Loads in RISA-3D

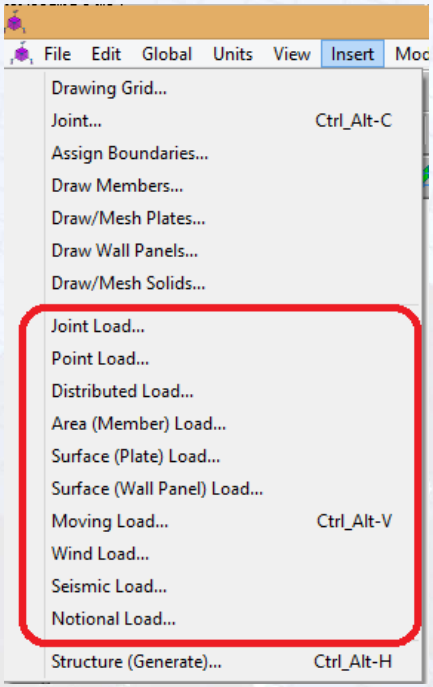
Presenter: Deborah Penko, P.E.

Agenda

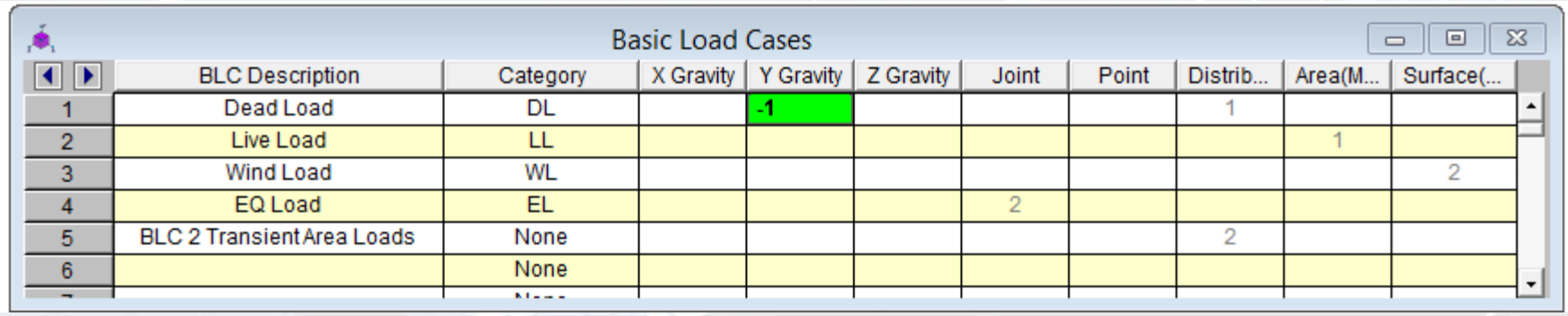
- Joint Loading
- Distributed Loading (aka Line Loads)
- Point Loading
- Area Loading
- Surface Loading
  - ✓ Plates
  - ✓ Walls
- Moving Loading
- Automated Loads- Wind & Seismic

Overview

- Graphical Interface
- Windows menu- Insert



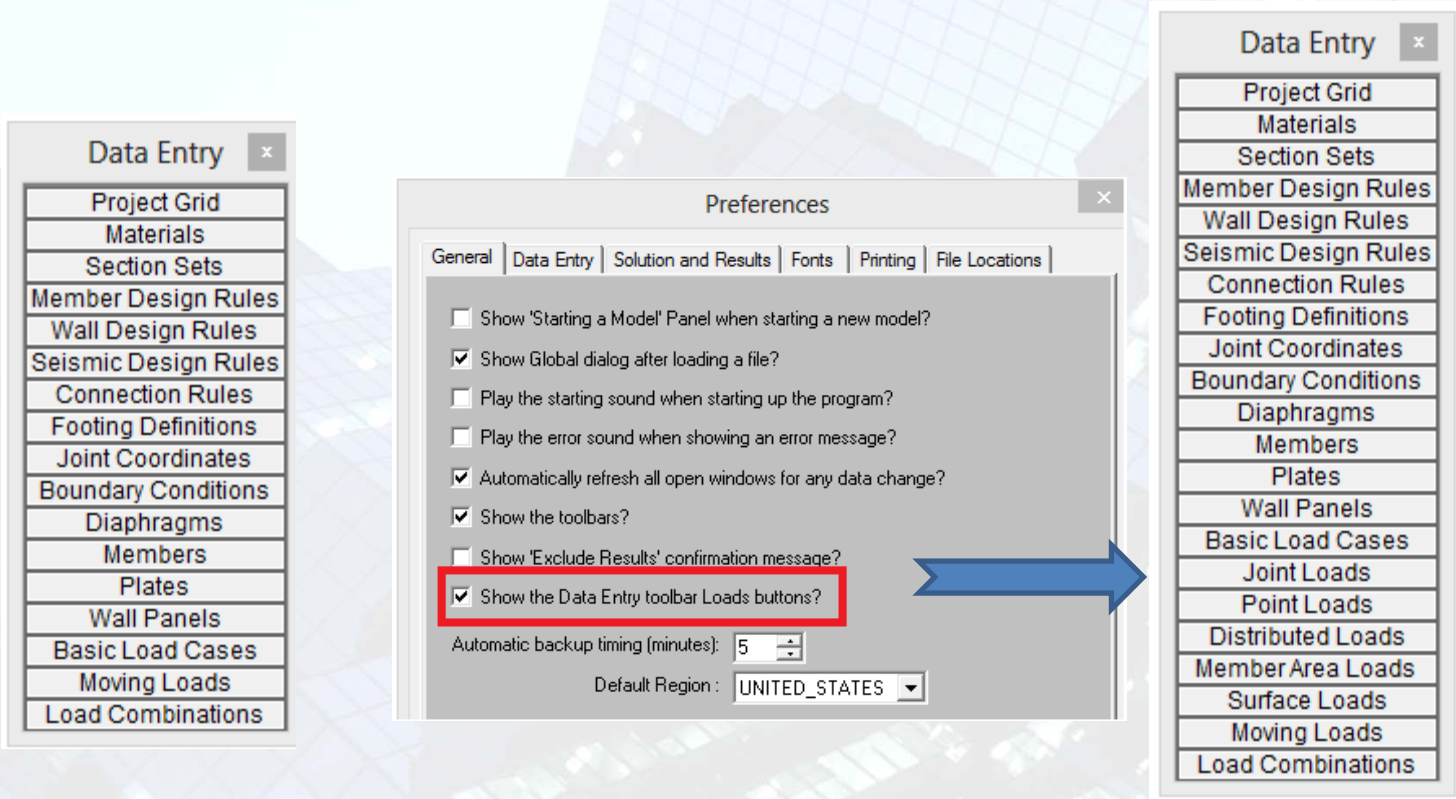
- Basic Load Cases- Allows you to access spreadsheets



Basic Load Cases

	BLC Description	Category	X Gravity	Y Gravity	Z Gravity	Joint	Point	Distrib...	Area(M...	Surface(...
1	Dead Load	DL		-1				1		
2	Live Load	LL							1	
3	Wind Load	WL								2
4	EQ Load	EL				2				
5	BLC 2 Transient Area Loads	None						2		
6		None								

Spreadsheets



Load Combinations

- Build your own combinations

Load Combinations

Combinations | Design

	Description	Sol...	PDelta	SRSS	BLC	Factor	BLC	Factor	BLC	Factor	BLC	Factor	BLC
1	IBC 16-8	☑			DL	1							
2	IBC 16-9	☑			DL	1	LL	1	LLS	1			
3	IBC 16-10 (a)	☑			DL	1							
4	IBC 16-12 (a)	☑			DL	1	WL	.6					
5	IBC 16-13 (a)	☑			DL	1	WL	.45	LL	.75	LLS	.75	
6	IBC 16-15	☑			DL	.6	WL	.6					

✓ Enter the Load Category – DL, LL, WL, etc.

