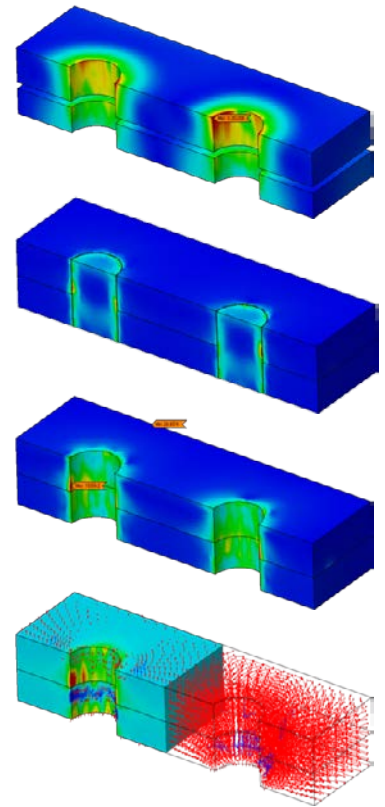


FEA NX 軟體介紹

New Paradigm in Advanced Structural Analysis



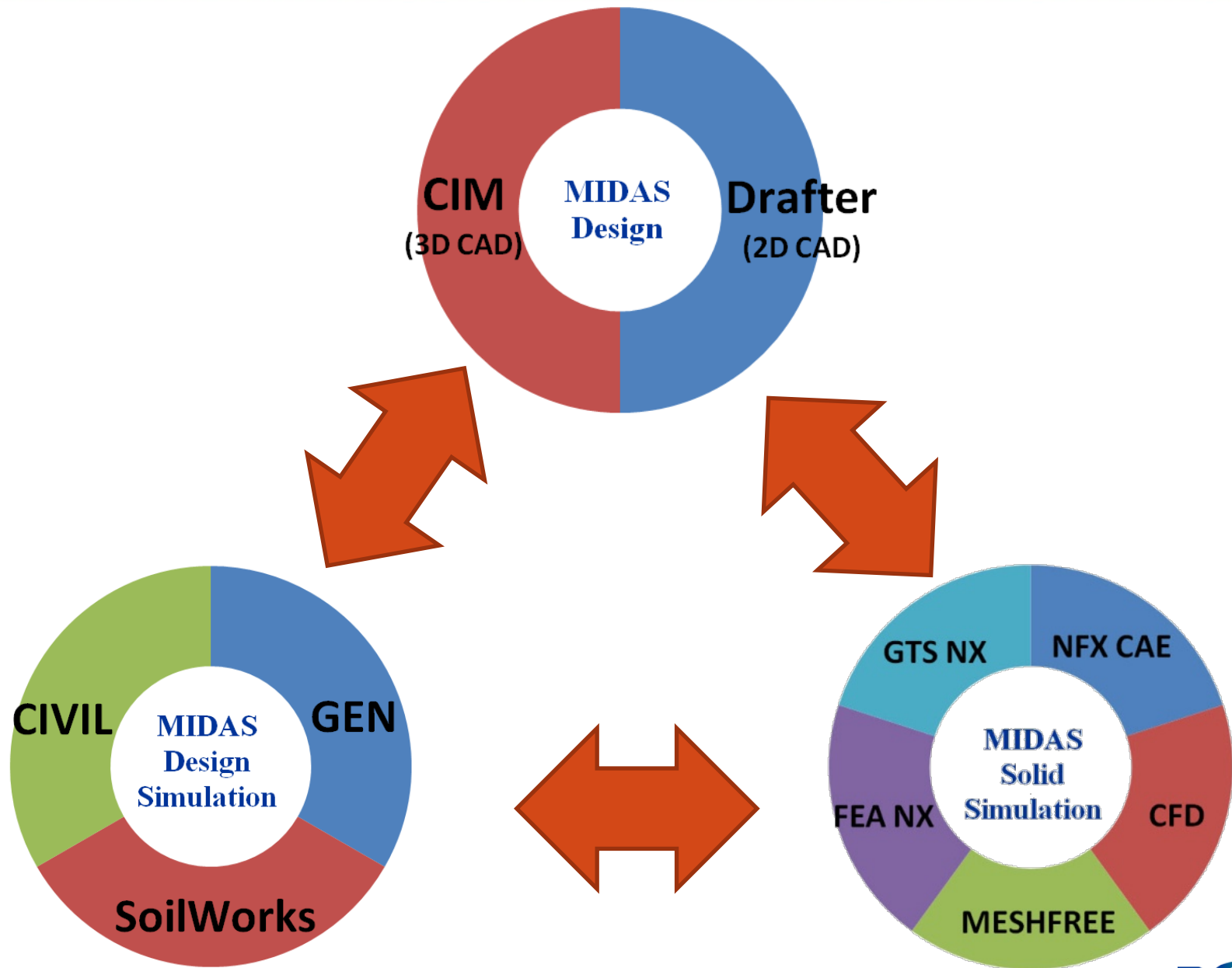
Contents

1. Overview
2. Geometry Modeling
3. Mesh Generation
4. Analysis
5. Post-processing
6. Application

Contents

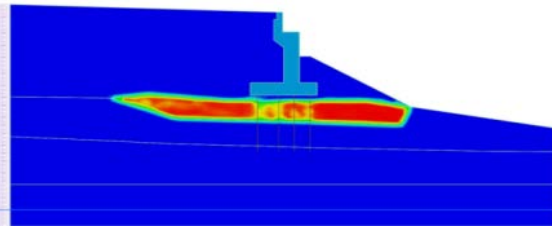
1. Overview
2. Geometry Modeling
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4. Analysis
5. Post-processing
6. Application

