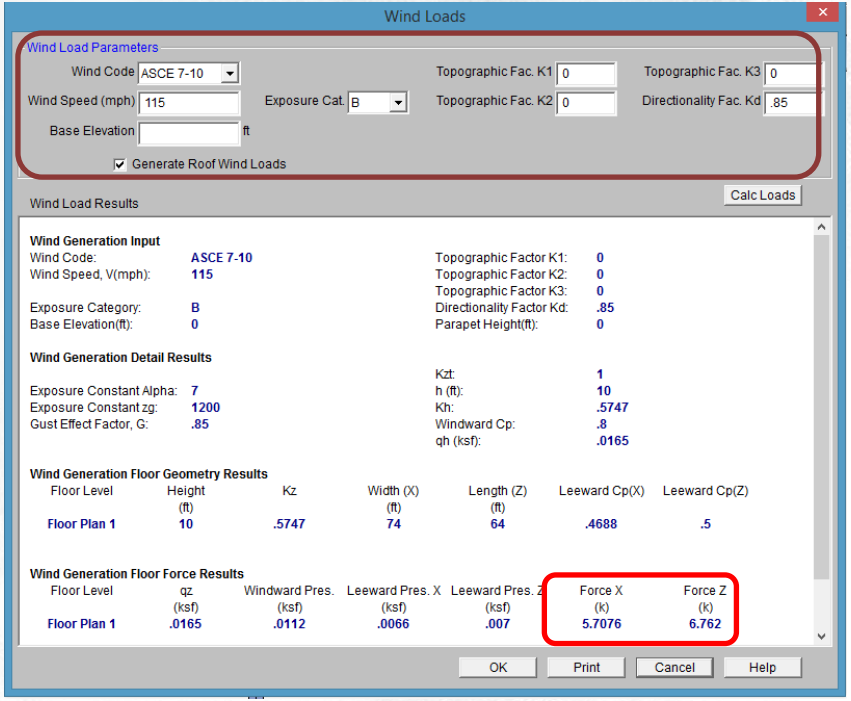


Automated Diaphragms:

