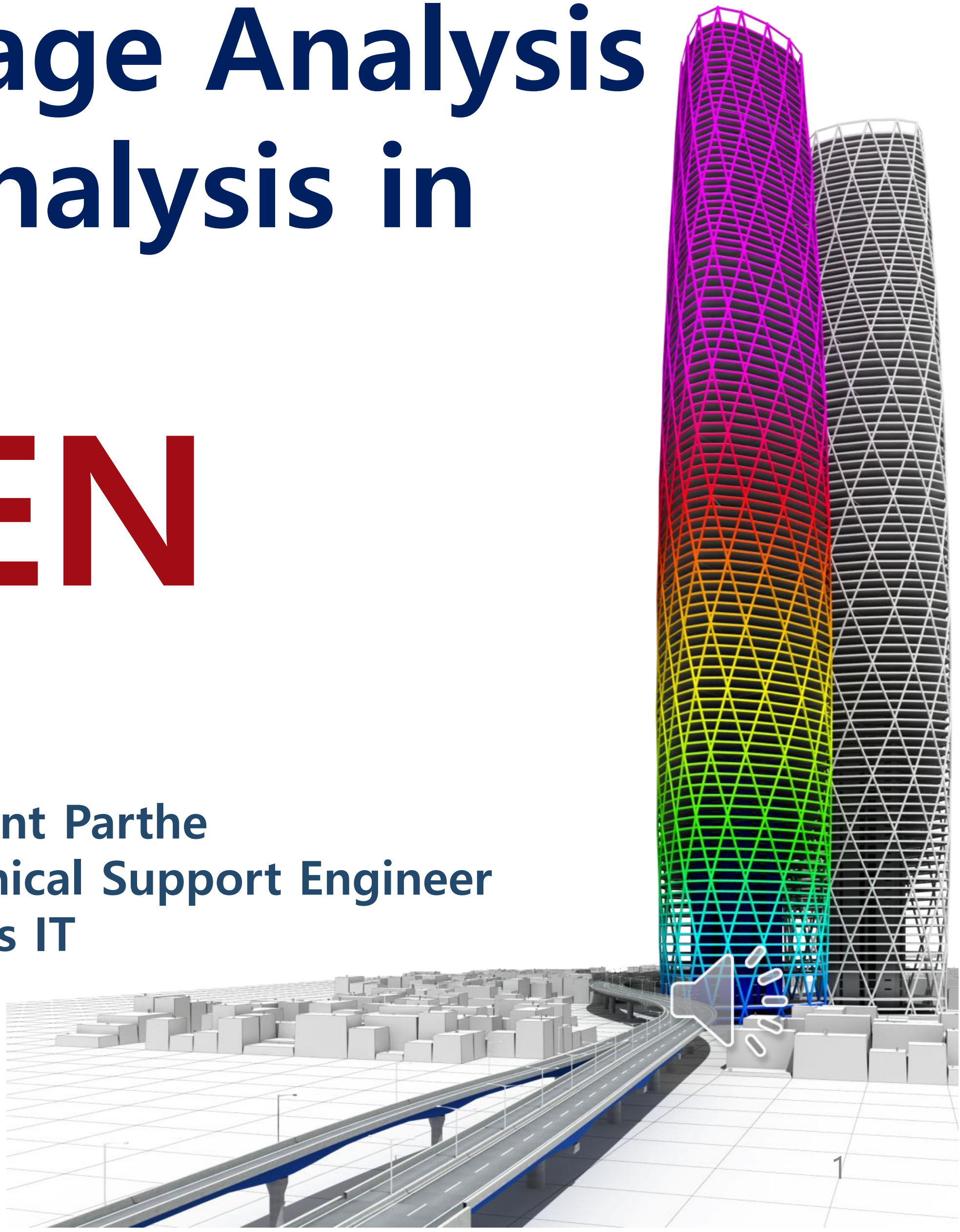
Construction Stage Analysis & Wind Load Analysis in Buildings on

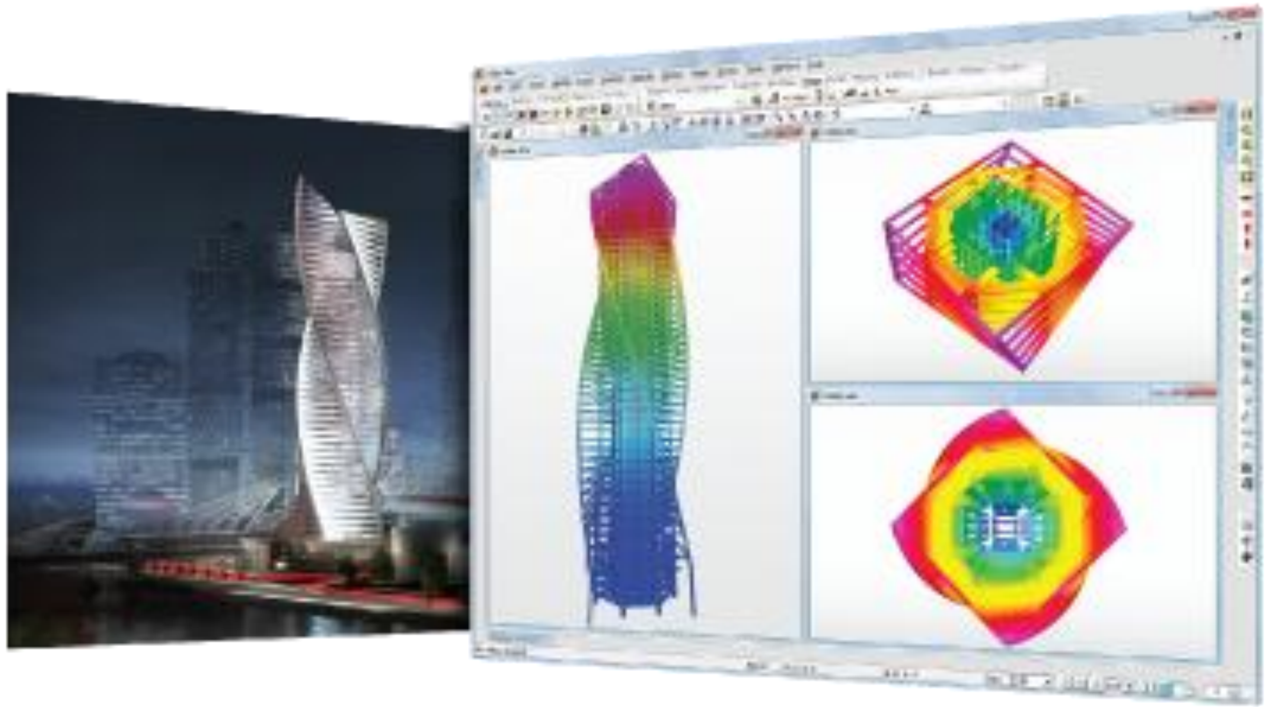
Midas GEN



- Vikrant Parthe
Technical Support Engineer
Midas IT

midas Gen

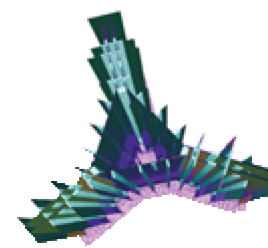
Tall Building Projects

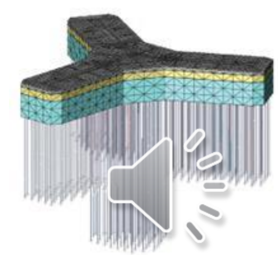


Moscow City Palace Tower (Russia)

Twisting 46-story Building with Composite Columns

Tall Building Projects





Kingdom Tower (Saudi Arabia)

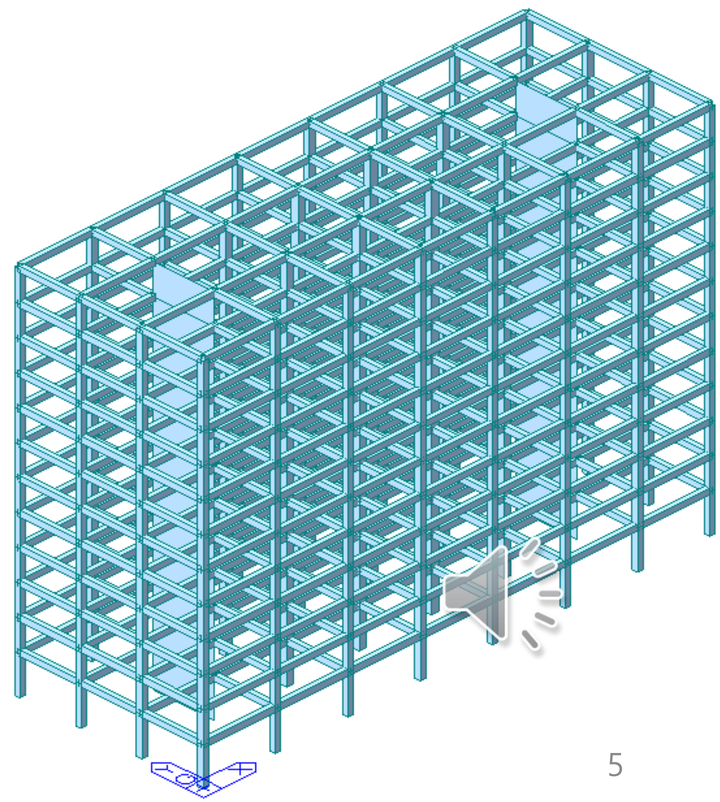
Over 1,000 meters in height

Tall Building Projects

Burj Khalifa (UAE)