MIDAS Software Integration

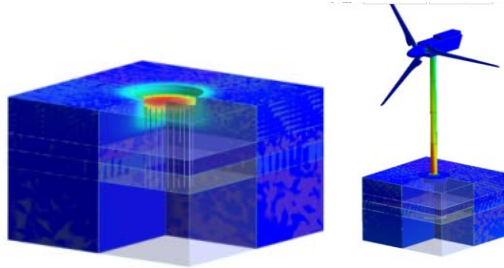


Solid Total Solution

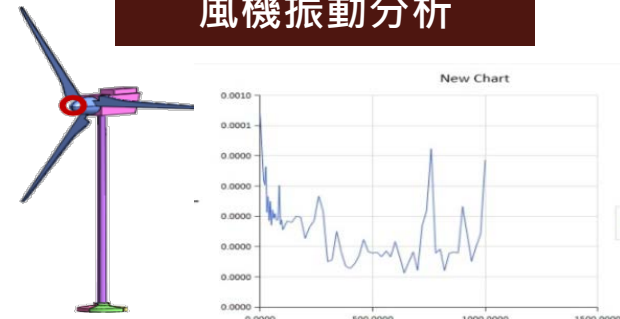
土壤液化分析



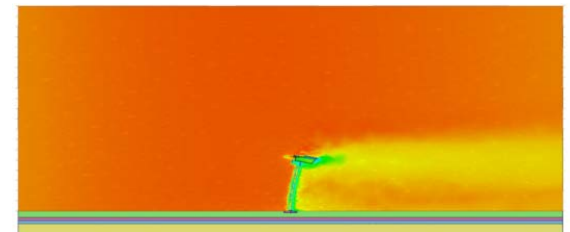
風機安裝施工階段分析



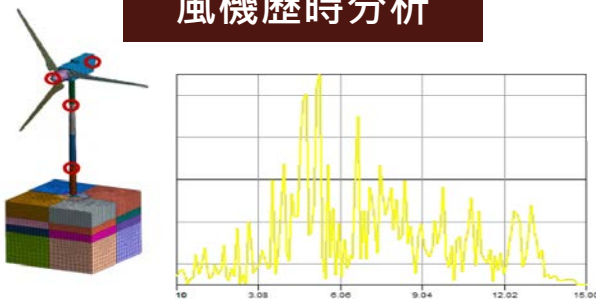
風機振動分析



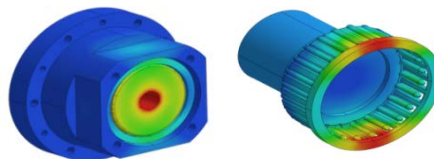
風機流固耦合分析



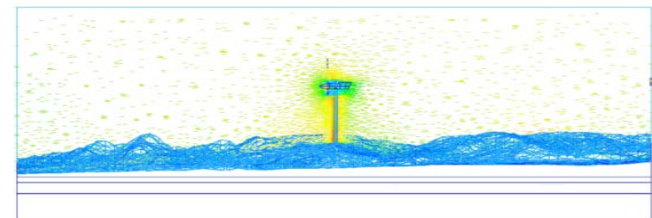
風機歷時分析



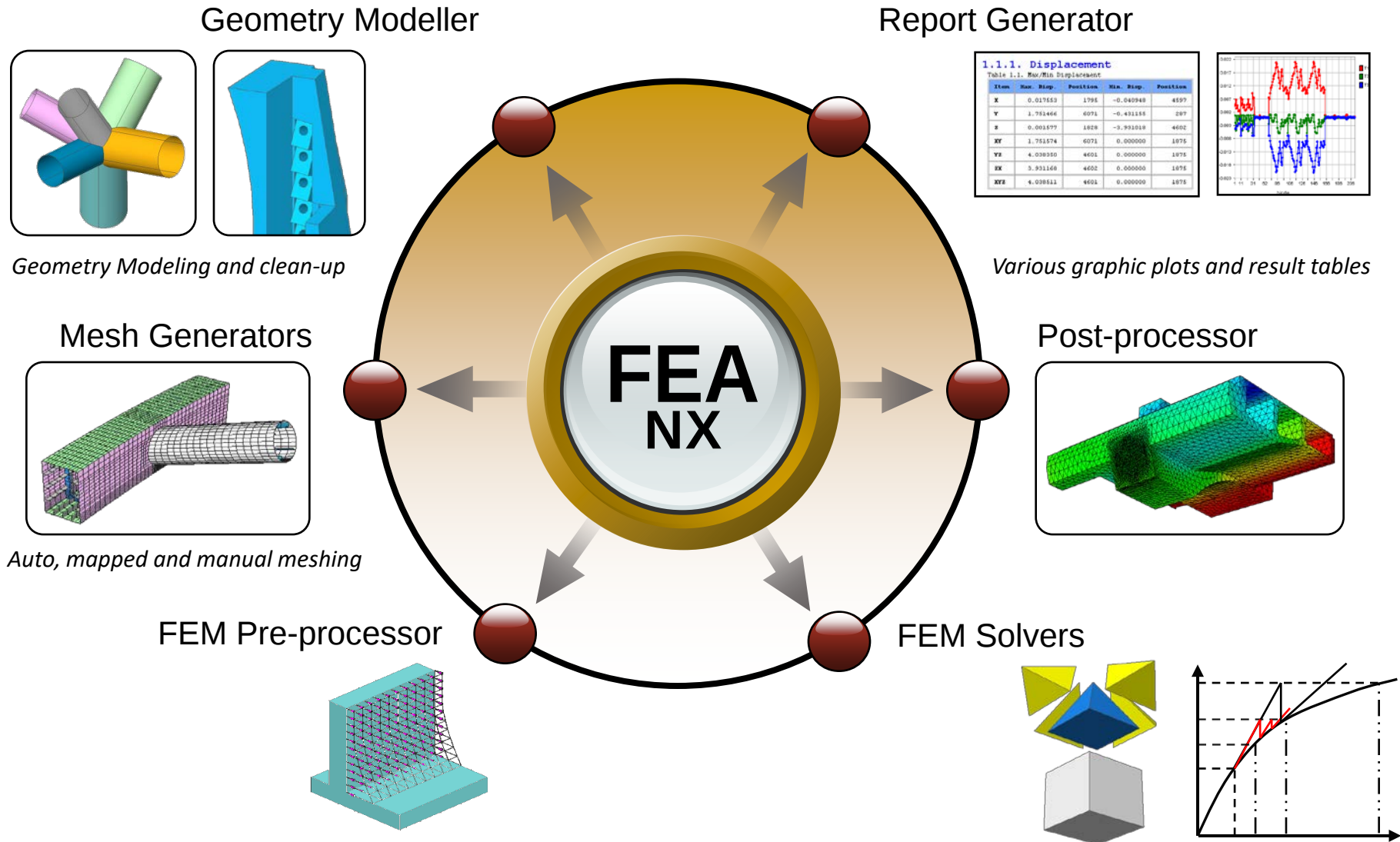
齒輪組分析



風機地形風場分析

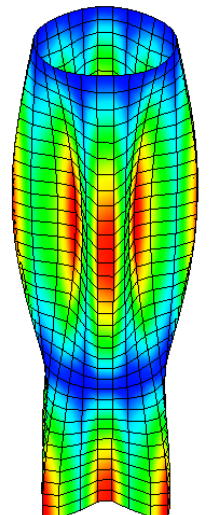
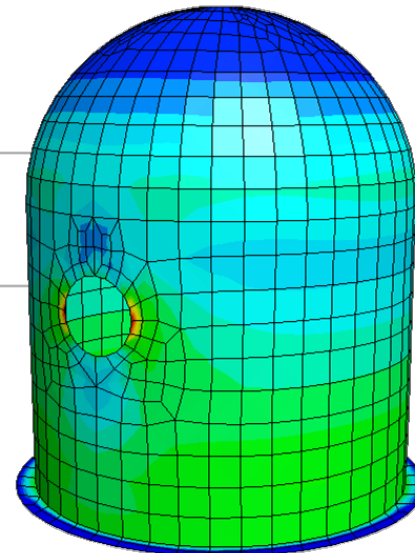
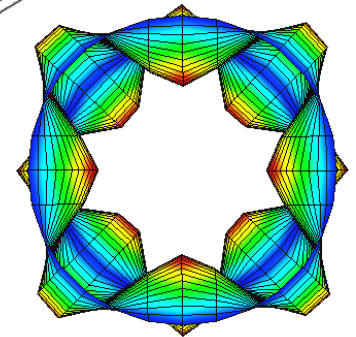