*** Must use Load Categories!!!

✓ Or the Basic Load Case (BLC) – 1 refers to "row 1"

BLC 1

Basic Load Cases

	BLC Description	Category	X Gravity	Y Gravity	Z Gravity	Joint	Point	Distrib.	Area(M	Surface(
1	Dead Load	DL		-1				1		
2	Live Load	LL							1	
3	Wind Load	WL								2
4	EQ Load	EL				2				

Load Combinations

Combinations | Design

	Description	Sol...	PDelta	SRSS	BLC	Factor	BLC	Factor
1	Dead Load	☑			1	1		

Load Combinations

- Load Combination can be **Nested**
  - ✓ 8 BLC's per LC
  - ✓ Combine LC's
  - ✓ Mix and match LC's and BLC's

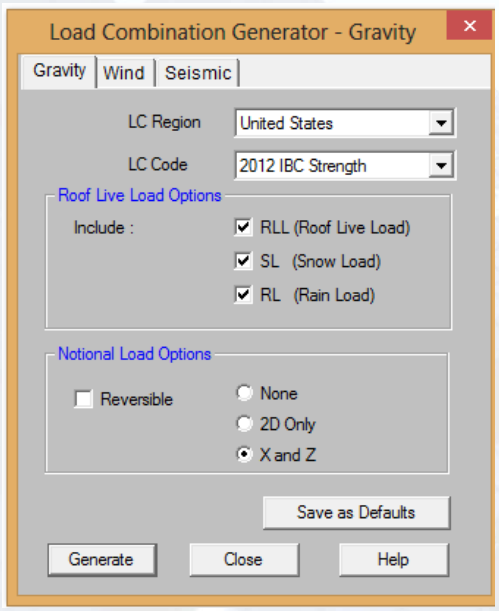
Load Combinations

Combinations | Design

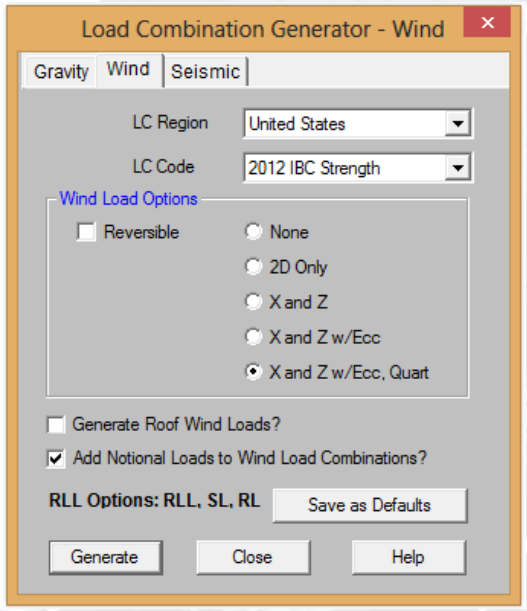
	Description	Solve	PDelta	SRSS	BLC	Factor	BLC	Factor	BLC	Factor	BLC	Factor	BLC	Factor	BLC	Factor	BLC	Factor	BLC	Factor
1	Gravity Loads	☑	Y		DL	1.2	LL	1.6	LLS	1.6	SL	.5	SLN	.5	FL	.5	OL1	1	OL2	1
2	Quartering Winds	☑	Y		WLX	.5	WLXP1	.5	WLXP2	.5	WLZ	.33	WLZP1	.33	WLZP2	.5				
3		☐																		
4	Nested Example 1	☑	Y		L1	1	L2	1												
5	Nested Example 2	☑	Y		L1	1	L2	1	OL3	1										

Load Combinations

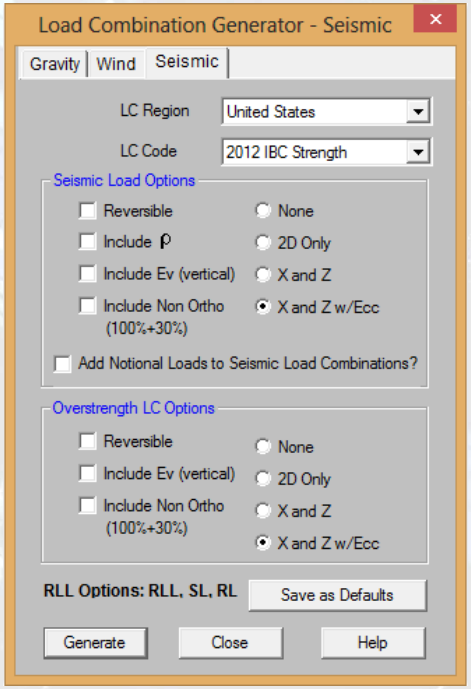
- Or Use the Load Combination Generator **LC Generator**