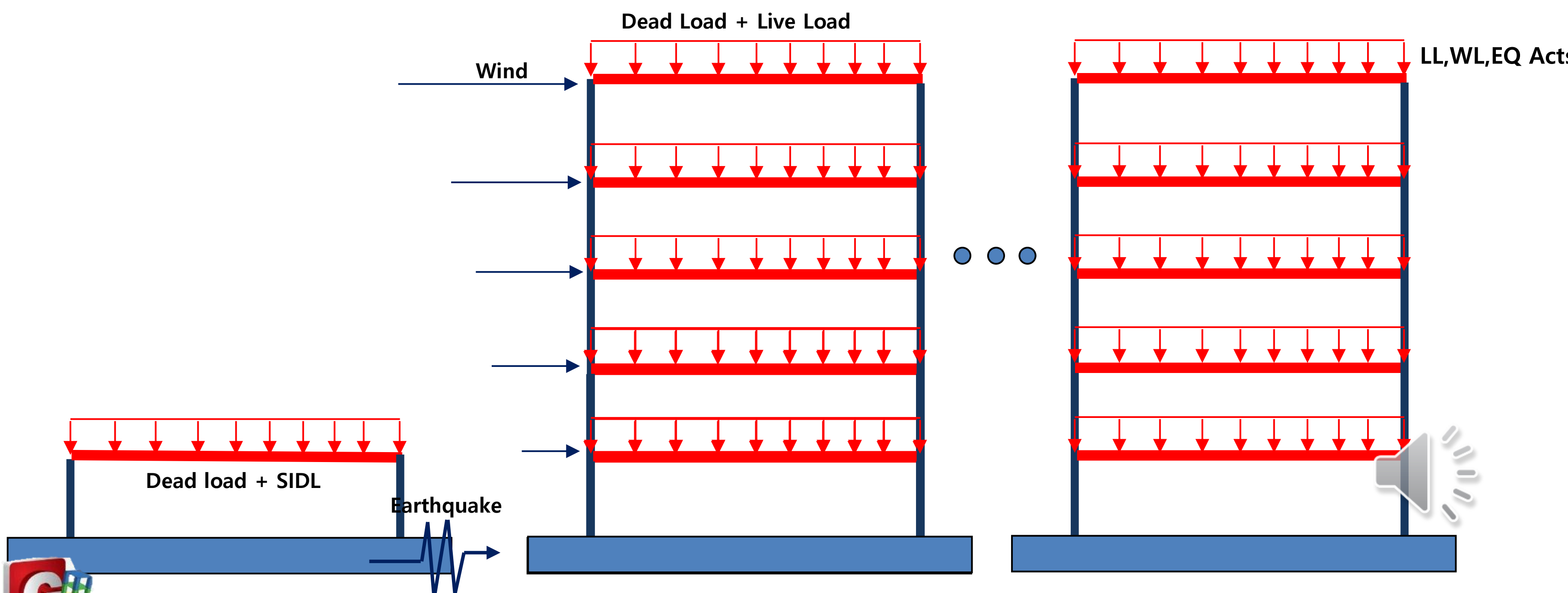
The World's Tallest Building

Contents



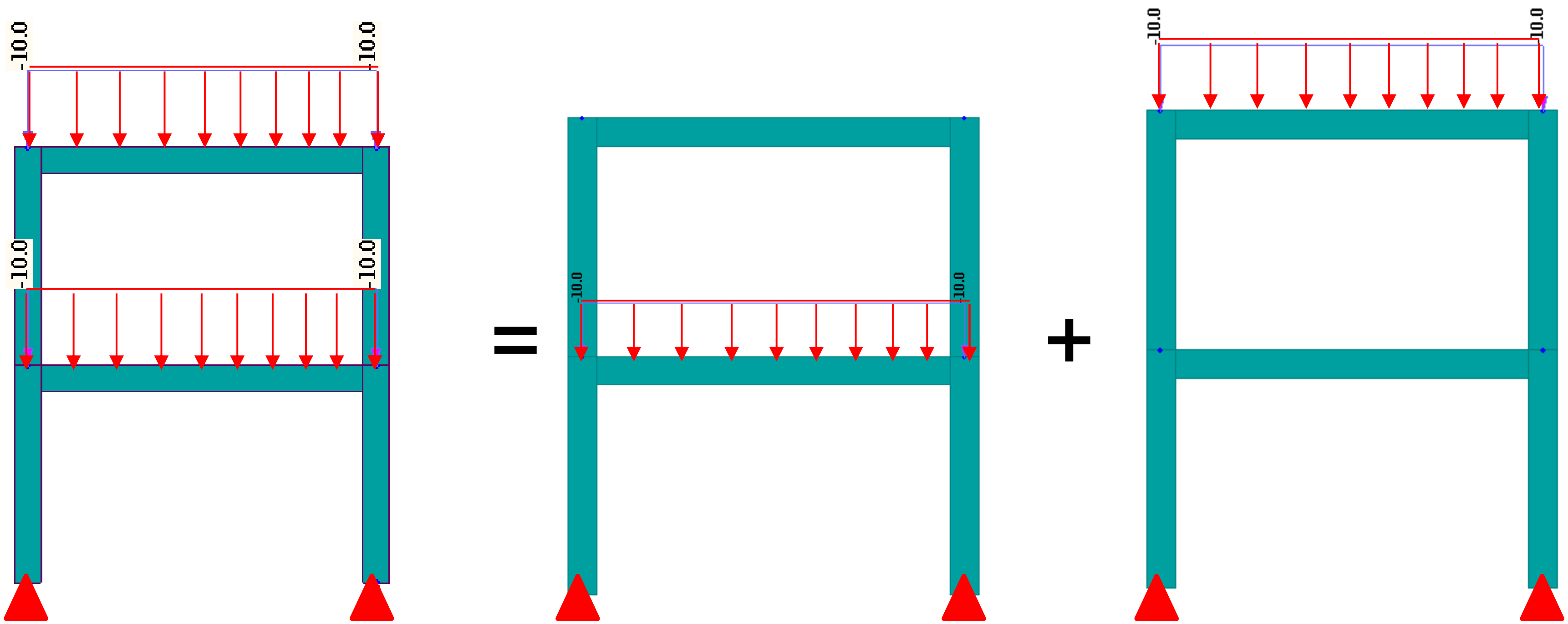
What is Construction Stage?

- Structural analysis → built and loaded in a **moment.**
- Construction of structures is a time taking process and during this period **Material** Properties, **Loads** and **Boundaries** conditions may change.



Why is CS Analysis Required?

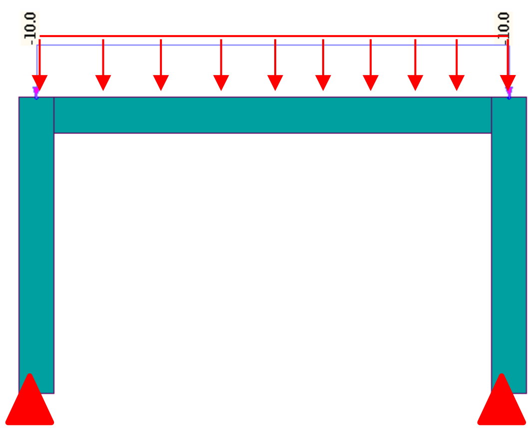
Conventional Analysis



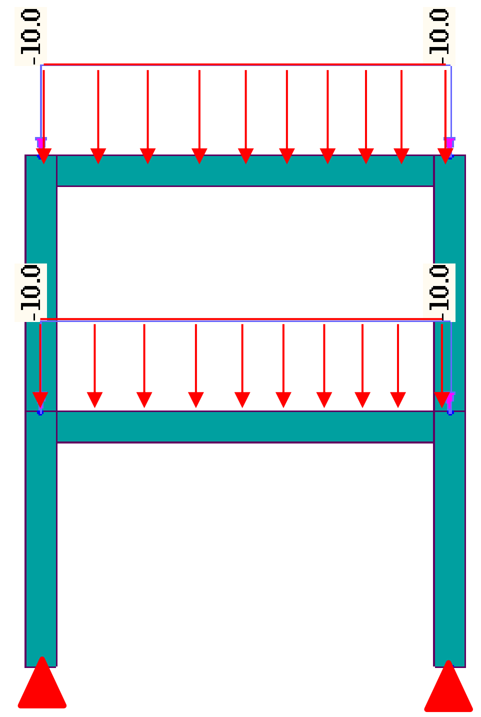
Superposition on same structure

Why is CS Analysis Required?