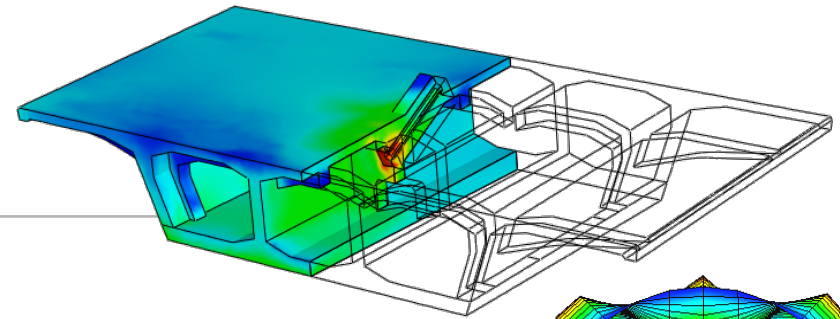


FEA NX Analysis Process



FEA NX Analysis Capabilities

- Static Analysis
- Construction Stage Analysis
- Reinforcement Analysis
- Buckling Analysis
- Eigenvalue Analysis
- Response Spectrum Analysis
- Time History Analysis(Linear/Nonlinear)
- Static Contact Analysis
- Interface Nonlinearity Analysis
- Nonlinear Analysis(Material/Geometric)
- Concrete Crack Analysis
- Heat of Hydration Analysis
- Heat Transfer Analysis
- Slope Stability Analysis
- Seepage Analysis
- Consolidation Analysis
- Coupled Analysis(Fully/Semi)