Gravity Loads



Wind Loads

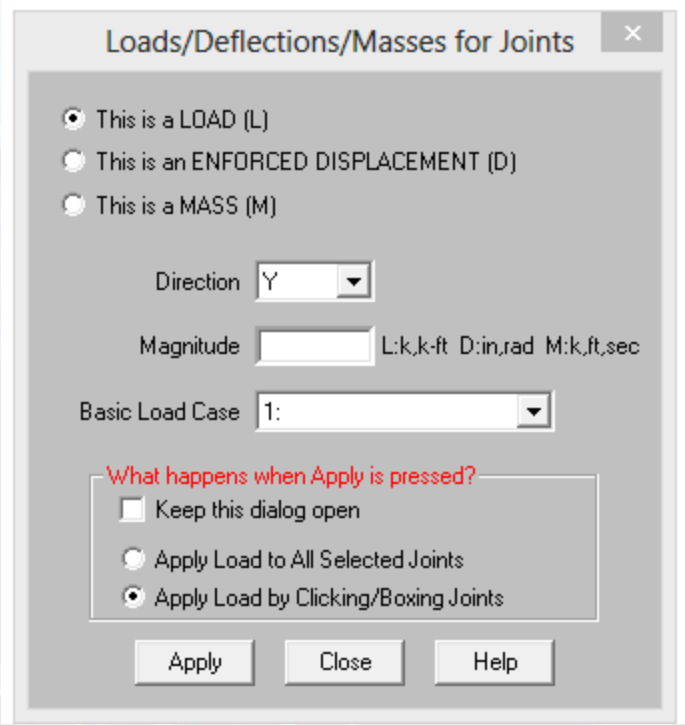


Seismic Loads

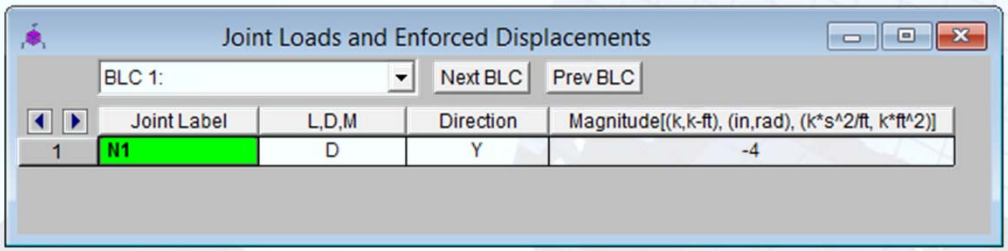
Joint Loads

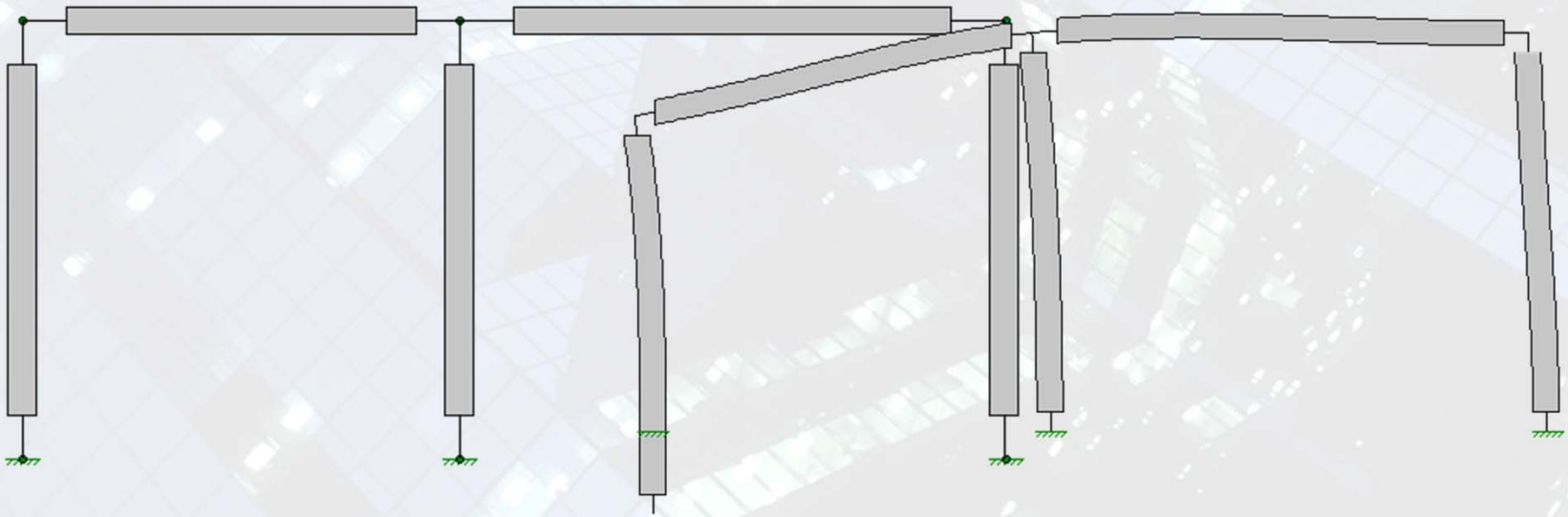
Apply to any Joint

- Load
  - ✓ Global Axis X, Y, Z
  - ✓ Moment MX, MY, MZ
- Enforced Displacement
- Mass
  - ✓ Directional Mass
  - ✓ Mass Moment of Inertia



Enforced Displacement

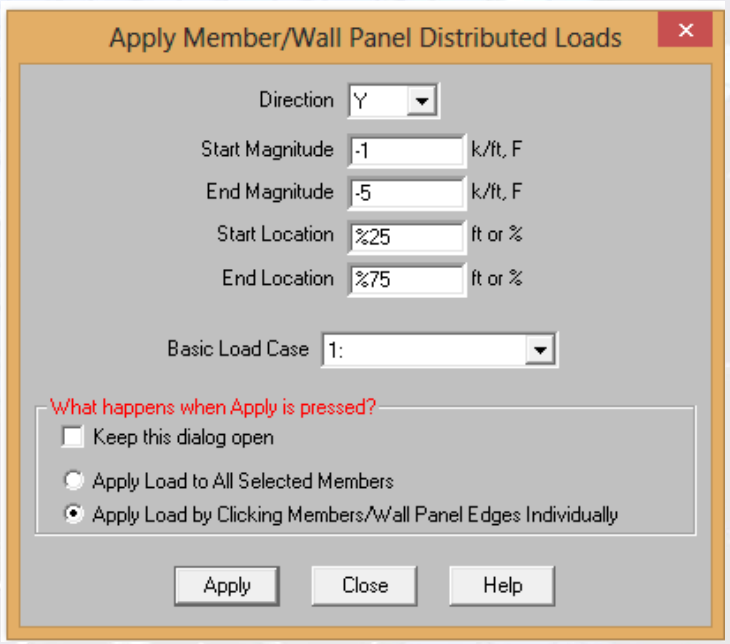


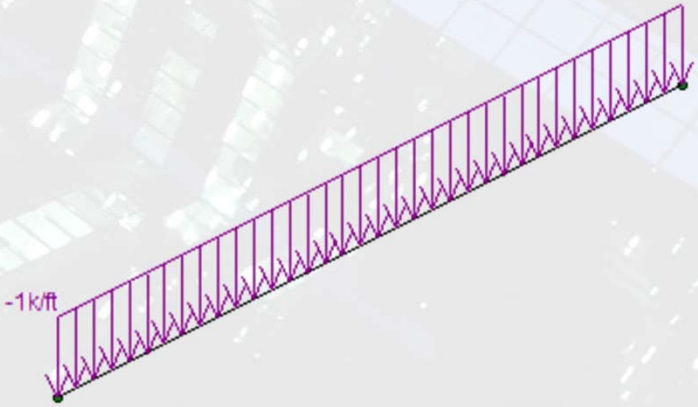


Joint Loads

Distributed Loads

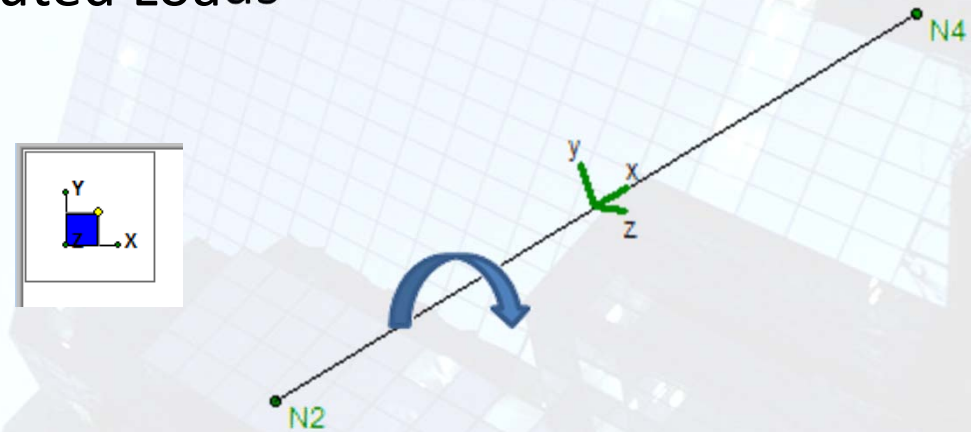
- Apply Distributed Loads to Members or Walls
- Taper loads
- Start or Stop anywhere

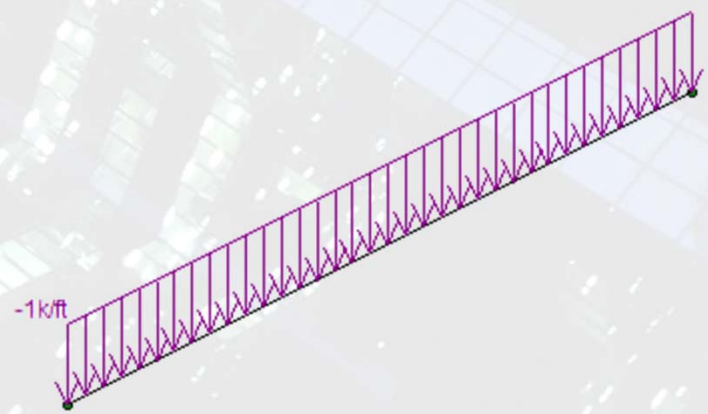




Distributed Loads

X, Y, Z	Global Axis
x, y, z	Local Axis
Mx	Torque about local x-axis
T	Thermal Loading
PX, PY, PZ	Projected Loading