Construction Stage Analysis



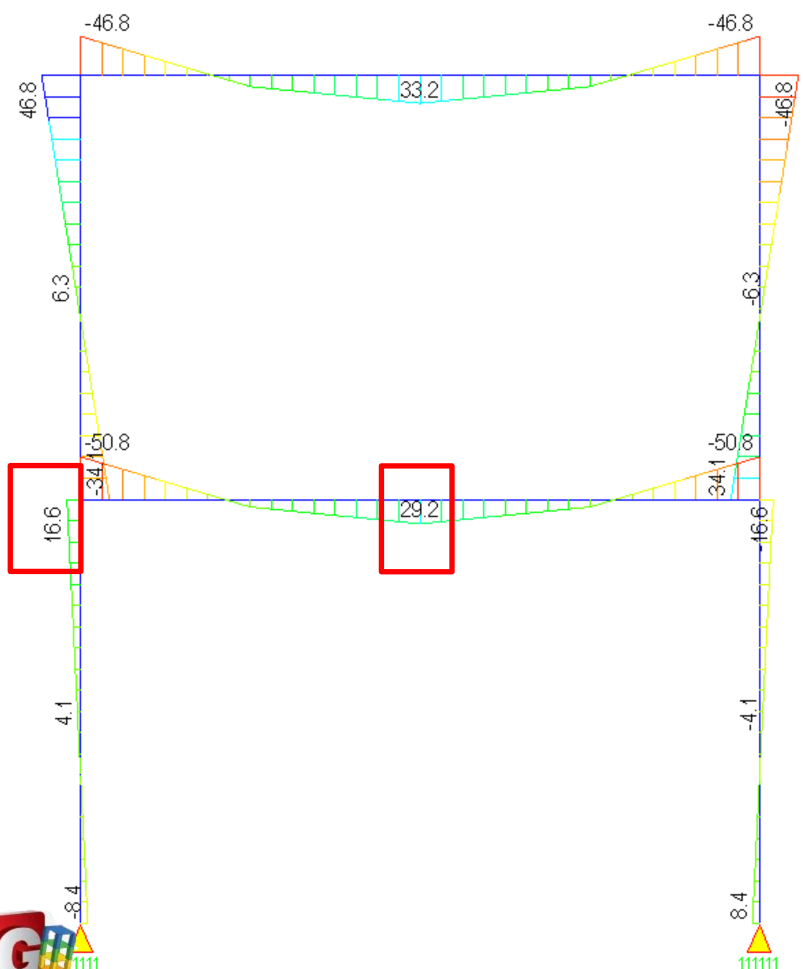
STAGE 1



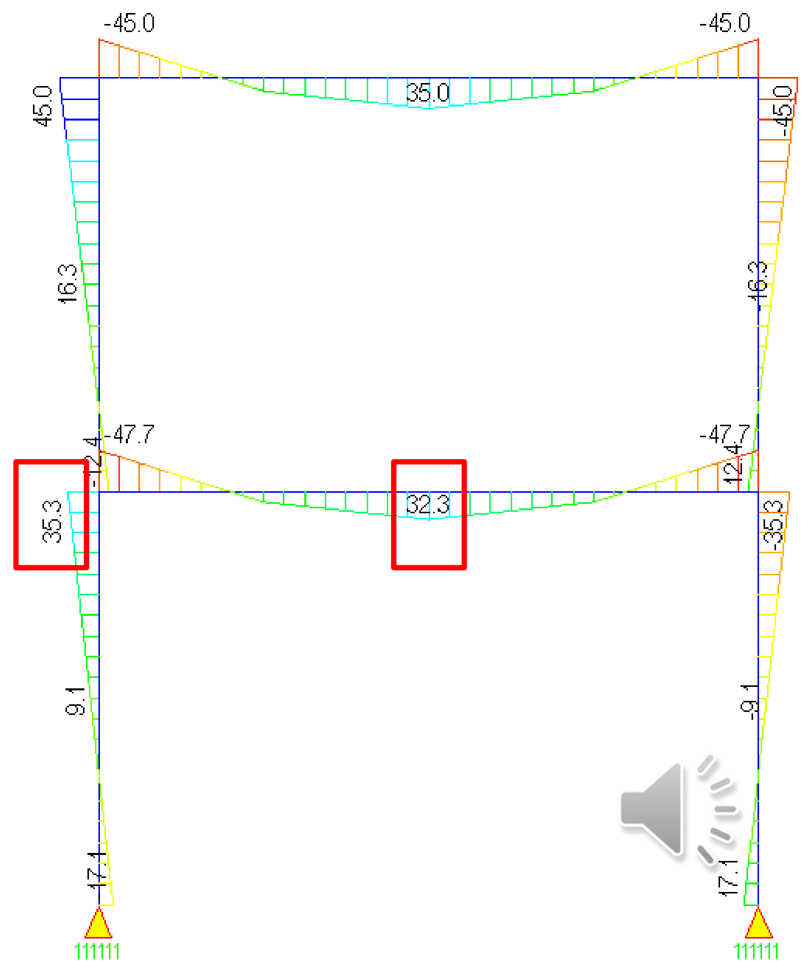
STAGE 2

Why is CS Analysis Required?

Conventional Analysis

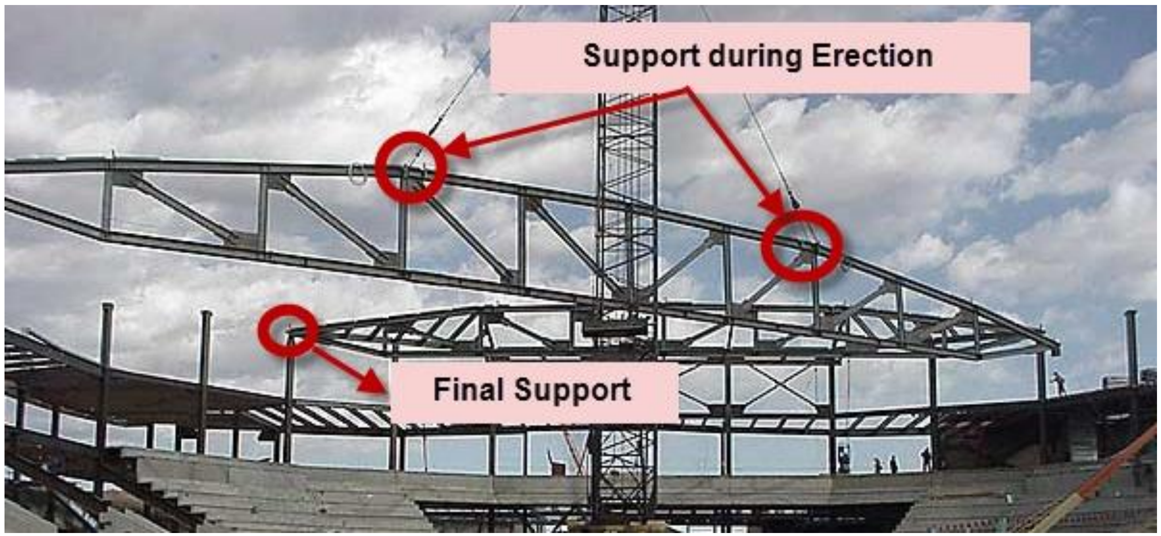


CS Analysis



Where is CS Analysis Considered?

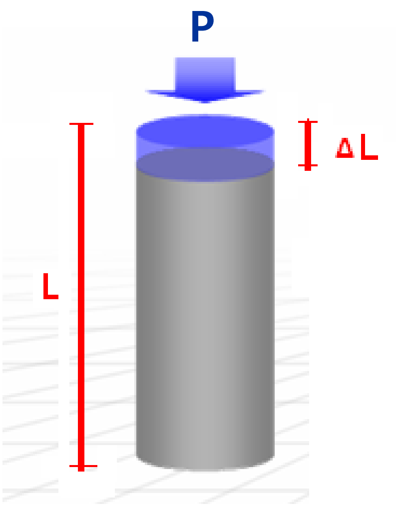
- ✓ **Long Span Trusses**

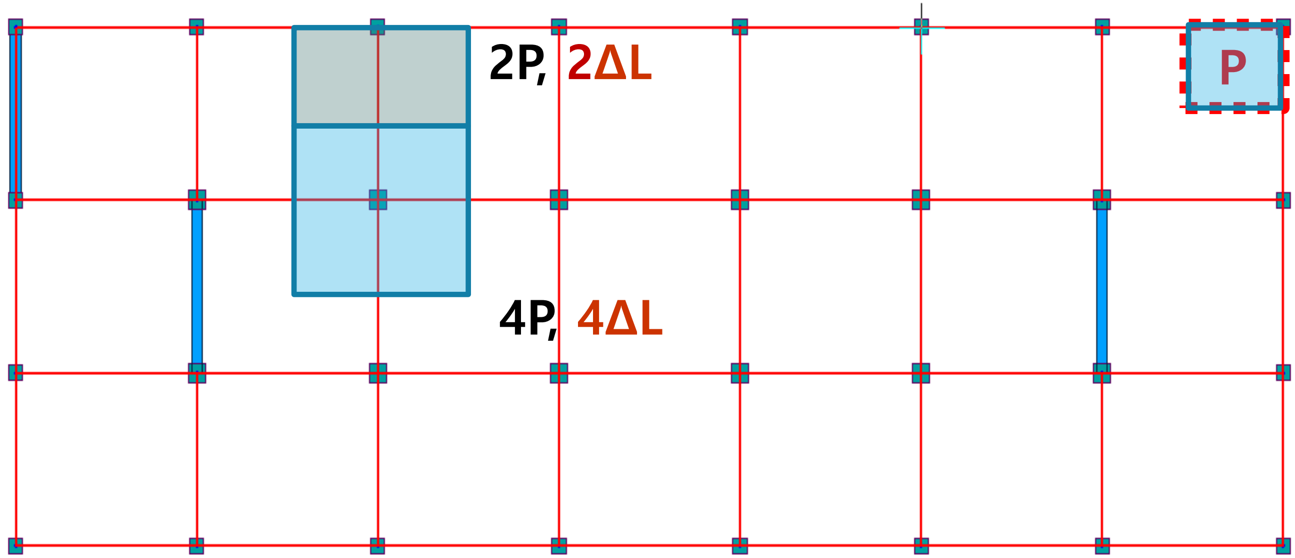


- ✓ **Long Span Slabs and Beams constructed in multiple stages**

CS Analysis → **Change in Support Conditions, Loading and Structural Configuration**