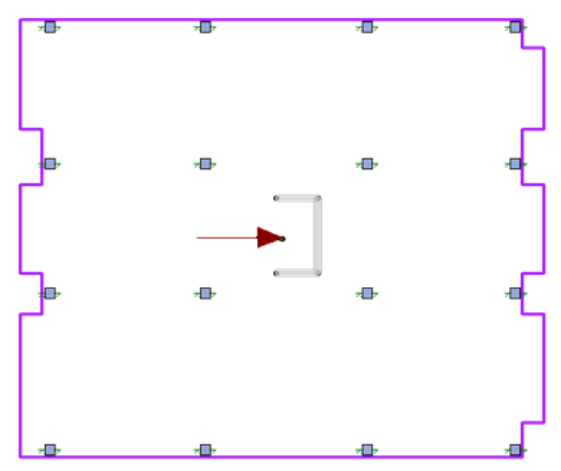
Rigid

# AUTOMATED LATERAL LOAD CALCULATION

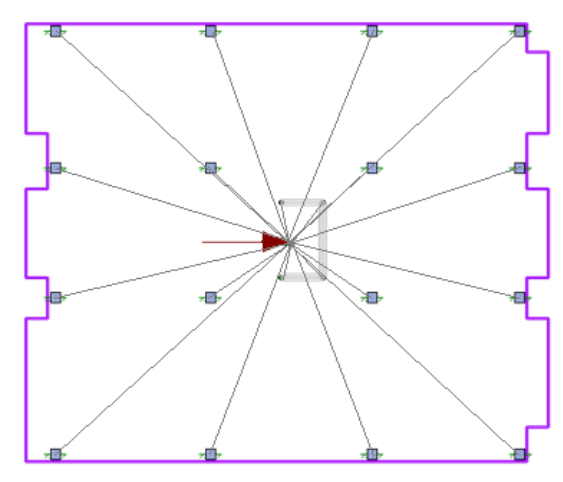


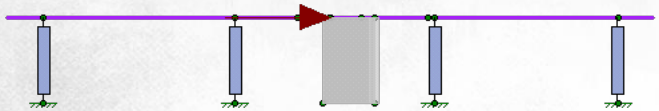
# RIGID DIAPHRAGM – LOAD APPLICATION



Plan View

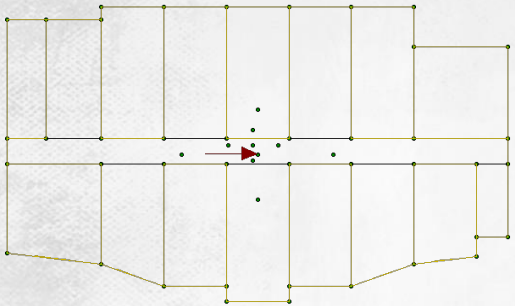


Internally- Rigid Links

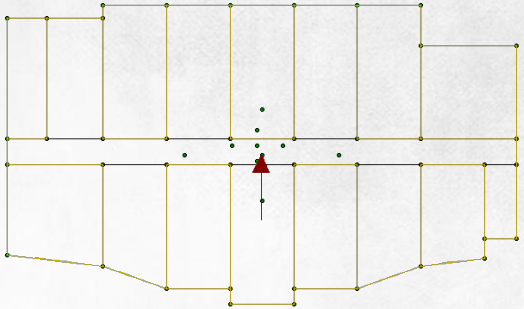


Elevation View

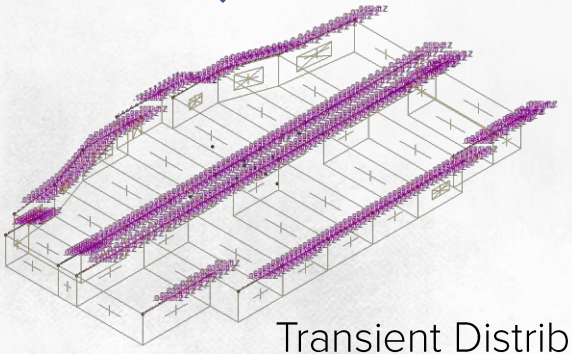
# FLEXIBLE DIAPHRAGM – LOAD APPLICATION

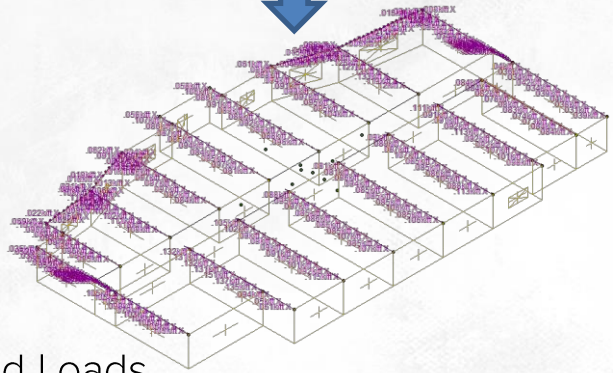


Wind Loads in Z direction (WLZ)



Wind Loads in X direction (WLX)