Distributed Loads

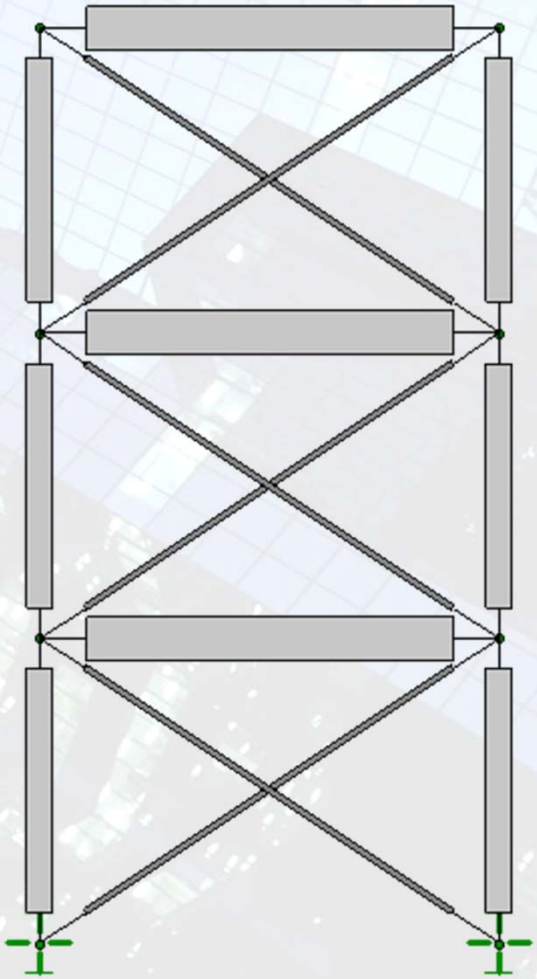
Thermal Loading

- Thermal Loads → effects of temperature differentials
- Cause the axial expansion or contraction of the member

Ambient Temperature defined:

Joint Coordinates and Temperatures

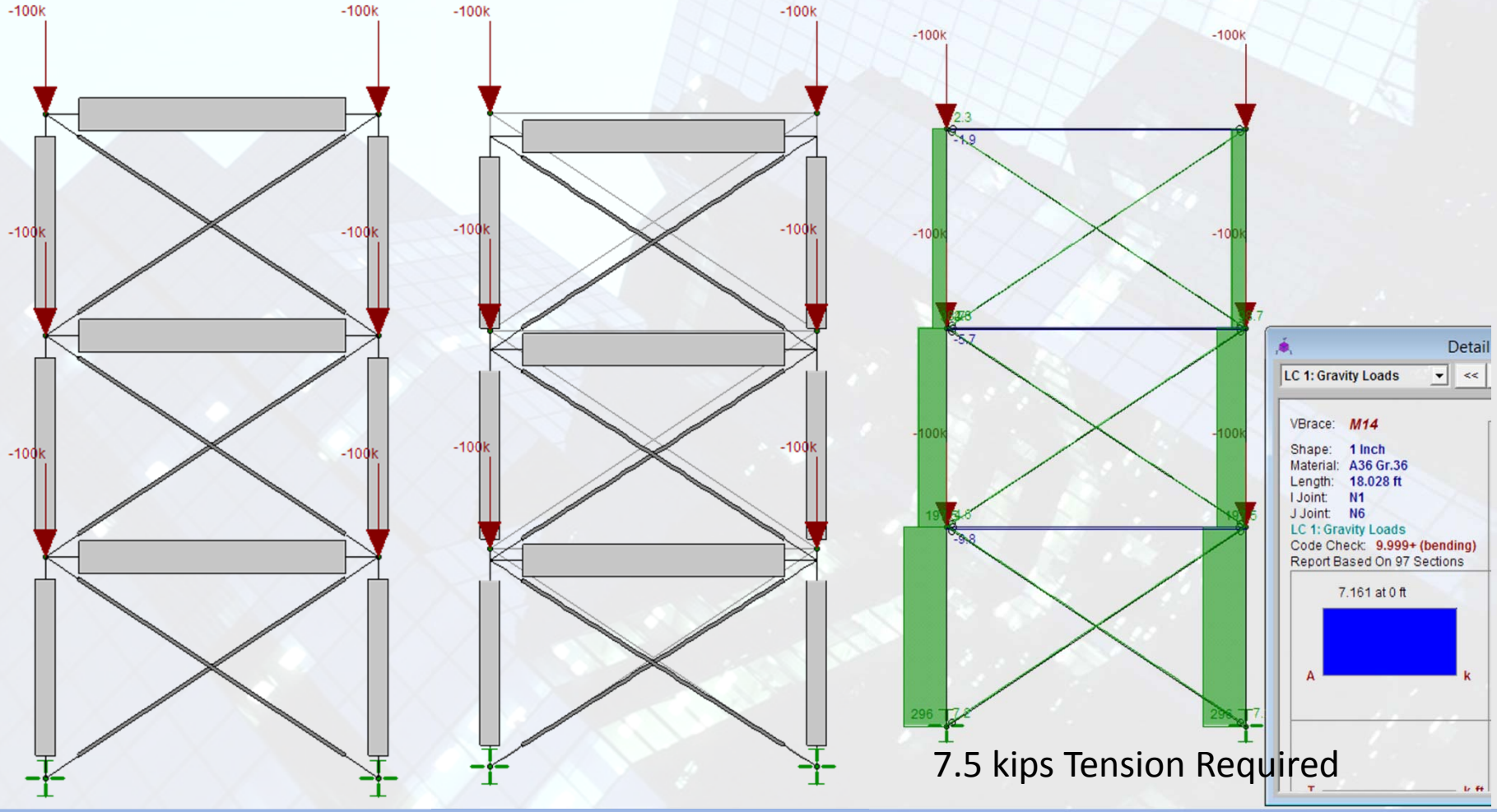
	Label	X [ft]	Y [ft]	Z [ft]	Temp [F]	Detach Fro...
1	N1	0	0	0	0	☐
2	N2	0	10	0	0	☐
3	N3	0	20	0	0	☐
4	N4	0	30	0	0	☐
5	N5	15	0	0	0	☐
6	N6	15	10	0	0	☐
7	N7	15	20	0	0	☐
8	N8	15	30	0	0	☐



Distributed Loads

Thermal Loading

For Example: Pre-Stress Brace Members



7.5 kips Tension Required

Distributed Loads

Thermal Loading

$Ft = A * E * \alpha * \Delta T$

Re-organized: $\Delta T = Ft / (A * E * \alpha)$

Ft= Calculated Thermal force

Ft= 7.5 kips

A = Member Cross Sectional Area

$A = 0.785\ in^2$

E = Elastic Modulus

E = 29000ksi

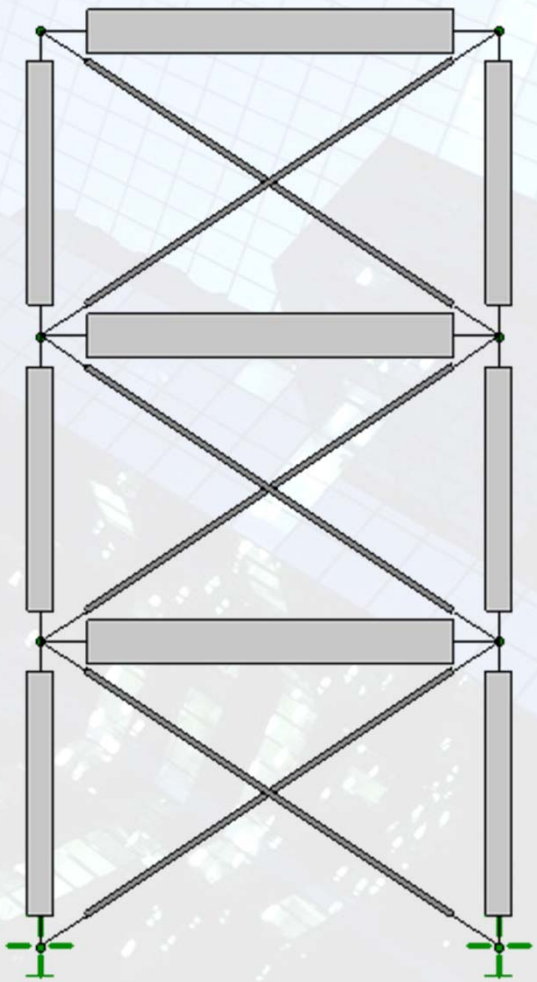
α = Coeff. of Thermal Expansion

$\alpha = .0000065$

Therefore:

ΔT = Stress Inducing Temperature

= 50



Let's see this model now!