Importance of Column Shortening





$$E = (\sigma / \varepsilon)$$

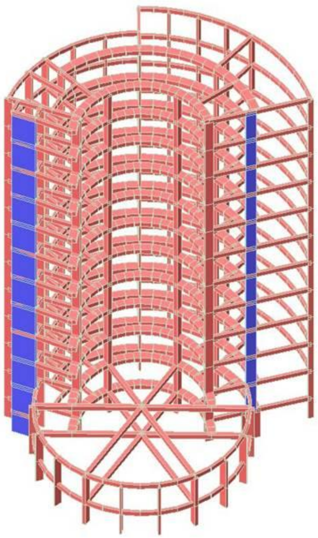
$$\Delta L = (PL/AE)$$

Differential shortening in Columns → Additional forces in Beams and Slabs

Effects of Column Shortening in Buildings

Steel Building → 80 Storey

Elastic Shortening ~ 180-255 mm



Concrete Building → 80 Storey

Elastic Shortening ~ 65 mm

Total Shortening ~ 180-230 mm

***Inelastic Shortening ~ 1 to 3 times Elastic shortening.**

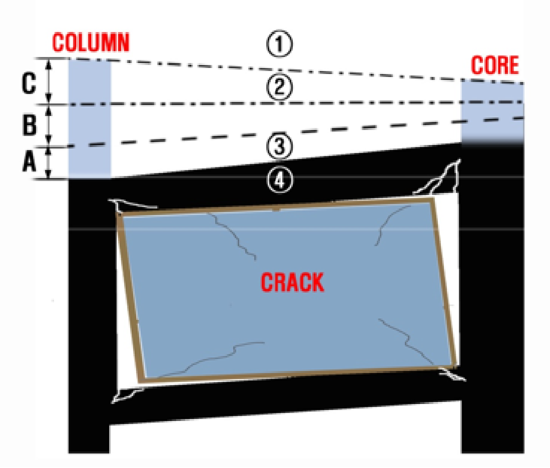
With increased height of structures, the effect of column shortening (Elastic & Inelastic) take on added significance and need special consideration in design and construction.

Compensation for Column Shortening in Buildings

Depending on the stage of construction:

- **Pre-slab installation shortenings:**
  Shortenings taking place up to the time of slab installation

- **Post-slab installation shortenings:**
  Shortenings taking place after the time of slab installation



① :Compensation

② : Design Level

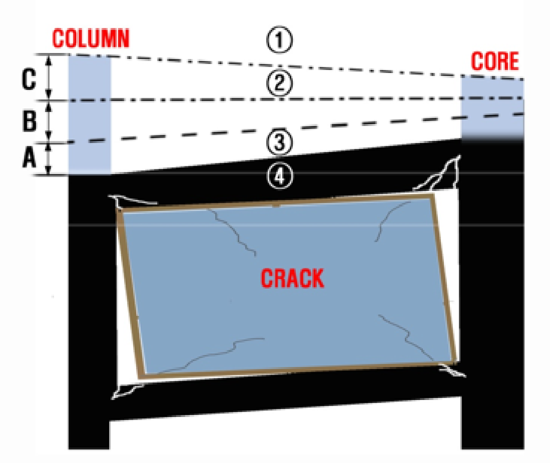
③: Pre-slab Installation shortening

④: Post-slab Installation shortening

Compensation for Column Shortening in Buildings

Depending on the construction material:

- **Reinforced Concrete Structure**
  - Pre-slab installation shortenings have no importance
  - Compensation by leveling the forms
  - Post-slab installation shortenings due to subsequent loads and creep/shrinkage



① :Compensation

② : Design Level

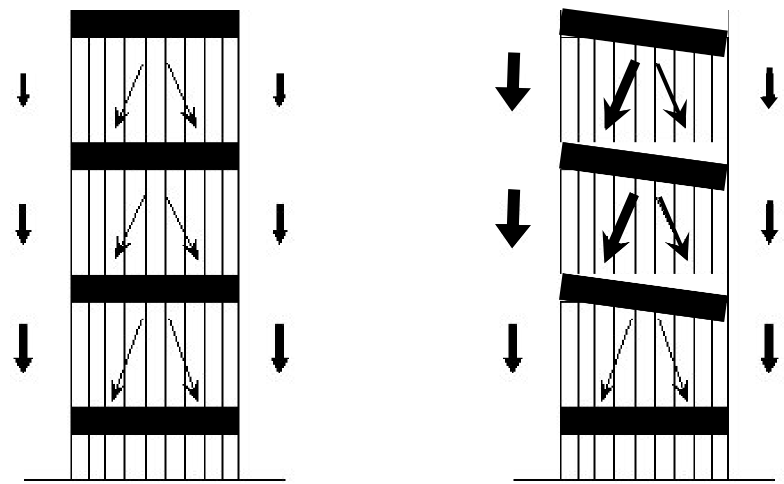
③: Pre-slab Installation shortening

④: Post-slab Installation shortening

Effects of Column Shortening in Buildings

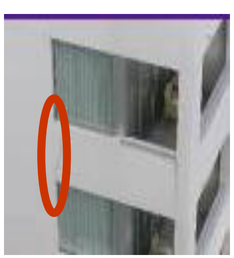
Structural Effects

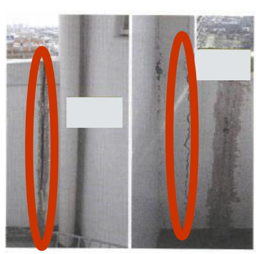
- Slabs may not be truly horizontal after some time.
- Beams could be subjected to higher bending moments.
- Load transfer.

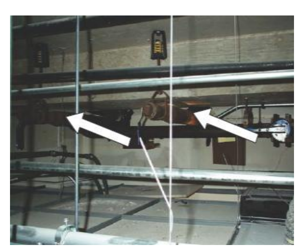


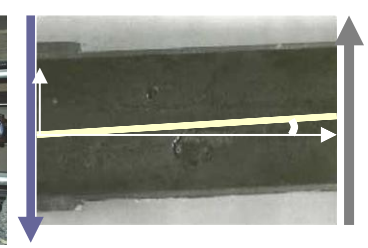
Non-Structural Effects

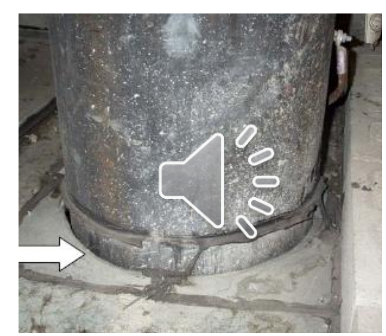
- Cracks in Partition Walls
- Inclination in Pipelines
- Deformation of vertical systems







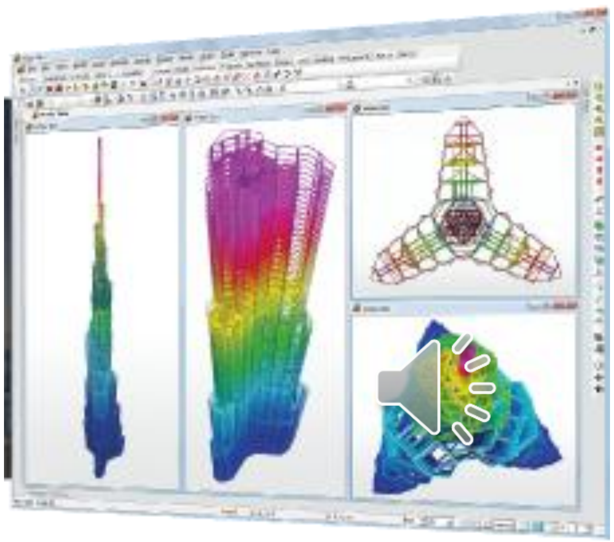




CS Analysis Steps in GEN

PROCEDURE

- Define material and sections
- Define and link time dependent material properties with material → Creep, Shrinkage and Compressive strength Variation
- Assign elements, boundaries and loads to the specific groups
- Specify CS analysis data → Specify duration of CS stage, elements loads and boundary activation and deactivation
- Perform analysis and check results



Result Interpretation in GEN

Base Stage

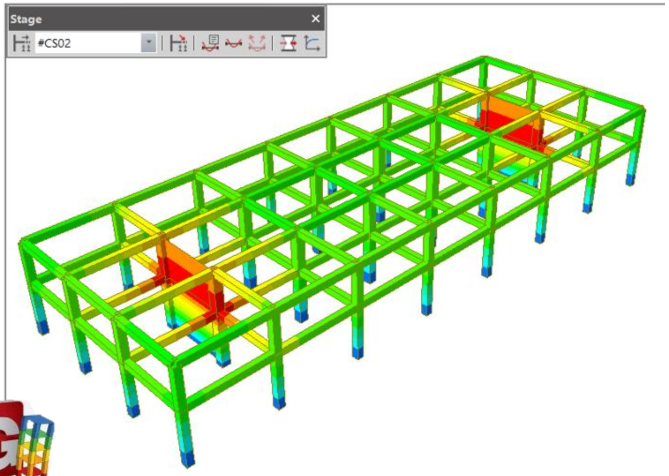
To edit the elements, loads and boundary conditions

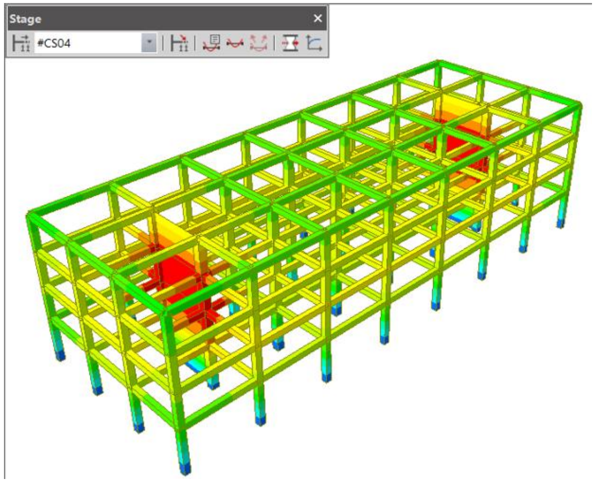
Construction Stage Results

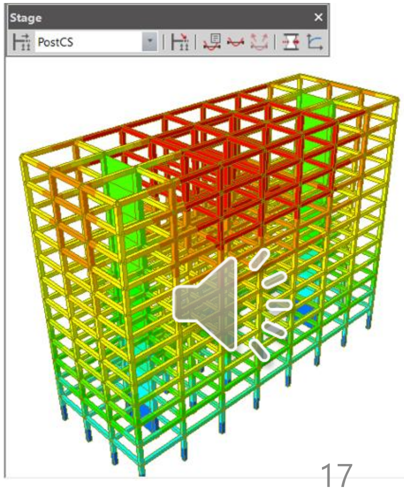
Results for each CS can be viewed including the creep and shrinkage effects