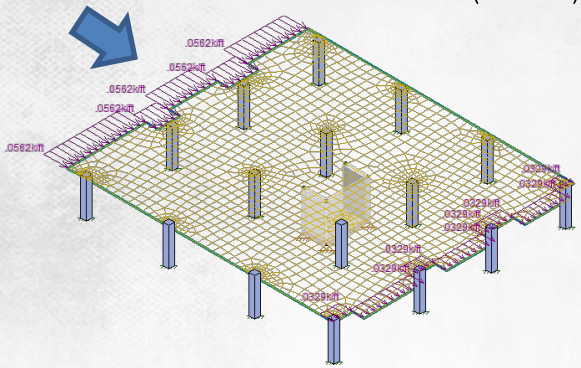




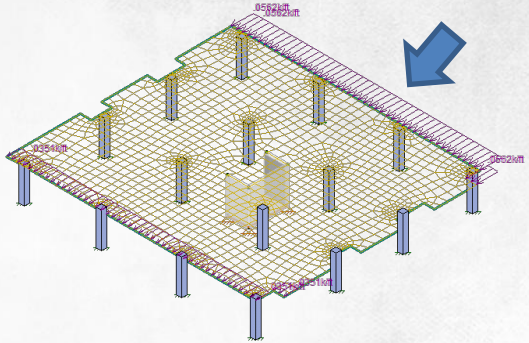
Transient Distributed Loads

# SEMI-RIGID DIAPHRAGM – WIND LOAD

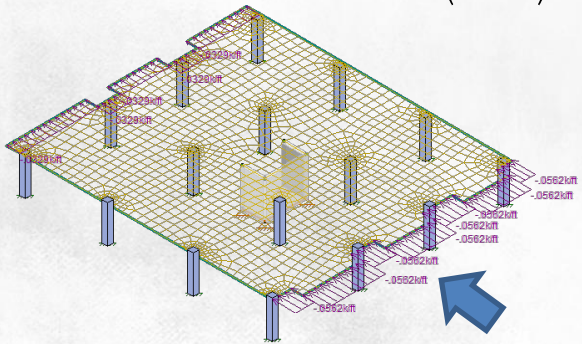
Wind Loads in +X direction (WL+X)



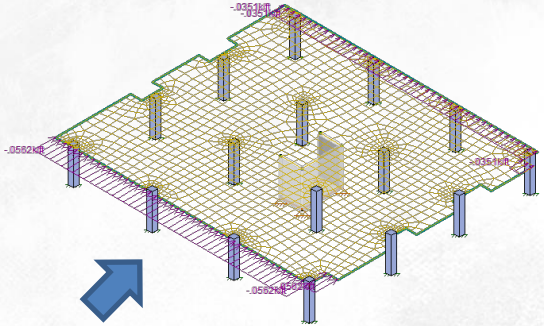
Wind Loads in +Z direction (WL+Z)



Wind Loads in -X direction (WL-X)

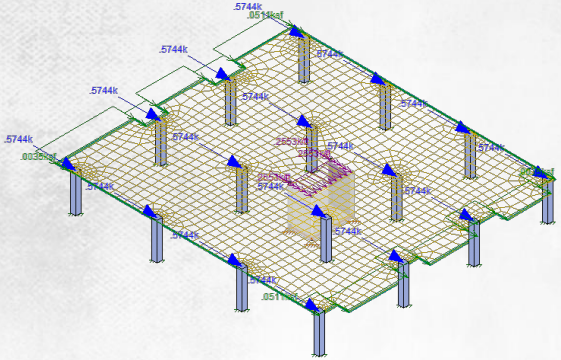


Wind Loads in -Z direction (WL-Z)

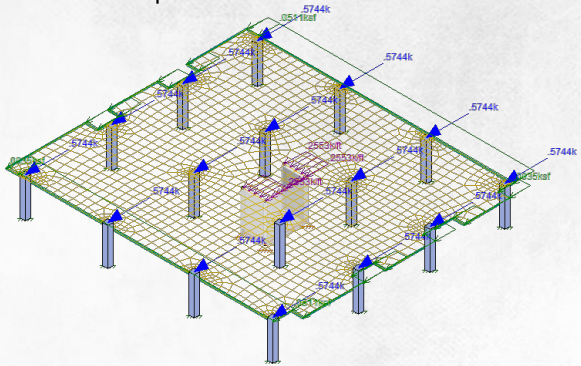


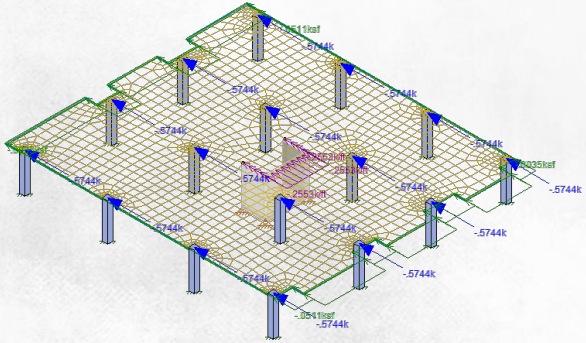
# SEMI-RIGID DIAPHRAGM – EARTHQUAKE LOAD