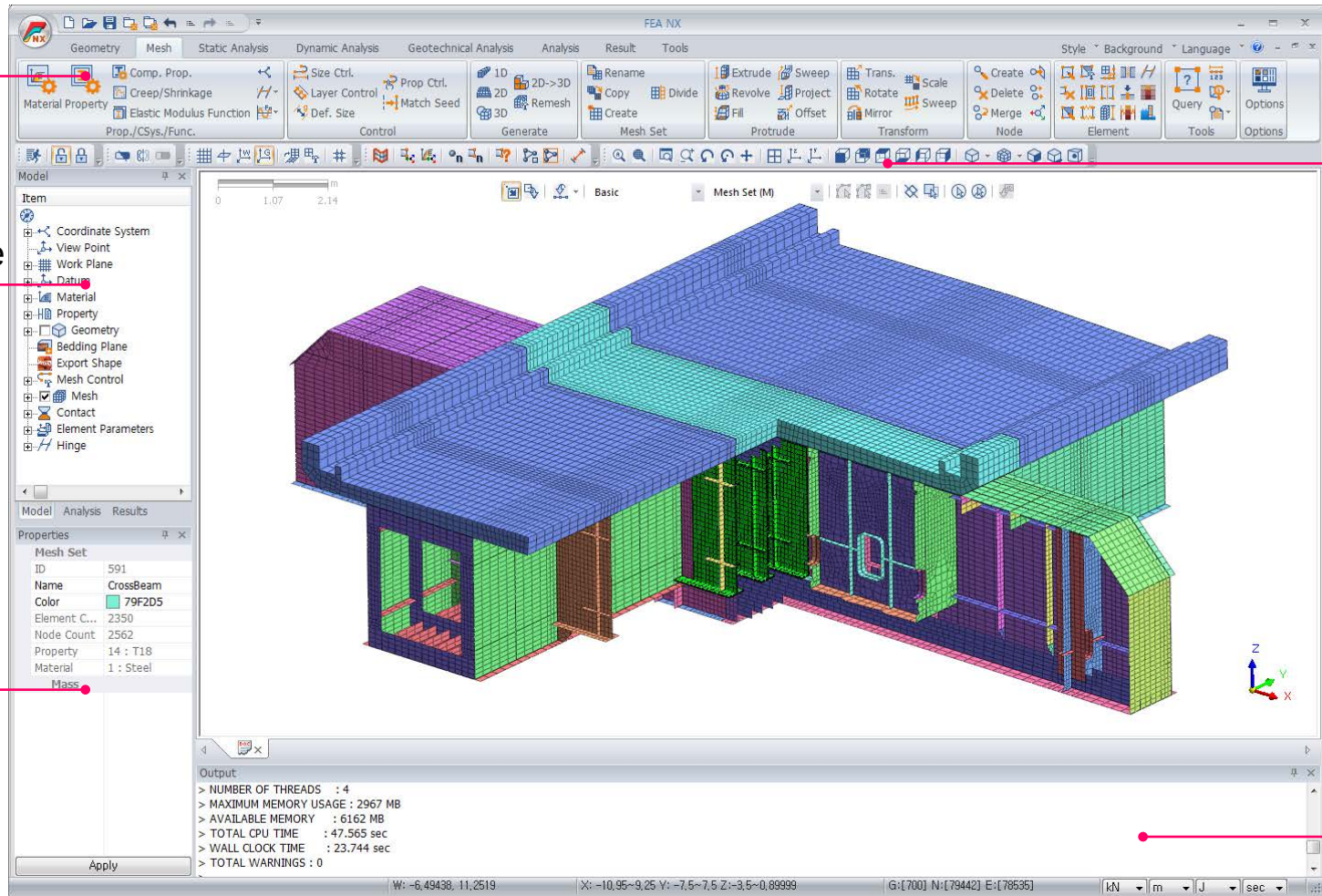
FEA NX GUI Enviroment

Main Menu

Works Tree

Property Window

Tabbed
Toolbar



Output
Window

64-bit environment platform

Next Generation Platform

Complete support for 64-bit

Control large scale model

Automated Modeling

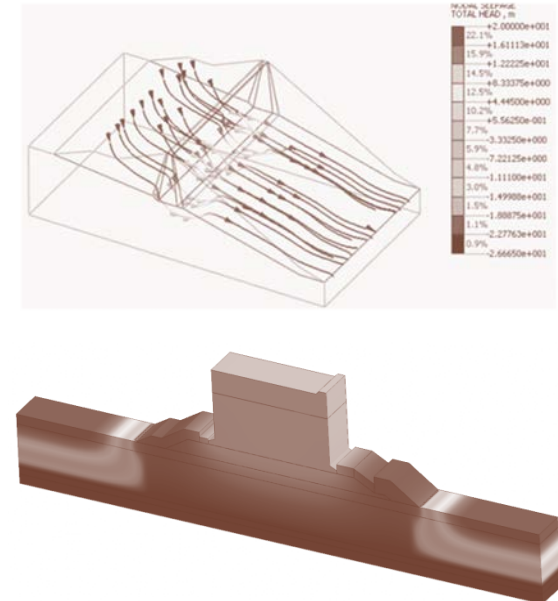
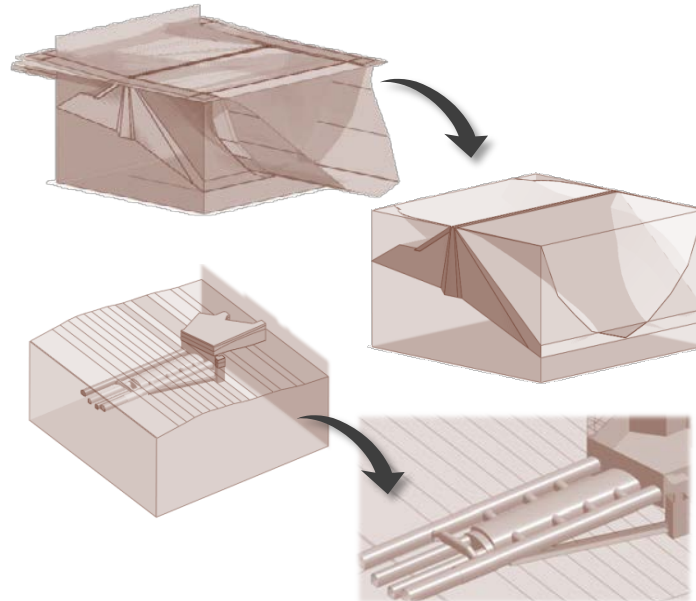
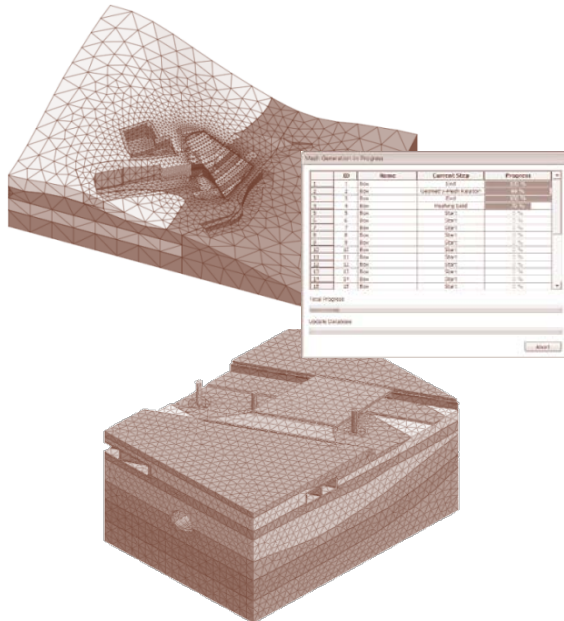
Stabilized geometric operation