Post CS

Results for the loads acting outside the CS (Seismic, wind, temperature, etc)

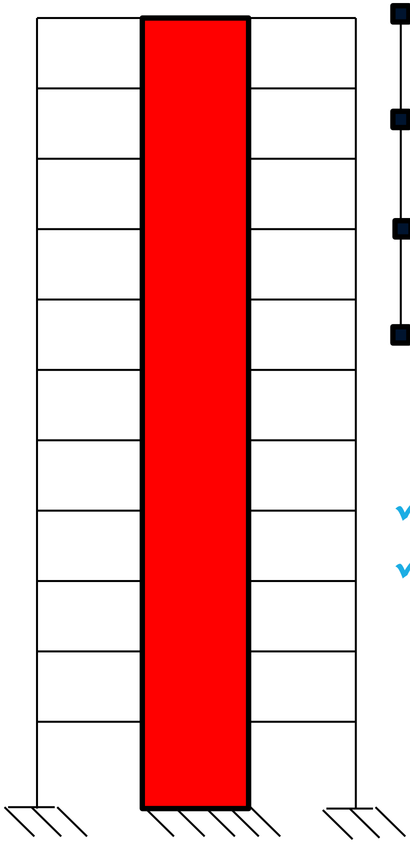




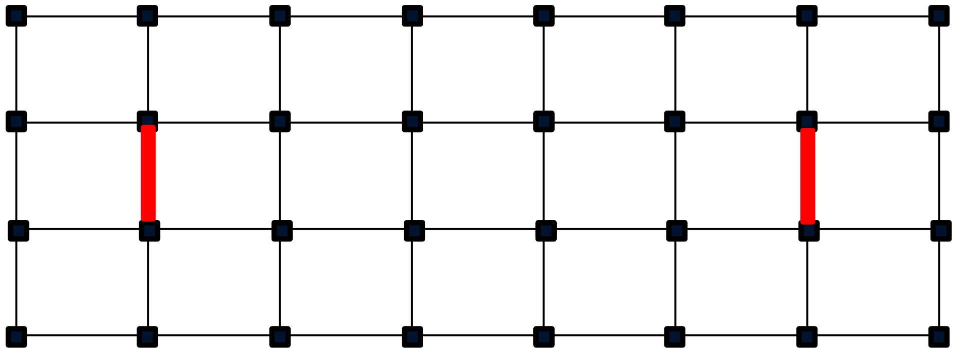


Live Demonstration

Model Details

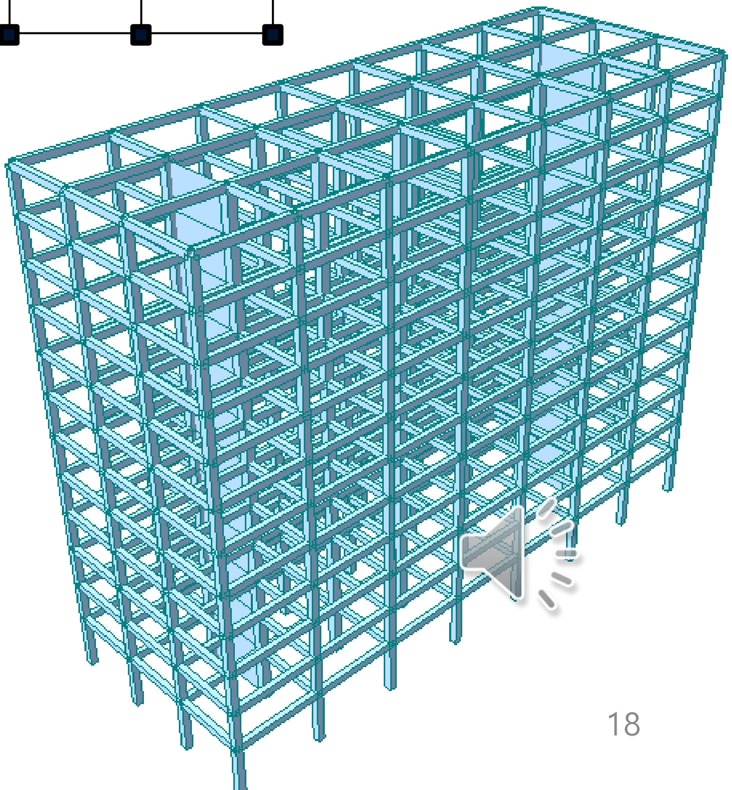


Elevation



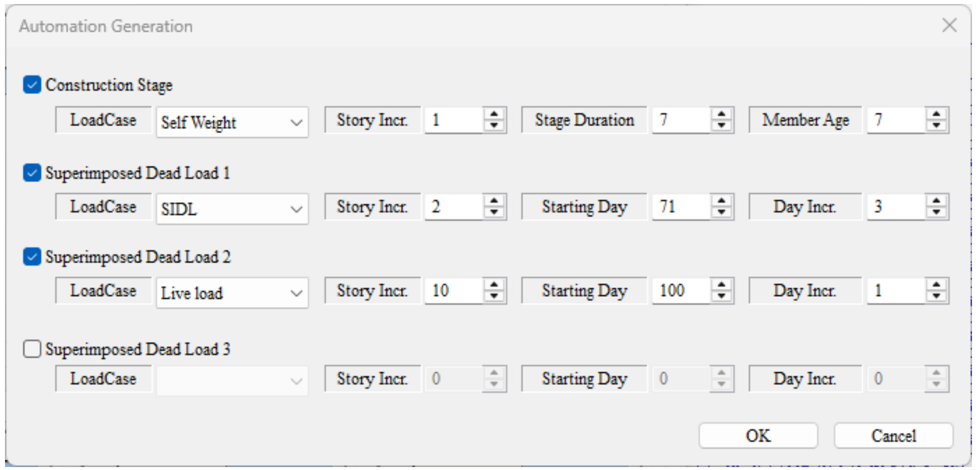
Plan

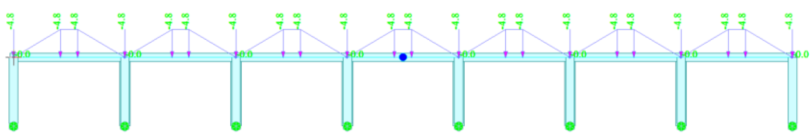
- ✓ 12 Story
- ✓ RC Frame-Shear wall Building