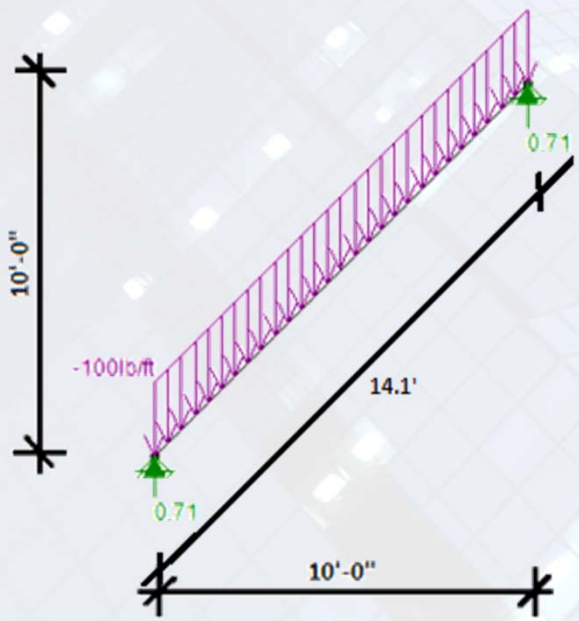
Distributed Loads

Projected Loading

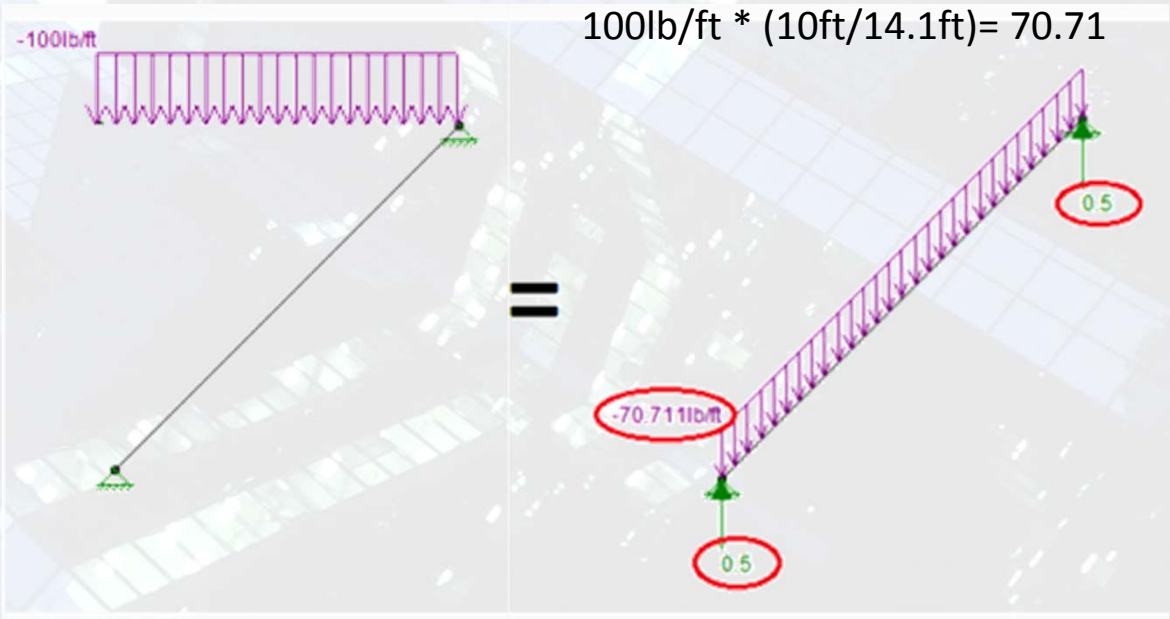
Projected Loads → Snow loads

Projected Load = Applied Load X (Member Length in Horz. Plane)
Actual Member Length

100 lb/ft Distributed Load on Y Axis

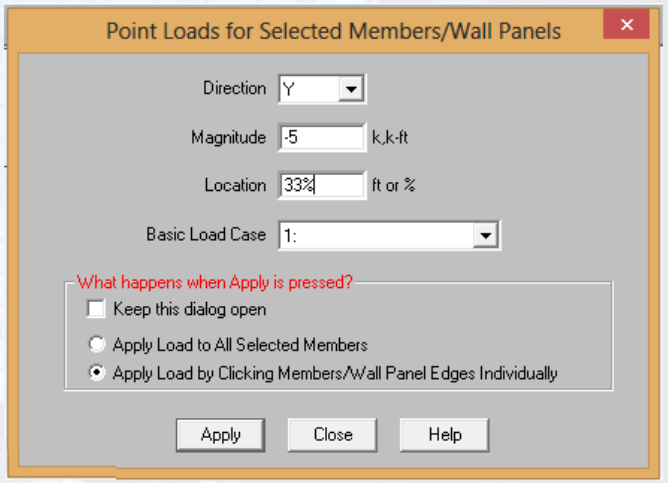


100 lb/ft Projected PY Load → Converts Load
100lb/ft * (10ft/14.1ft)= 70.71

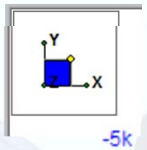


Distributed Loads

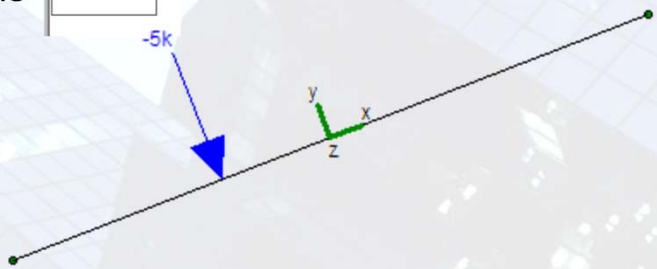
Point Loads



X, Y, Z — Global Axis

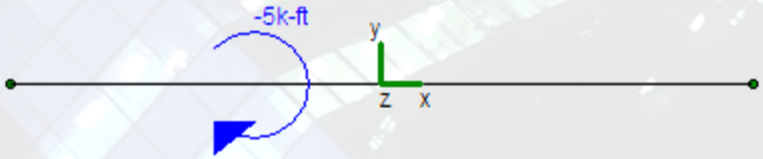


x, y, z — Local Axis



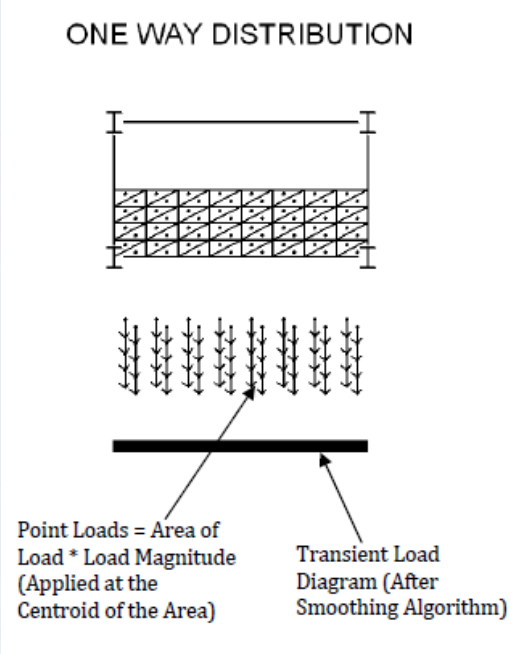
My, Mz — Moment about the member local axis