Diverse automatic tools

Universal Solver

New MIDAS solver

Advanced analysis conditions



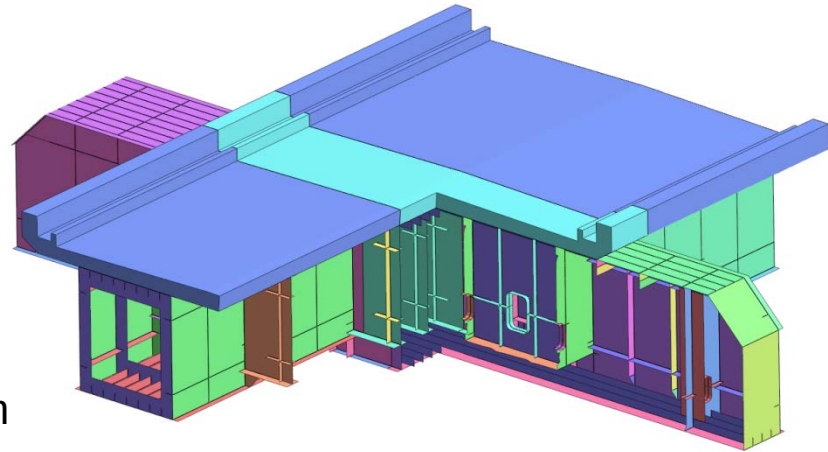
Contents

1. Overview
2. Geometry Modeling
3. Mesh Generation
4. Analysis
5. Post-processing
6. Application

CAD File Import

■ Import (Geometry)

- AutoCAD
- Parasolid / ACIS / STEP
- IGES / Pro-E
- CATIA V4 / V5
- SolidWorks / Unigraphics
- Inventor Part / Inventor Assem



Imported CAD Geometry

Import the geometries or FE model in the selected file



Import CAD File...

Import the CAD file into a current project



DXF 2D (Wireframe)...

Import the DXF 2D file into a current project



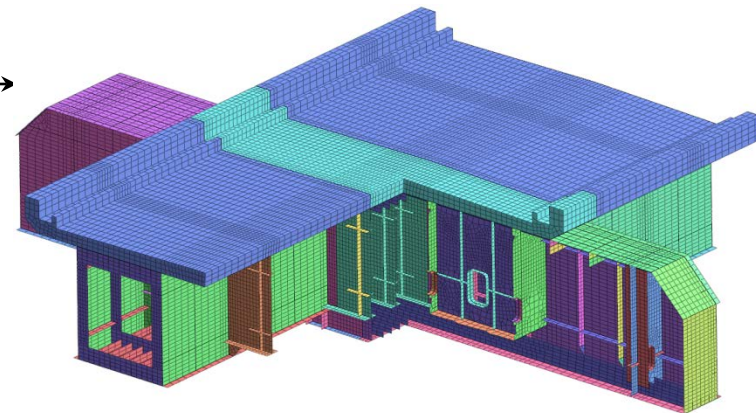
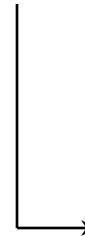
DXF 3D (Wireframe)...

Import the DXF 3D file into a current project



DWG (Wireframe)...

Import the DWG file into a current project



Generated Mesh

CAD File Export

■ Export (Geometry)

- Parasolid
- STL



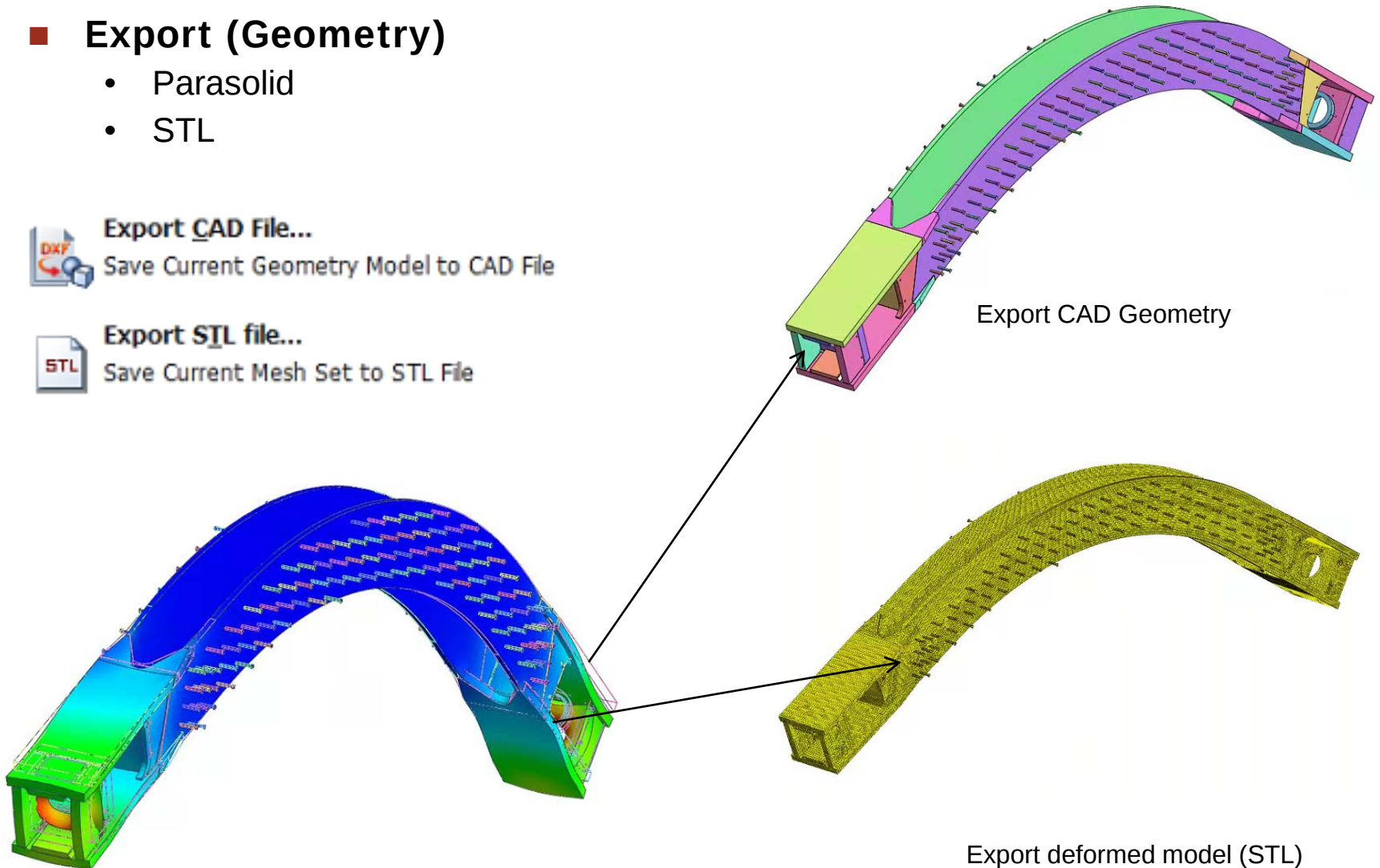
Export CAD File...