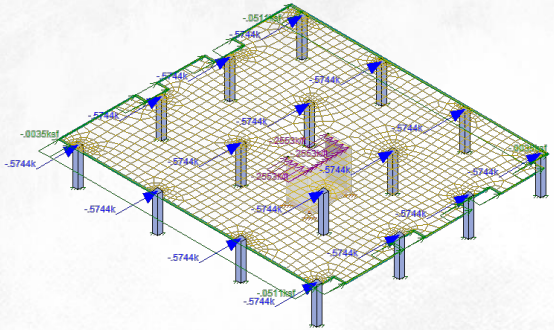
Earthquake Loads in ELX



Earthquake Loads in ELZ







# SEMI-RIGID LATERAL LOADS

Basic Load Cases

| | BLC Description | Category | X Gravity | Y Gravity | Z Gravity | Joint | Point | Distrib... | Area(M... | Surfac... |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Dead Load | DL (Deac | | -1 | | | | | | 1 |
| 2 | Live Load | LL | | | | | | | | 1 |
| 3 | Live Load Special (public ass | LLS | | | | | | | | |
| 4 | Roof Live Load | RLL | | | | | | | | |
| 5 | Snow Load | SL | | | | | | | | |
| 6 | Snow Load Nonshedding | SLN | | | | | | | | |
| 7 | Rain Load | RL | | | | | | | | |
| 8 | Wind Load X | WLX | | | | | | | | |
| 9 | Partial X Wind Load 1 | WLXP1 | | | | | | | | |
| 10 | Partial X Wind Load 2 | WLXP2 | | | | | | | | |
| 11 | Wind Load Z | WLZ | | | | | | | | |
| 12 | Partial Z Wind Load 1 | WLZP1 | | | | | | | | |
| 13 | Partial Z Wind Load 2 | WLZP2 | | | | | | | | |
| 14 | Earthquake Load X | ELX | | | | | 16 | 3 | | 2 |
| 15 | Earthquake Load X Plus Z Ec | ELX+Z | | | | | 16 | 3 | | 2 |
| 16 | Earthquake Load X Minus Z E | ELX-Z | | | | | 16 | 3 | | 2 |
| 17 | Earthquake Load Z | ELZ | | | | | 16 | 3 | | 2 |
| 18 | Earthquake Load Z Plus X Ec | ELZ+X | | | | | 16 | 3 | | 2 |
| 19 | Earthquake Load Z Minus X E | ELZ-X | | | | | 16 | 3 | | 2 |
| 20 | Other Load 1 | OL1 | | | | | | | | |
| 21 | Other Load 2 | OL2 | | | | | | | | |
| 22 | Other Load 3 | OL3 | | | | | | | | |
| 23 | Other Load 4 | OL4 | | | | | | | | |
| 24 | Wind Load Roof +X | WLX+R | | | | | | | | |
| 25 | Wind Load Roof -X | WLX-R | | | | | | | | |
| 26 | Wind Load Roof +Z | WLZ+R | | | | | | | | |
| 27 | Wind Load Roof -Z | WLZ-R | | | | | | | | |
| 28 | Semi-Rigid Wind Load +X | WL+X | | | | | | 13 | | |
| 29 | Semi-Rigid Wind Load -X | WL-X | | | | | | 13 | | |
| 30 | Semi-Rigid Wind Load +Z | WL+Z | | | | | | 6 | | |
| 31 | Semi-Rigid Wind Load -Z | WL-Z | | | | | | 6 | | |

Load Combination Generator - Wind

Gravity | Wind | Seismic

LC Region: United States

LC Code: 2012 IBC Strength

Wind Load Options

- Reversible
- None
- 2D Only
- X and Z
- X and Z w/Ecc
- X and Z w/Ecc, Quart

- Generate Roof Wind Loads?
- Generate Semi-Rigid Diaphragm Loads?
- Add Notional Loads to Wind Load Combinations?