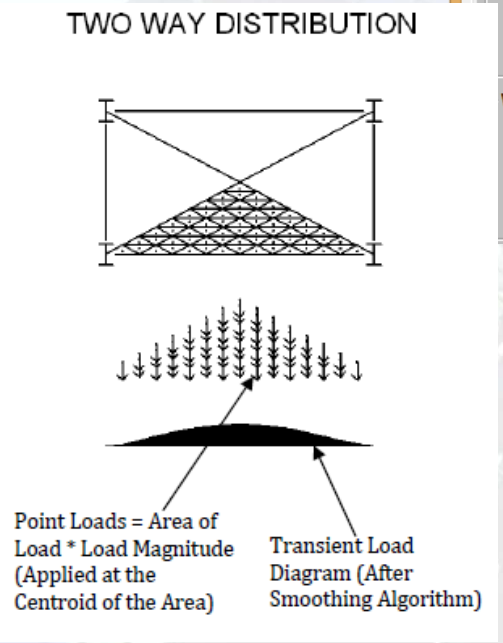
Mx — Torsional Moment about local x axis

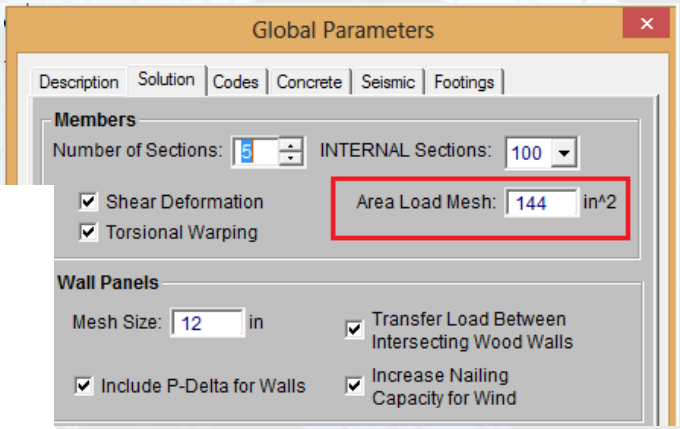


Area Loading

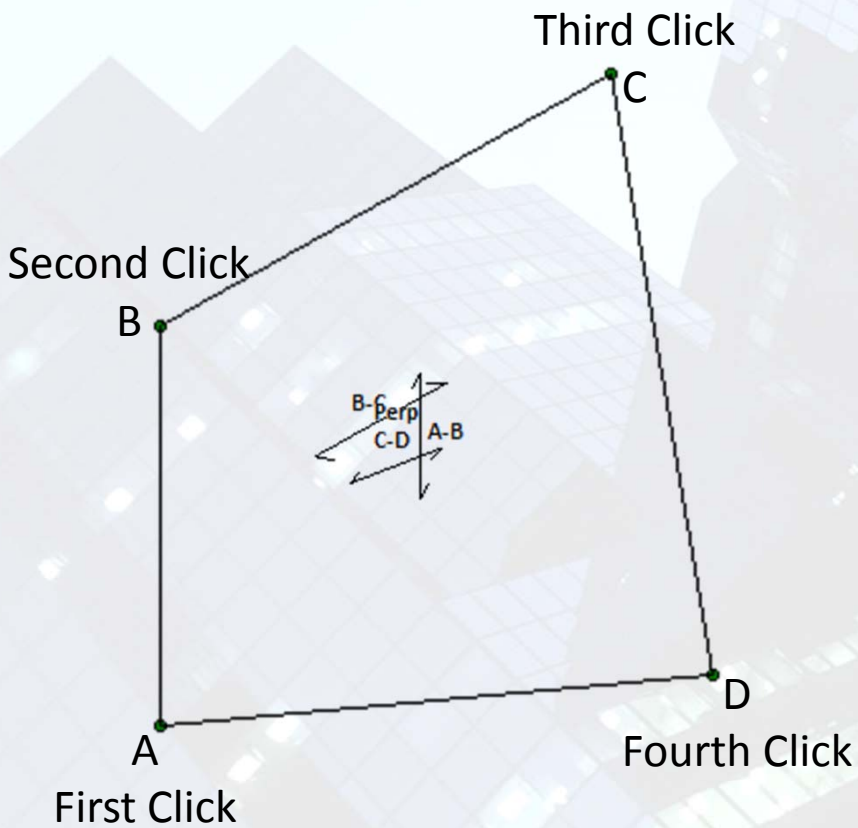
- Define polygon (3 or 4 sides)
- Loads applied to Members & Walls
- Define One-Way or Two-Way Load Attribution

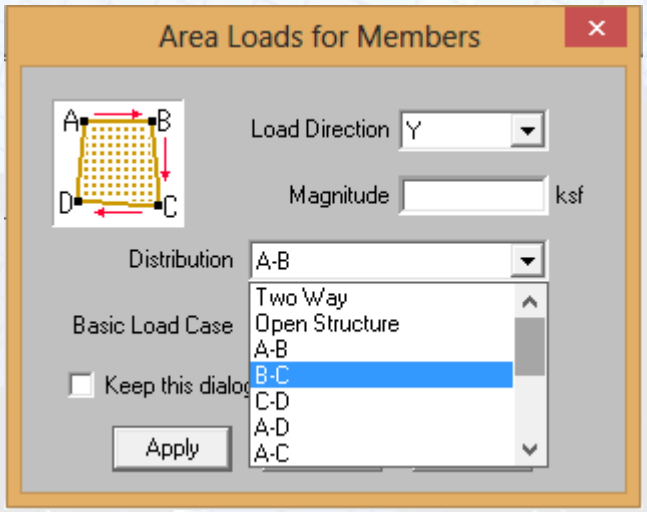






Area Loading





Area Loads

Area Loading

- What is a Transient Area Load?

Basic Load Cases

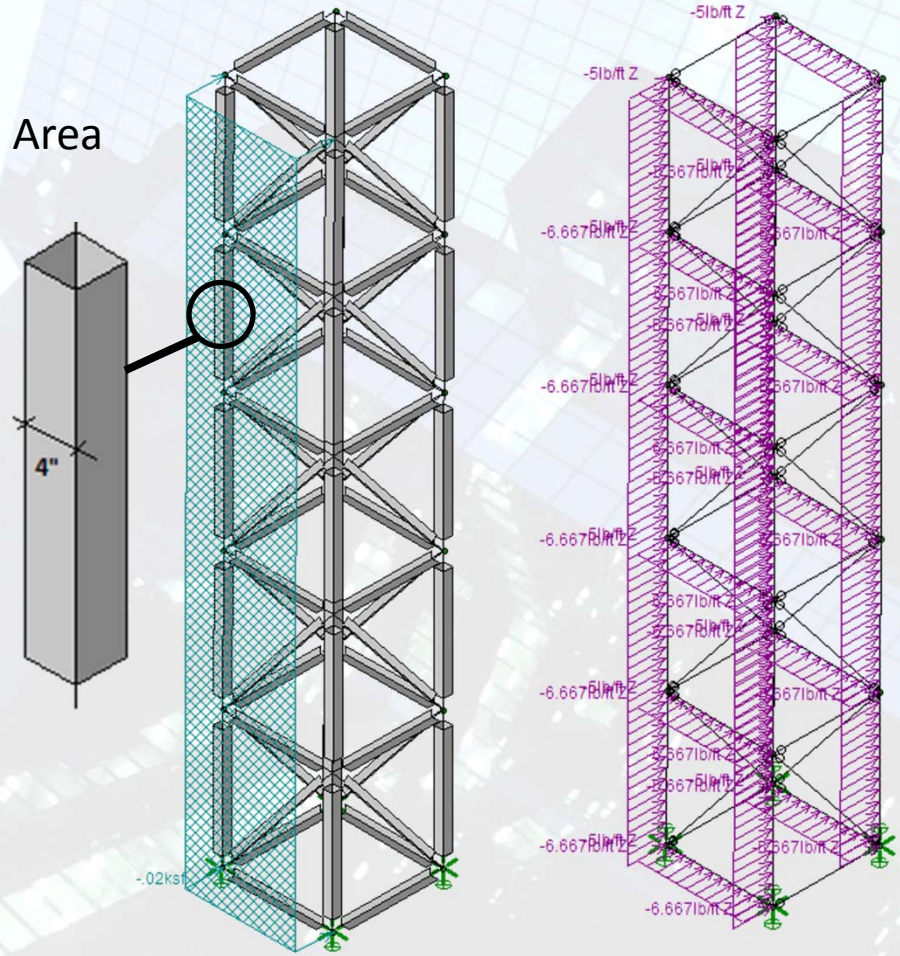
	BLC Description	Category	X Gravity	Y Gravity	Z Gravity	Joint
1	Dead Load	DL		-1		
2	Live Load	LL				
3	Wind Load	WL				
4	EQ Load	EL				2
5	BLC 2 Transient Area Loads	None				
6		None				