Live Demonstration

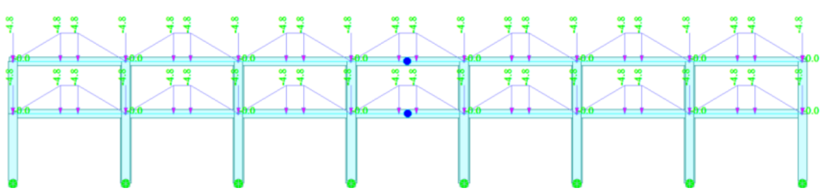
Construction Stage Definitions





CS-1

Load: Self Weight
Stage Duration: 7 Days
Member age: 7 Days
Story Increment: 1

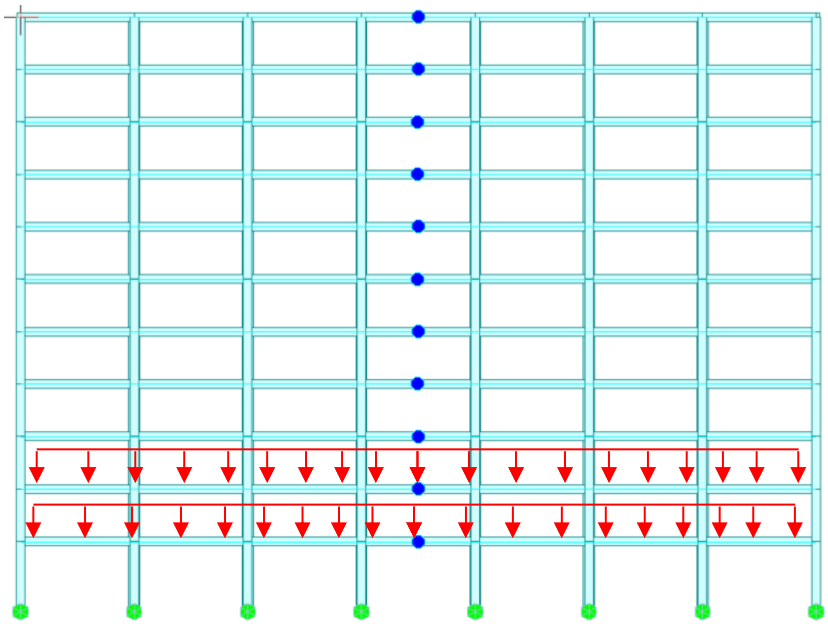


CS-2

Load: Self Weight
Stage Duration: 7 Days
Member age: 7 Days
Story Increment: 1

Live Demonstration

Construction Stage Definitions

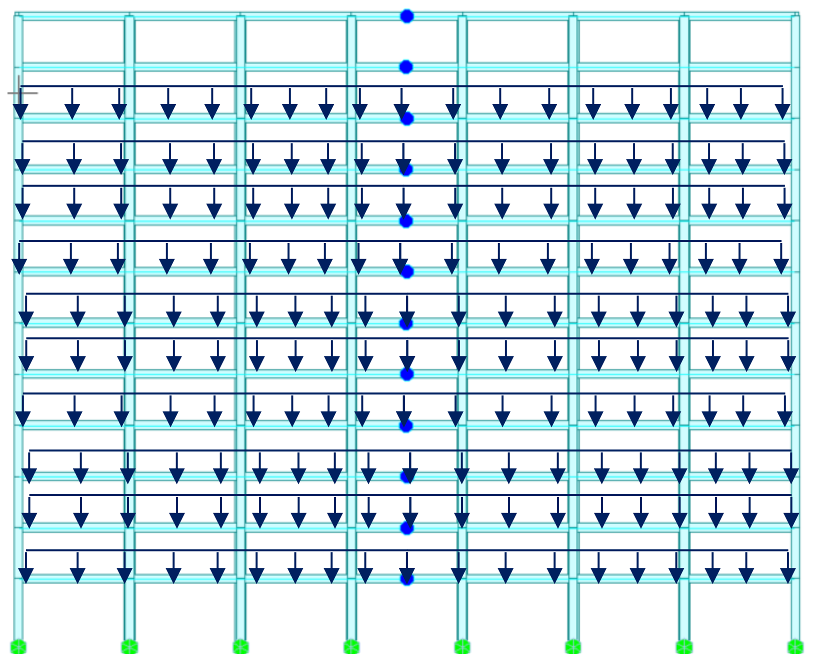


CS-11

Load: SIDL
Stage Duration: 7 Days
Starting day: 71st Day
Story Increment: 2
Day Increament: 3

Live Demonstration

Construction Stage Definitions



CS- Dummy

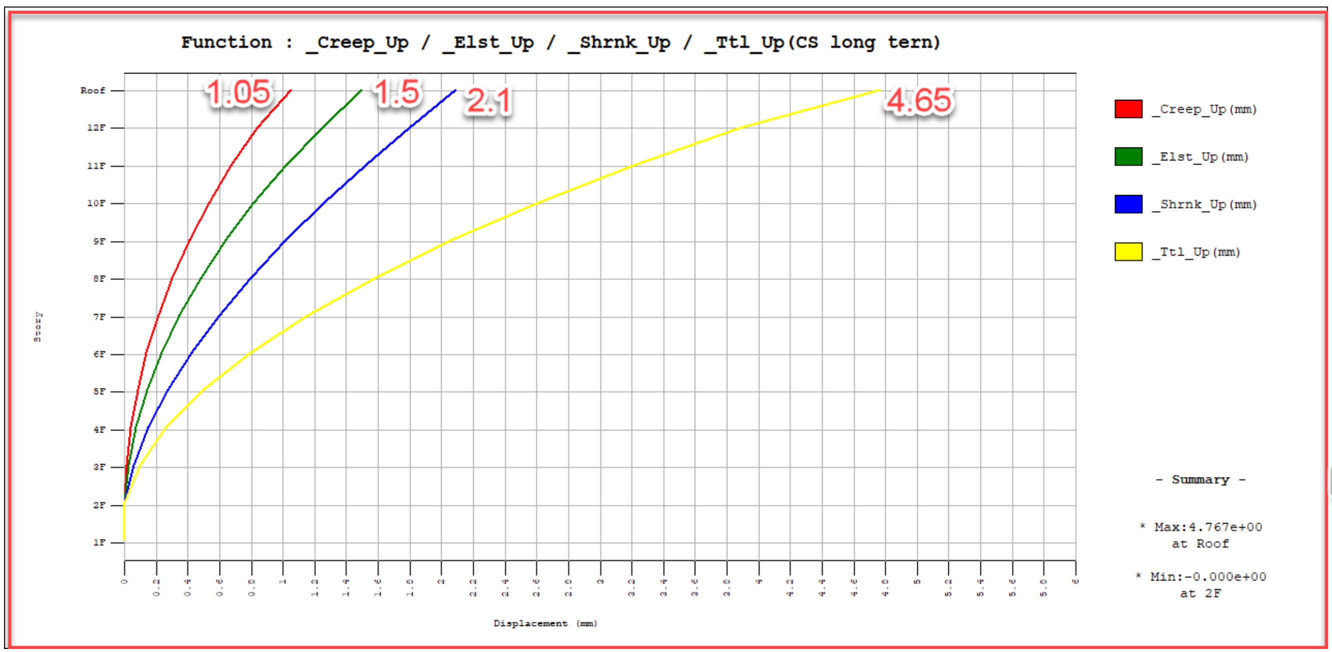
Load: Live Load
Stage Duration: 17 Days
Starting day: 100th Day
Story Increment: 10
Day increment: 1 day

Capabilities of CS Analysis in GEN

Column Shortening Graphs

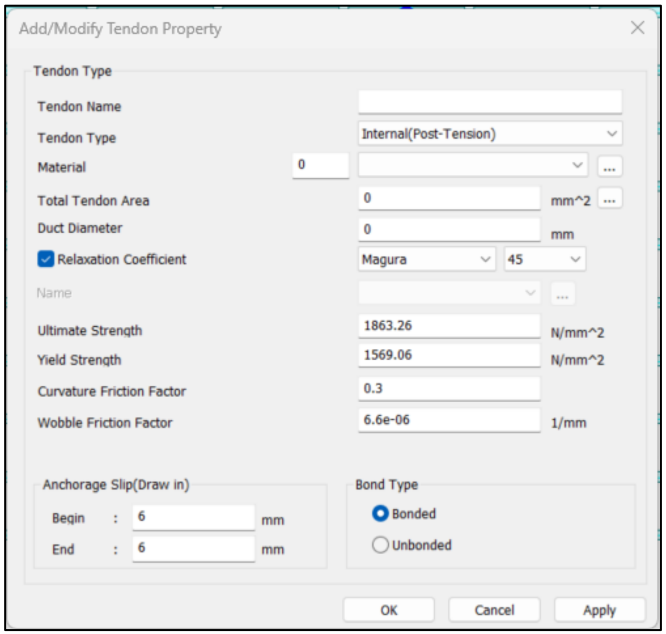
Data Availability

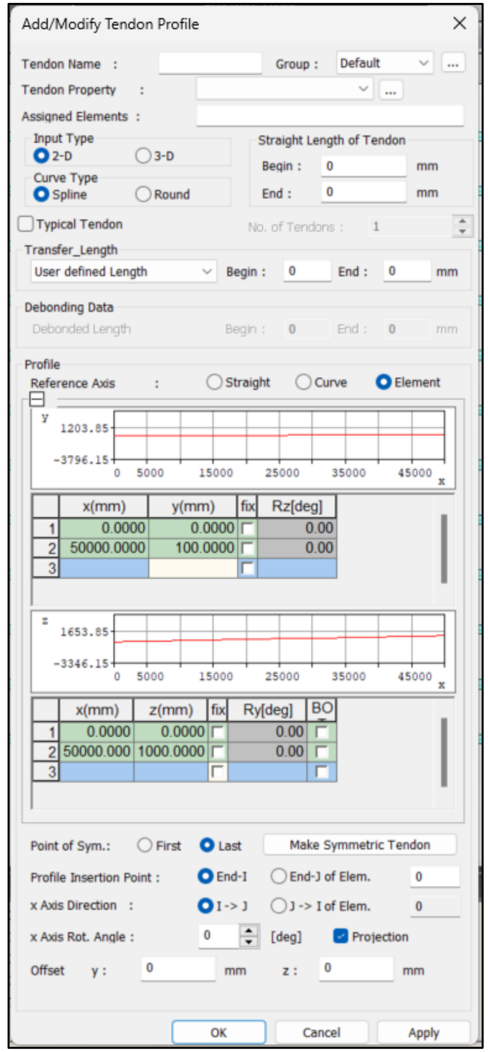
- ✓ Separate data for shortening by elastic deformations, creep and shrinkage.
- ✓ Data for up to casting and subsequent to casting.