Save Current Geometry Model to CAD File



Export STL file...

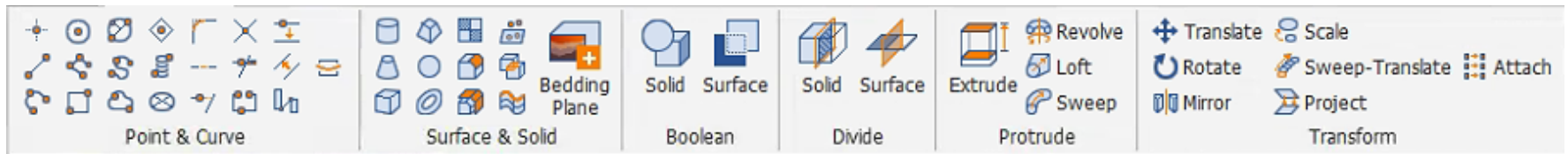
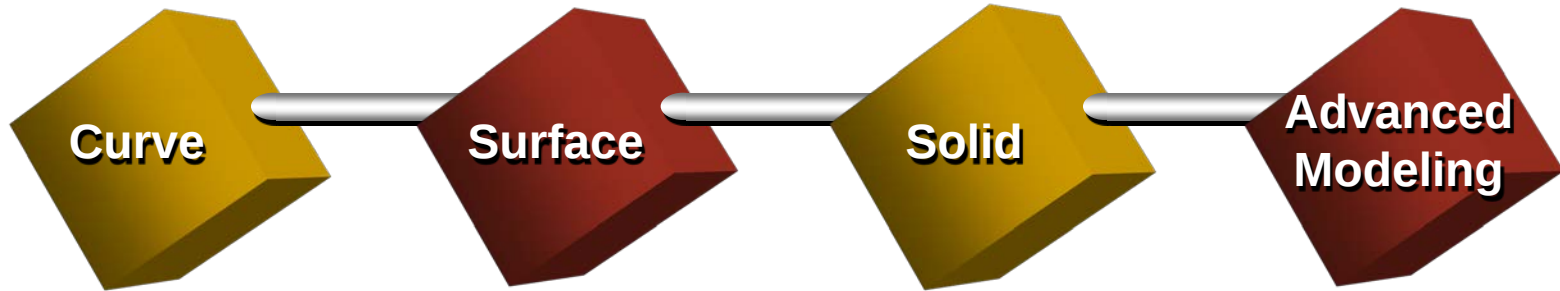
Save Current Mesh Set to STL File



Export CAD Geometry

Export deformed model (STL)

Geometry Modeling



- Line, Polyline
- Arc, Circle
- Polygon
- B-Spline
- Tunnel Section
- Fillet, Chamfer
- Trim, Extend
- Intersect
- Offset
- Break, Merge
- ...

- Face
- Coons Face
- Grid Face
- Point
- Fillet, Chamfer
- Sew, Fuse
- Divide
- Offset
- Auto Connect
- Imprint
- ...

- Box, Wedge
- Cylinder, Cone
- Sphere, Torus
- Divide
- Boolean Op. (Fuse, Cut, ...)
- Super Shape
- ...

- Extrude
- Revolve
- Loft
- Sweep
- Fillet, Chamfer
- Offset, Draft
- Shelling
- Check, Repair
- Transform
- ...

Advanced Modeling functions support both **top-down** and **bottom-up** approaches in **surface** & **solid** Modeling.

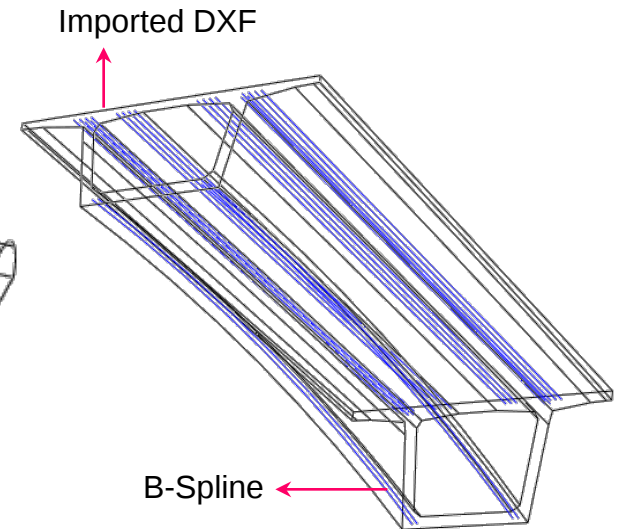
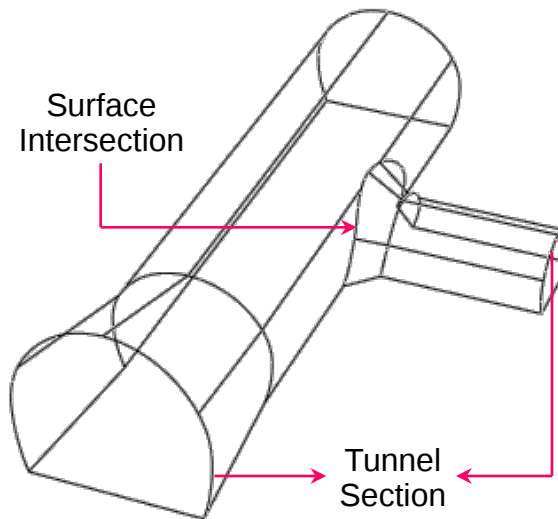
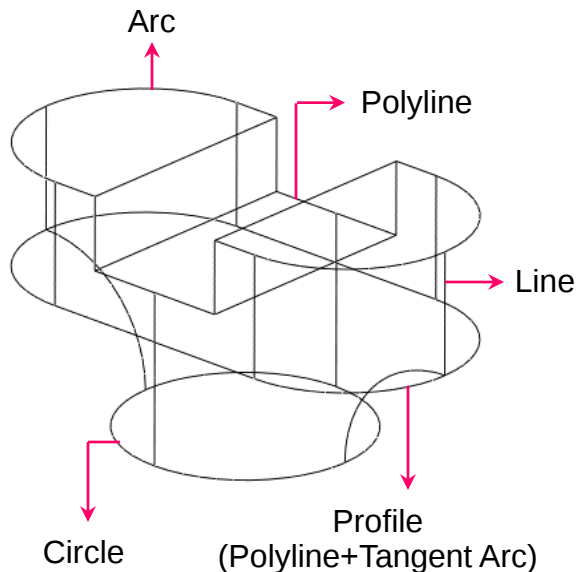
Curve Modeling