Let's take a look at an example model…

Open Structure Loading

Loads applied based on Projected Surface Area

HSS4x4x6
width = 4in



Transient Load:

20lbf * 4”/12” = 6.667 lb/ft

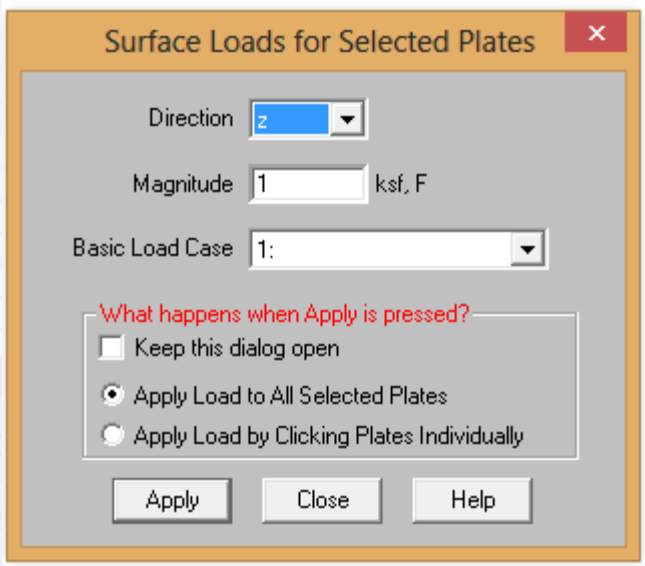
Note:

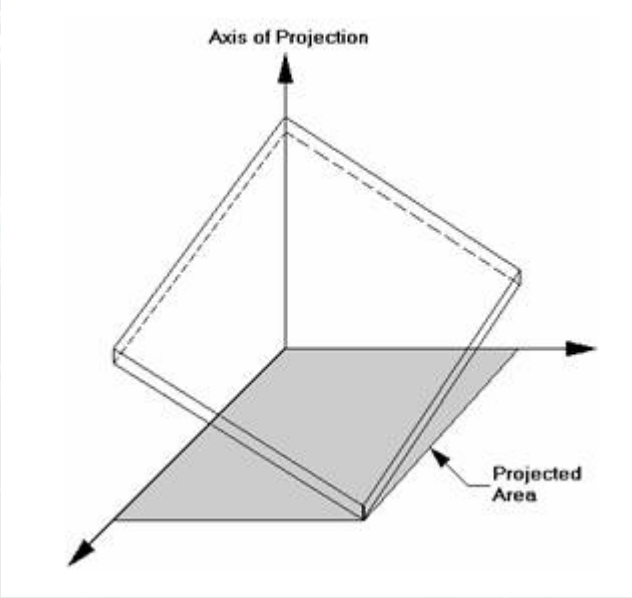
- Braces don’t get area loads
- No Shielding

Area Loads

Apply to Plates

X, Y, Z	Global Axis
x, y, z	Local Axis
PX, PY, PZ	Projected Loading
T	Thermal Loading

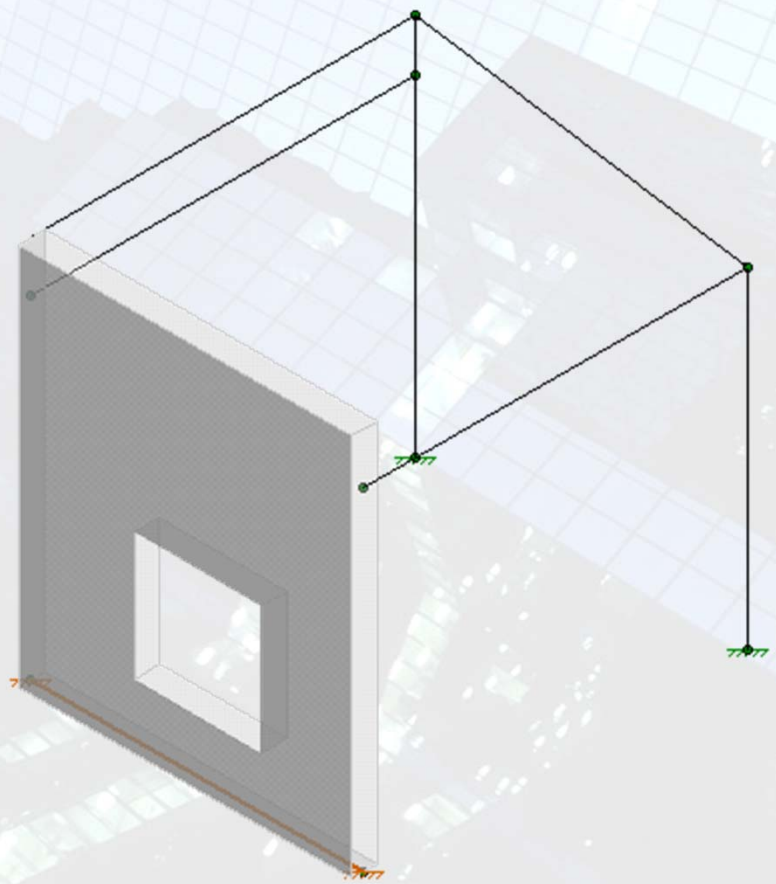




Let's take a look at an example of a tank now!

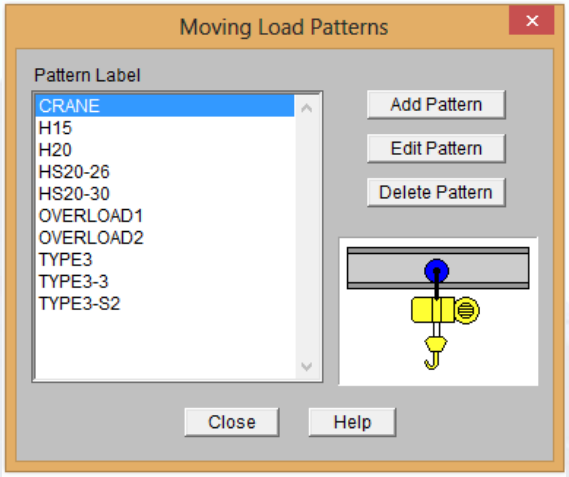
Wall Panel Loading Options

- Surface Loading
  - ✓ Full wall or Partial
  - ✓ Constant or Tapered force
- Distributed Loading
- Joint Loading
  - ANYWHERE!
- Area Loading