RLL Options: RLL, SL, RL

Save as Defaults

Generate | Close | Help

Load Combination Generator - Seismic

Gravity | Wind | Seismic

LC Region: United States

LC Code: 2012 IBC Strength

Seismic Load Options

- Reversible
- Include ρ
- Include Ev (vertical)
- Include Non Ortho (100%+30%)
- None
- 2D Only
- X and Z
- X and Z w/Ecc

- Add Notional Loads to Seismic Load Combinations?

Overstrength LC Options

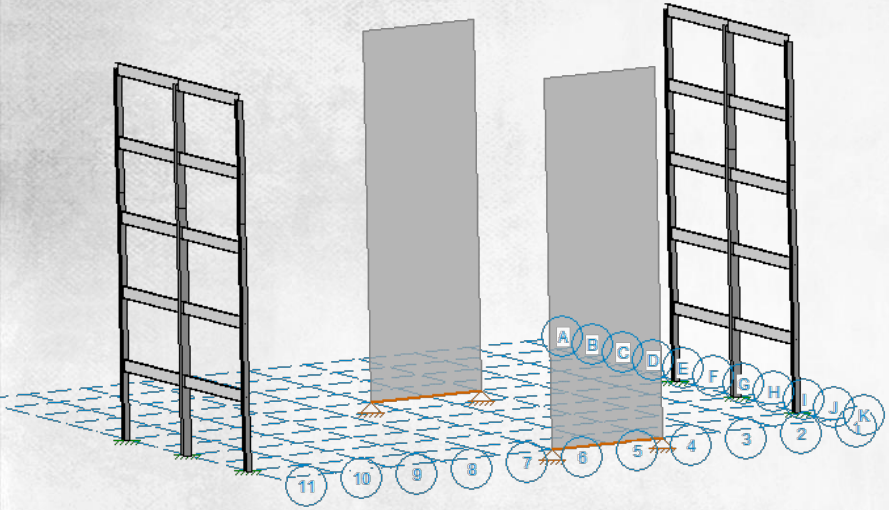
- Reversible
- Include Ev (vertical)
- Include Non Ortho (100%+30%)
- None
- 2D Only
- X and Z
- X and Z w/Ecc