Generation

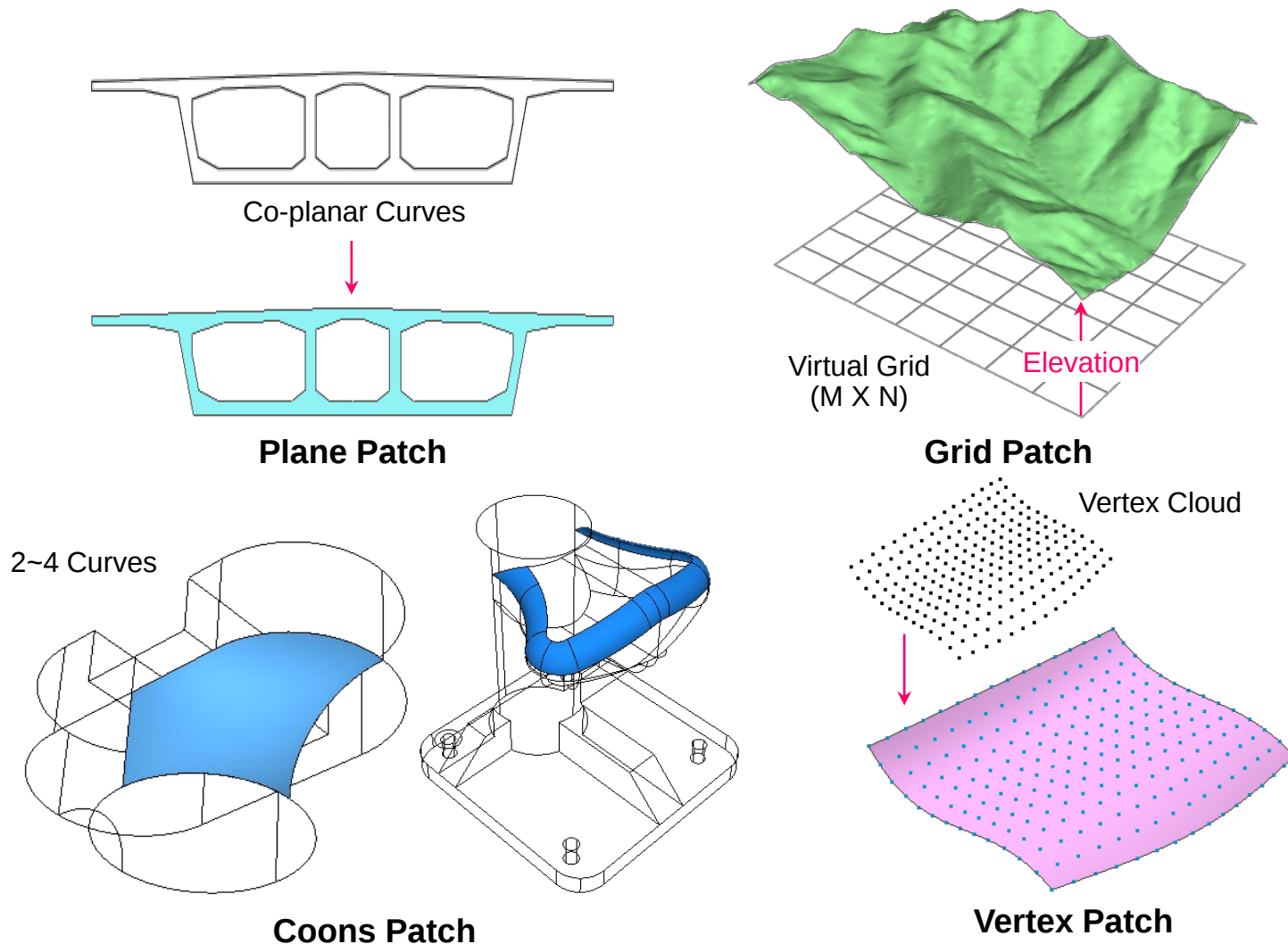
- Line
- Arc
- Circle
- Ellipse
- Tunnel
- B-Spline
- Polyline
- Rectangle
- Polygon
- Profile
- Shortest Path Line
- Surface Intersection
- Offset Curve
- Extrude Point