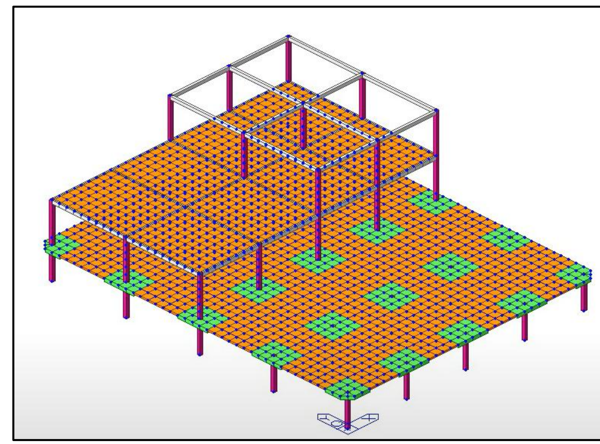


Capabilities of CS Analysis in GEN

Tendon Loss

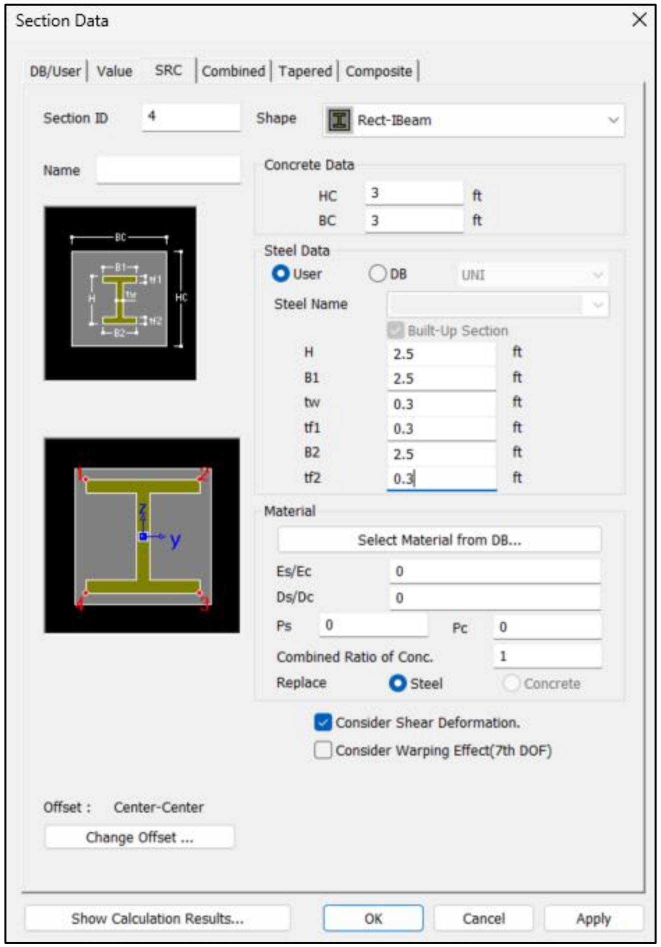


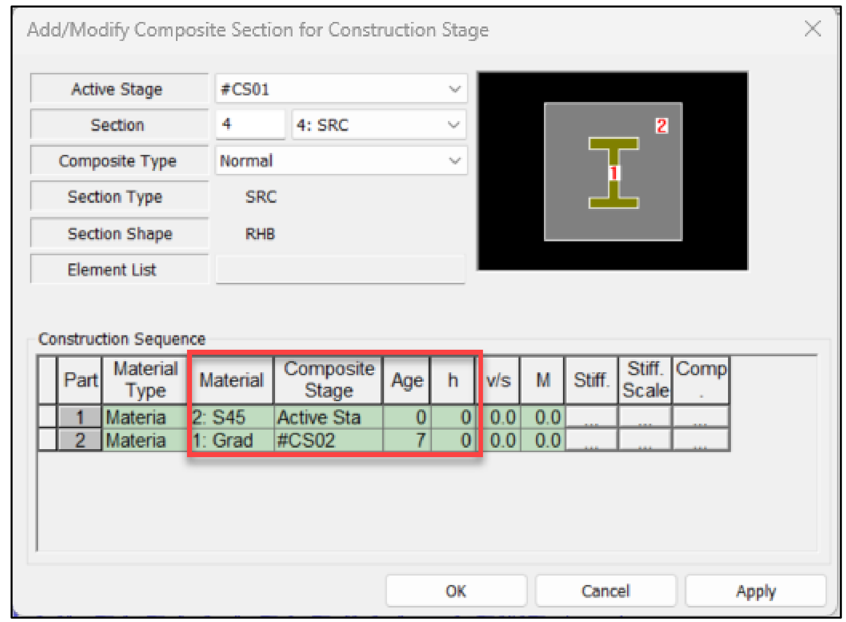




Capabilities of CS Analysis in GEN

Composite Section in CS

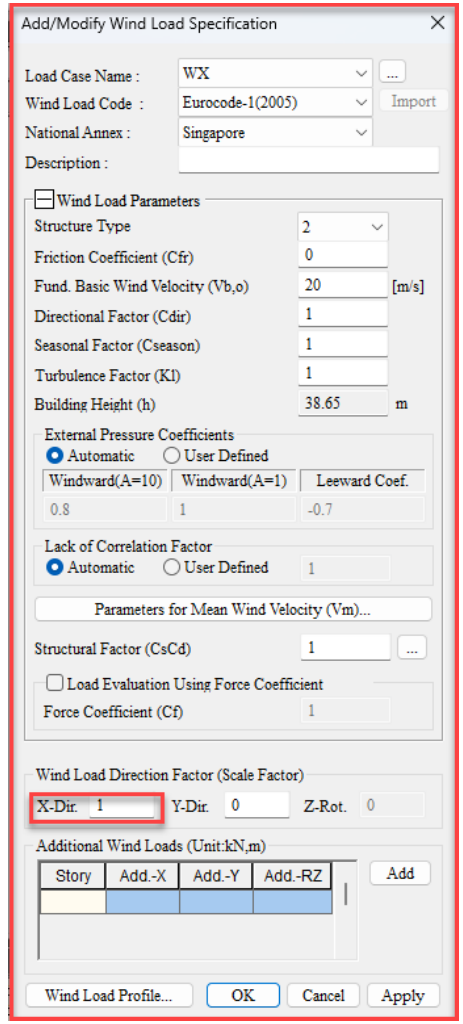


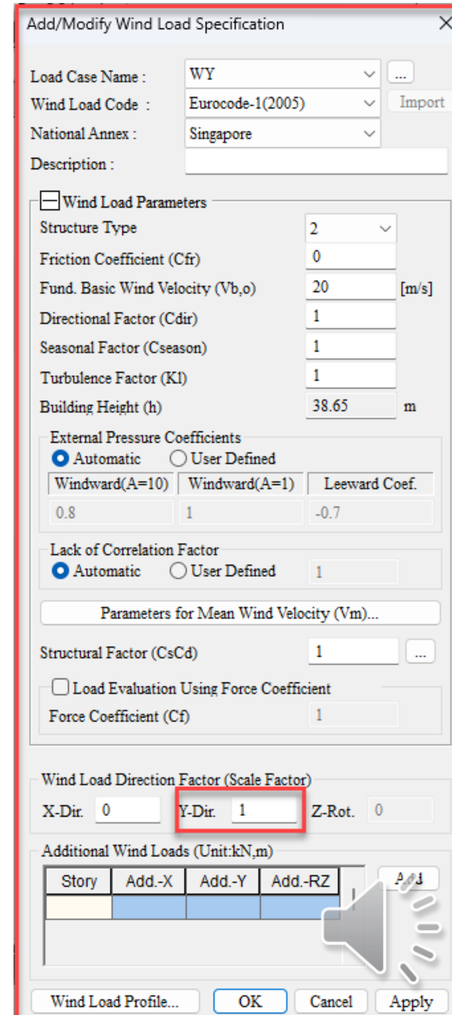


Wind Load Analysis

Wind load cases

- ✓ Wind load in X direction
- ✓ Wind load in Y direction

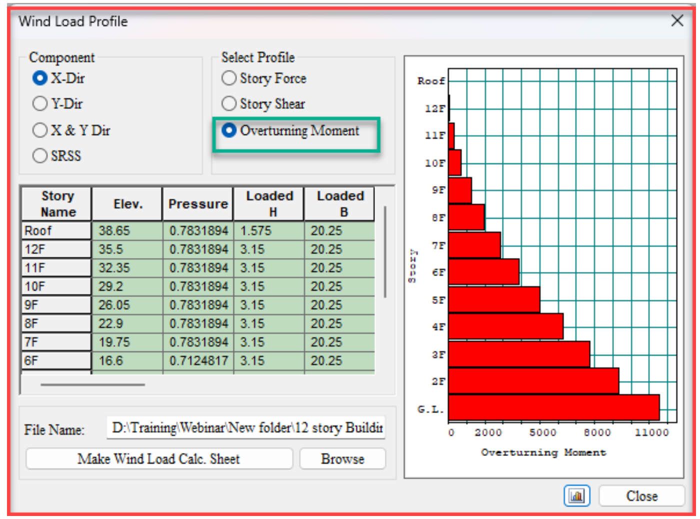


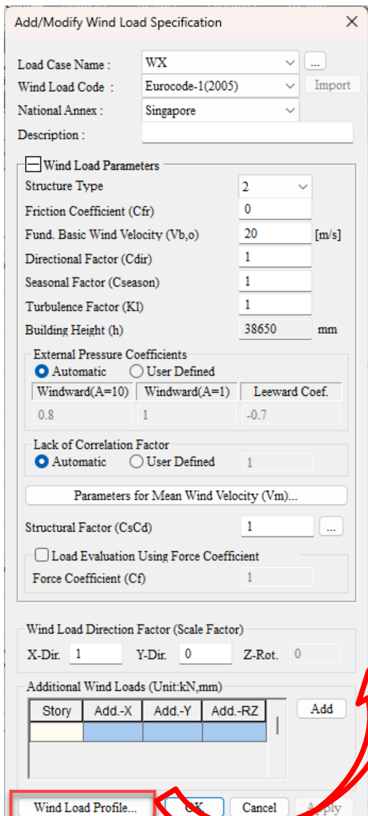


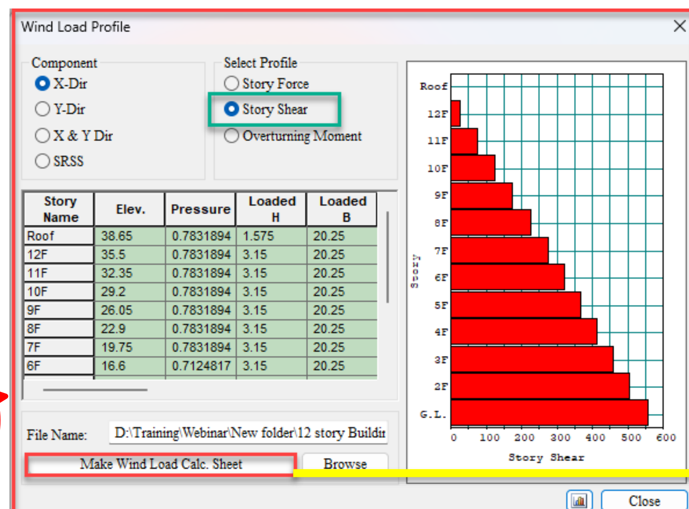
Wind Load Analysis

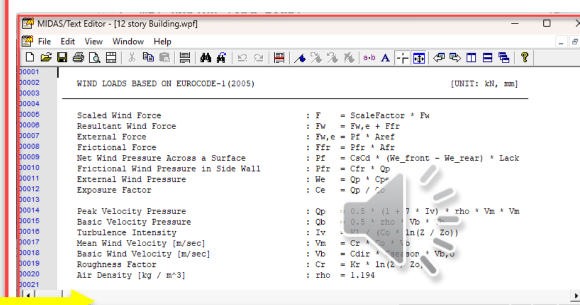
Wind load Profile

- ✓ Story shear
- ✓ Overturning moment









Wind Load Analysis

MIDAS

Storey checks

- ✓ Story Drift
- ✓ Story Displacement
- ✓ Torsional irregularity

Start Page | MIDAS/Gen | Result-[Story Drift] | Result-[Story Displacement] | Re

Load Case	Node	Story	Level (mm)	Story Height (mm)	Maximum Displacement (mm)	Average Displacement (mm)	Maximum / Average
WX	385	Roof	38650.00	0.00	4.0059	4.0059	1.0000
WX	353	12F	35500.00	3150.00	3.9536	3.9536	1.0000
WX	321	11F	32350.00	3150.00	3.8548	3.8548	1.0000
WX	289	10F	29200.00	3150.00	3.7004	3.7004	1.0000
WX	257	9F	26050.00	3150.00	3.4878	3.4878	1.0000
WX	225	8F	22900.00	3150.00	3.2168	3.2168	1.0000
WX	193	7F	19750.00	3150.00	2.8880	2.8880	1.0000
WX	161	6F	16600.00	3150.00	2.5034	2.5034	1.0000
WX	129	5F	13450.00	3150.00	2.0653	2.0653	1.0000
WX	97	4F	10300.00	3150.00	1.5763	1.5763	1.0000
WX	65	3F	7150.00	3150.00	1.0439	1.0439	1.0000
WX	1	2F	4000.00	3150.00	0.4949	0.4949	1.0000
WX	0	1F	0.00	4000.00	0.0000	0.0000	0.0000

Start Page | MIDAS/Gen | Result-[Story Drift] | Result-[Story Displacement] | Result-[Torsional Irregularity Check]

Load Case	Story	Story Height (mm)	P-Delta Incremental Factor (ad)	Allowable Story Drift Ratio	Maximum Drift of All Vertical Elements					Drift at the Center of Mass				
					Node	Story Drift (mm)	Modified Drift (mm)	Story Drift Ratio	Remark	Story Drift (mm)	Modified Drift (mm)	Drift Factor (Maximum/Current)	Story Drift Ratio	Remark