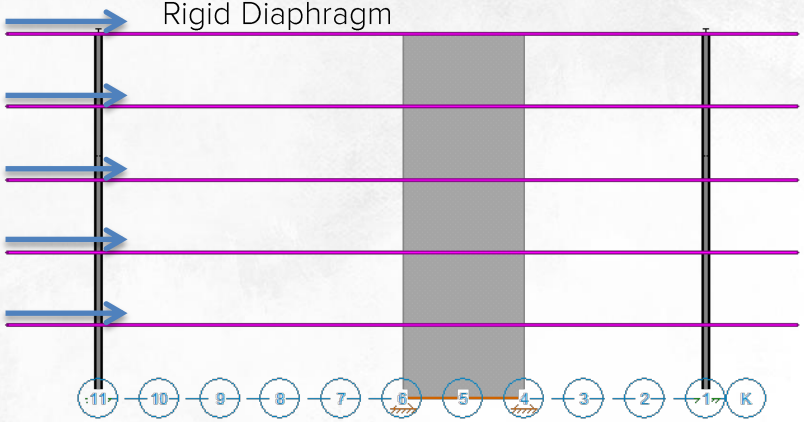
RLL Options: None

Save as Defaults

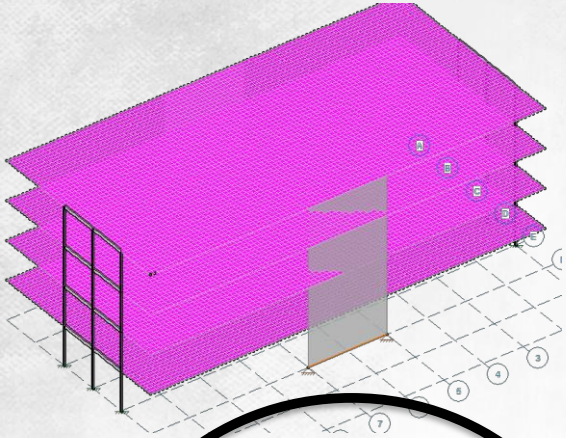
Generate | Close | Help

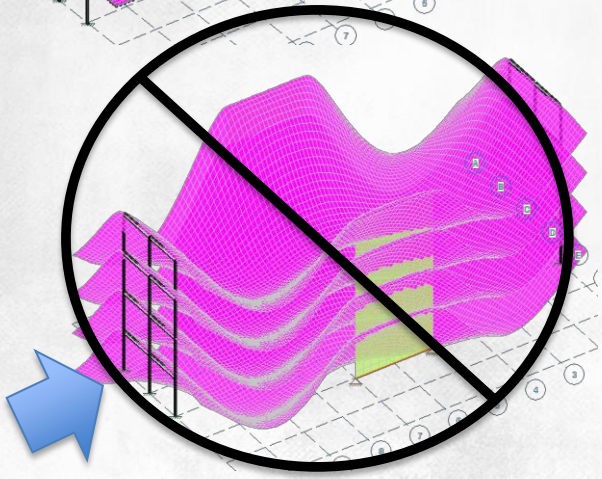
# MODELING TIP- RIGID



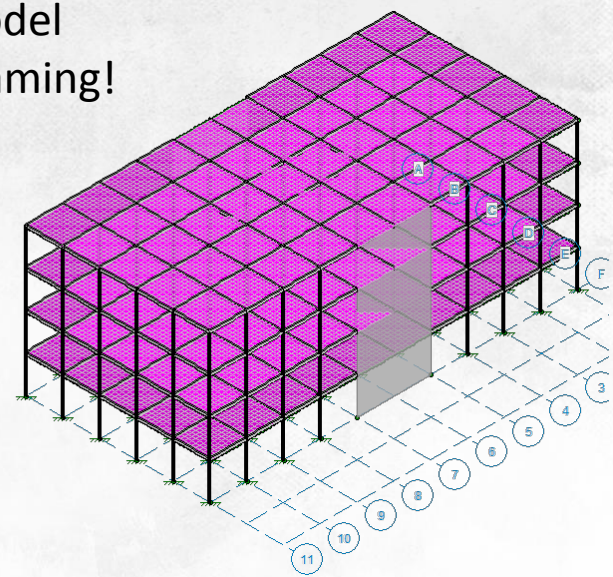



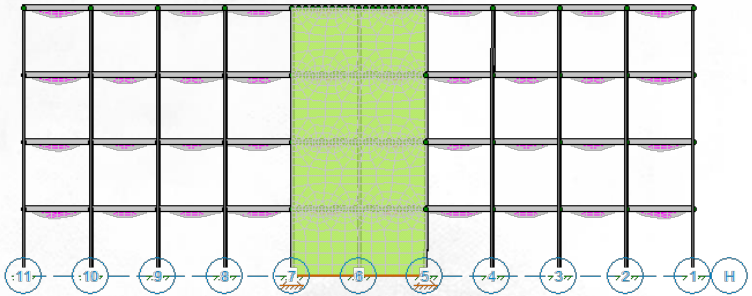
# MODELING TIP- SEMI



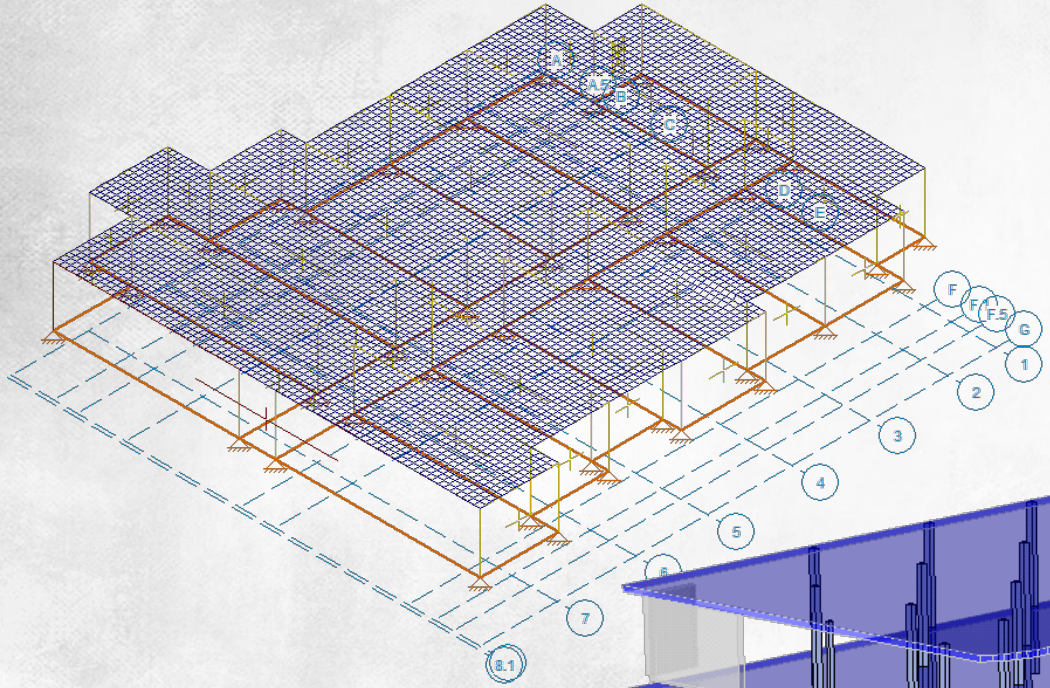