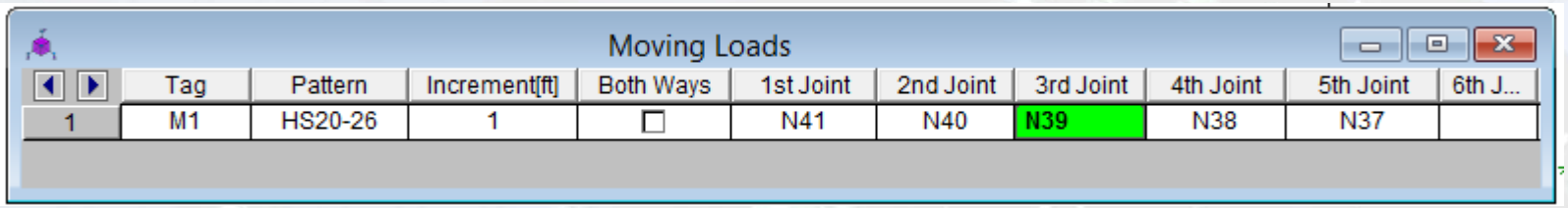


Moving Loads- Two Step Process

1. Define the Moving Load Pattern



2. Apply the Moving Load

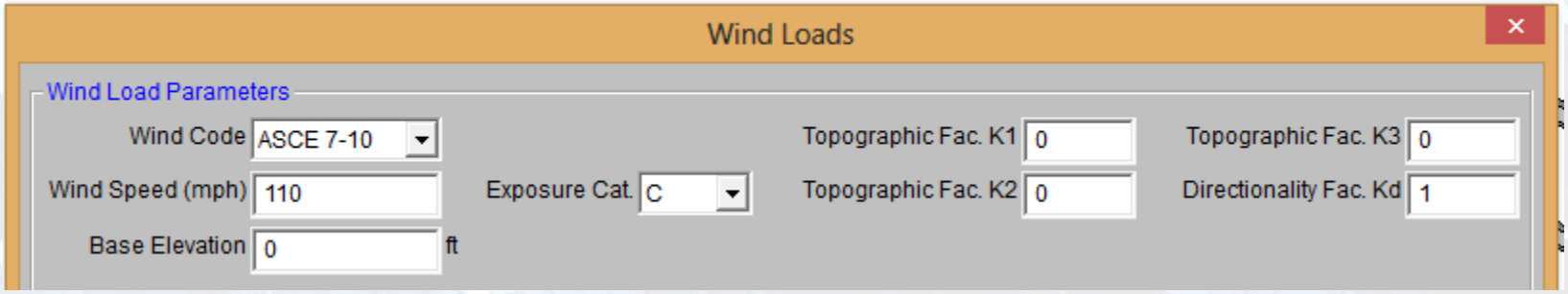


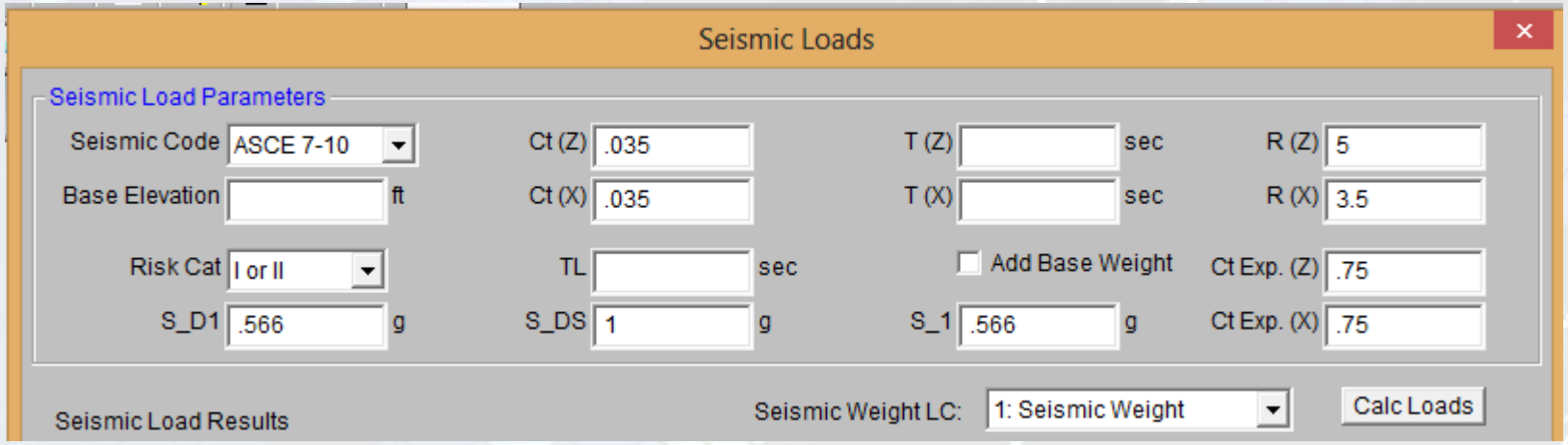
	Tag	Pattern	Increment[ft]	Both Ways	1st Joint	2nd Joint	3rd Joint	4th Joint	5th Joint	6th J...
1	M1	HS20-26	1	☐	N41	N40	N39	N38	N37	

Let's take a look at an example!

Automatic Load Generation

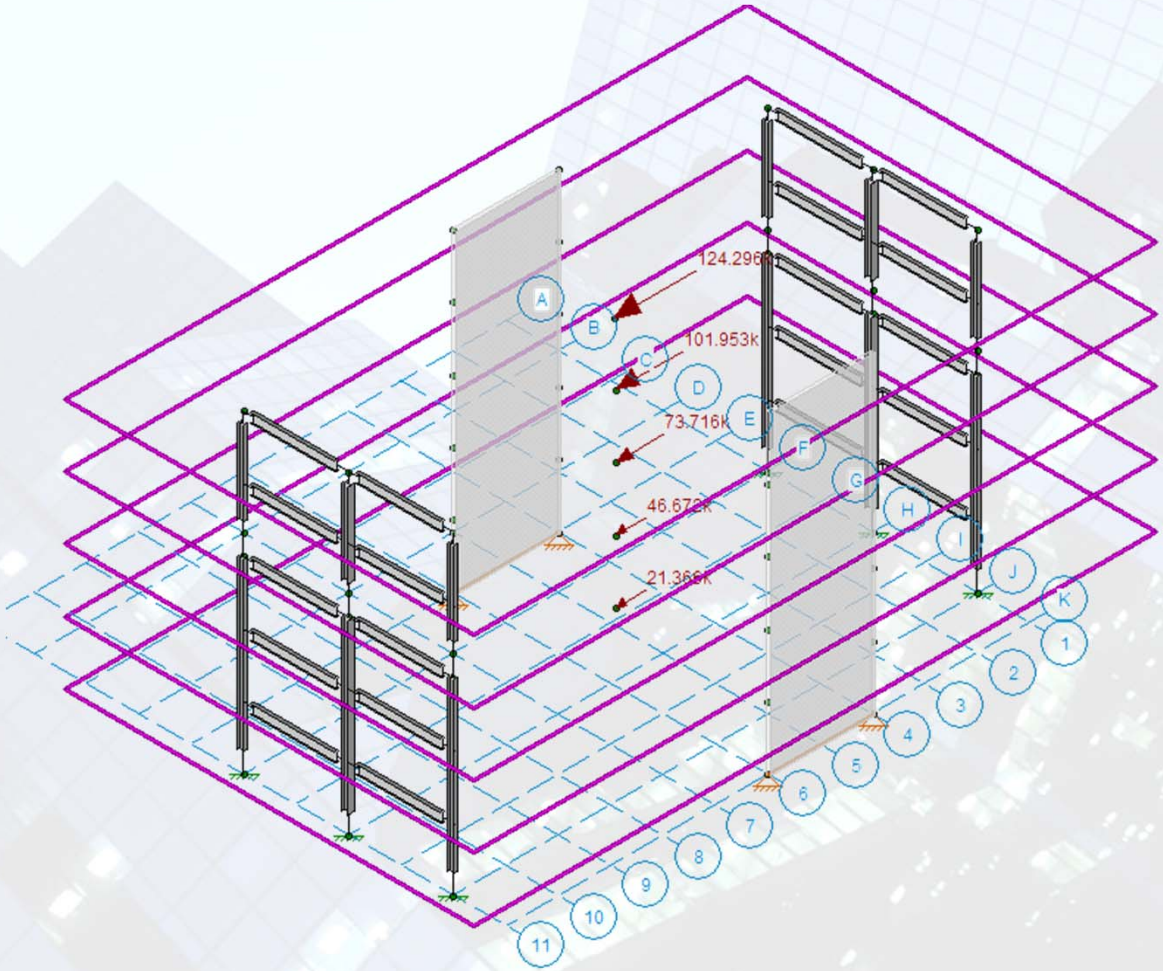
- Building Design with Rigid Diaphragms→ Automated Loads





Wind & Seismic Loading

Automatic Load Generation



Wind & Seismic Loading

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 Penko, P.E.