RMC,Not Used, Cd=1, Ie=1.5, Scale Factor=1, Allowable Ratio=0.015 Press right mouse button and click 'Set Story Drift Parameters...' menu to change RMC or Cd/Ie/Scale Factor/Allowable Ratio/Beta!														
WX	12F	3150.00	1.00	0.0150	355	0.0523	0.0523	0.0000	OK	0.0523	0.0523	1.0000	0.0000	OK
WX	11F	3150.00	1.00	0.0150	323	0.0987	0.0987	0.0000	OK	0.0987	0.0987	1.0000	0.0000	OK
WX	10F	3150.00	1.00	0.0150	291	0.1545	0.1545	0.0000	OK	0.1545	0.1545	1.0000	0.0000	OK
WX	9F	3150.00	1.00	0.0150	259	0.2125	0.2125	0.0001	OK	0.2125	0.2125	1.0000	0.0001	OK
WX	8F	3150.00	1.00											
WX	7F	3150.00	1.00											
WX	6F	3150.00	1.00											
WX	5F	3150.00	1.00											
WX	4F	3150.00	1.00											
WX	3F	3150.00	1.00											
WX	2F	3150.00	1.00											
WX	1F	4000.00	1.00											

Start Page | MIDAS/Gen | Result-[Story Drift] | Result-[Story Displacement] | Result-[Torsional Irregularity Check]

Load Case	Story	Level (mm)	Story Height (mm)	Average Value of Extreme Points		Maximum Value		Remark
				Story Drift (mm)	1.2*Story Drift (mm)	Node	Story Drift (mm)	
WX	12F	35500.00	3150.00	0.0523	0.0628	355	0.0523	Regular
WX	11F	32350.00	3150.00	0.0987	0.1185	323	0.0987	Regular
WX	10F	29200.00	3150.00	0.1545	0.1854	291	0.1545	Regular
WX	9F	26050.00	3150.00	0.2125	0.2551	259	0.2125	Regular
WX	8F	22900.00	3150.00	0.2710	0.3252	227	0.2710	Regular
WX	7F	19750.00	3150.00	0.3288	0.3946	195	0.3288	Regular
WX	6F	16600.00	3150.00	0.3847	0.4616	163	0.3847	Regular
WX	5F	13450.00	3150.00	0.4381	0.5257	131	0.4381	Regular
WX	4F	10300.00	3150.00	0.4890	0.5868	99	0.4890	Regular
WX	3F	7150.00	3150.00	0.5324	0.6389	67	0.5324	Regular
WX	2F	4000.00	3150.00	0.5490	0.6588	3	0.5490	Regular
WX	1F	0.00	4000.00	0.4949	0.5939	35	0.4949	Regular

midas Gen

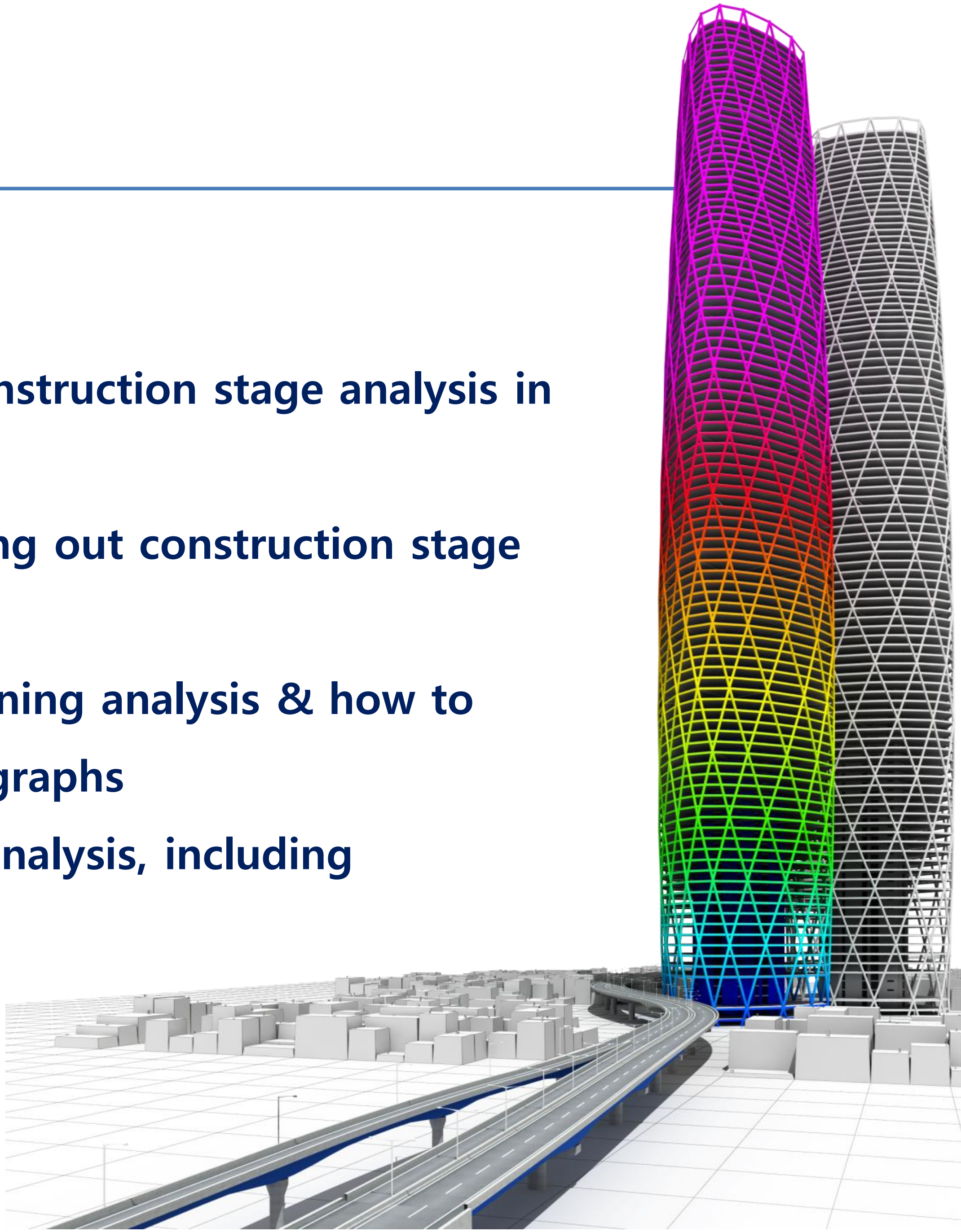
Summary

✓ Studied the importance of construction stage analysis in buildings

✓ Learned the process of carrying out construction stage Analysis in midas GEN

✓ Learned about column shortening analysis & how to generate column shortening graphs

✓ Studied the static wind load analysis, including story checks



Thank You

Contact us at: https://midas-support.zendesk.com