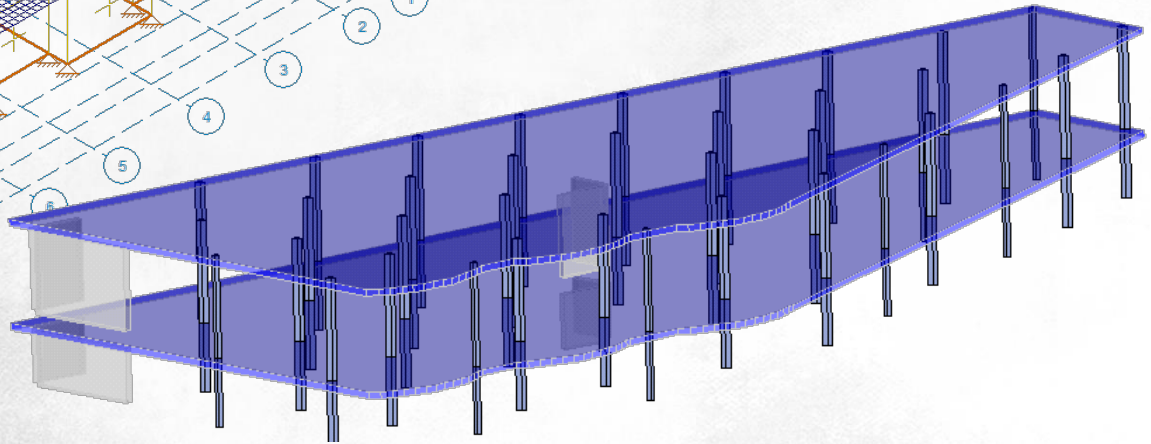
Model
All Framing!





# LET'S REVIEW SOME MODELS



# QUESTIONS?

**Please let us know if you have questions**

- We will answer questions for the next 5 minutes
- Once the webinar is closed, we will post all Q&A's at **risa.com**
- For further information, contact us at **info@risa.com**