Modification

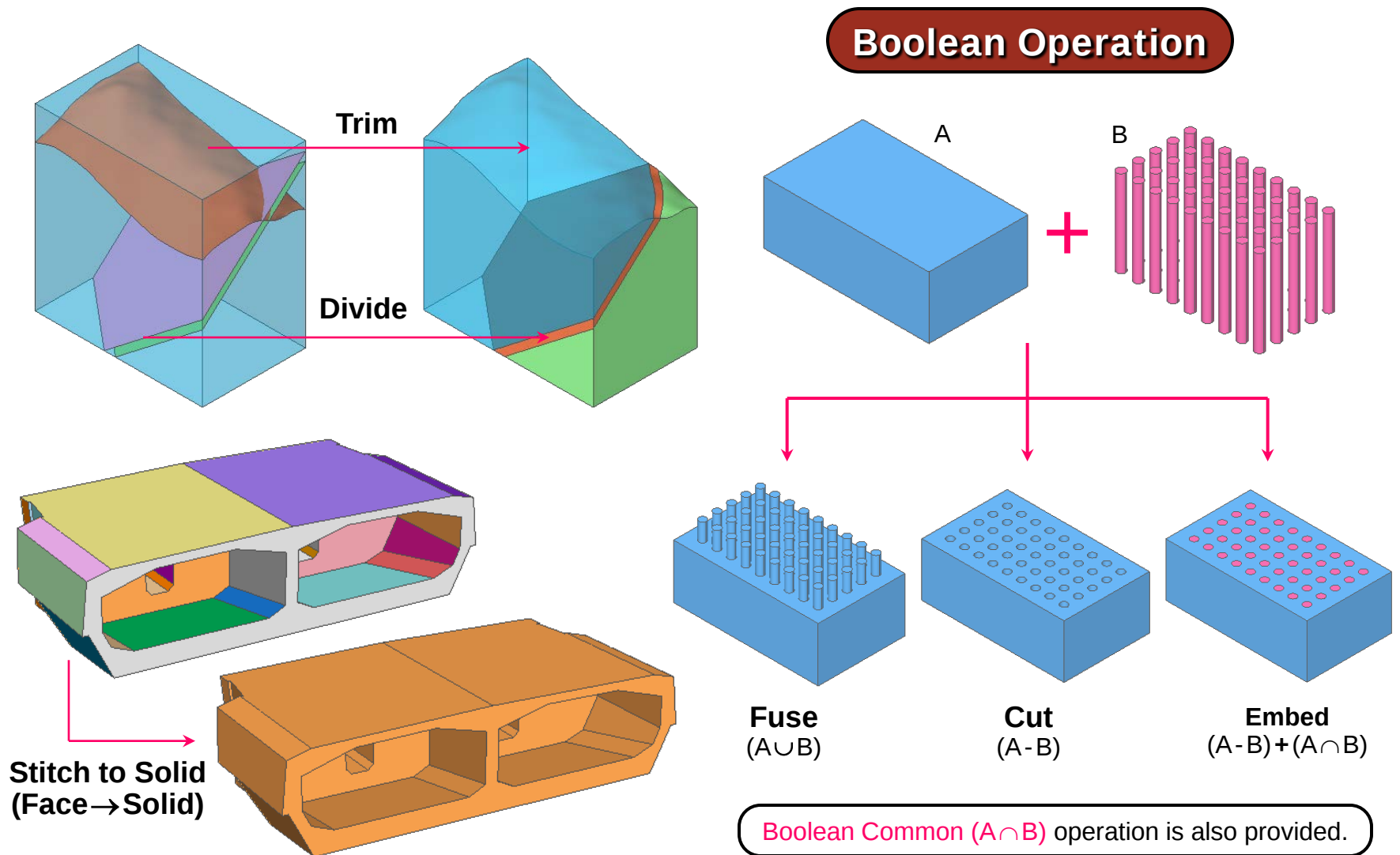
- Fillet / Chamfer
- Trim / Extend
- Merge / Break
- Intersect
- Make Wire



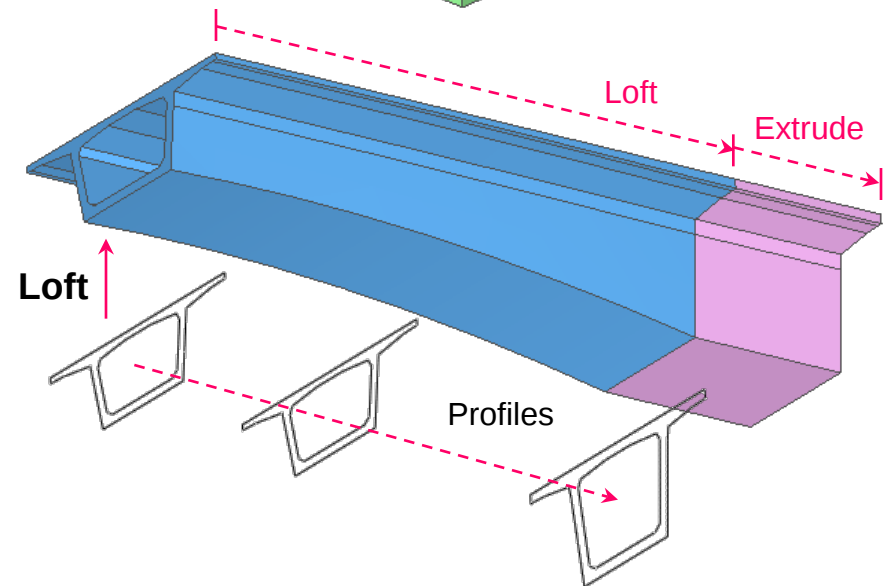
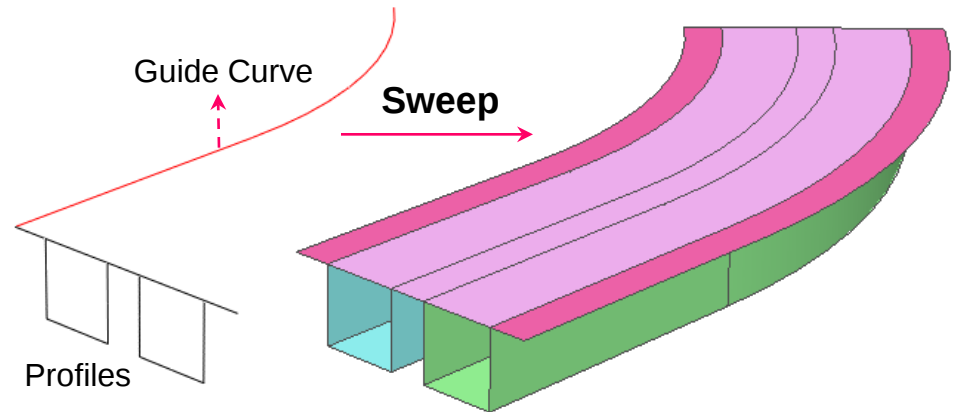
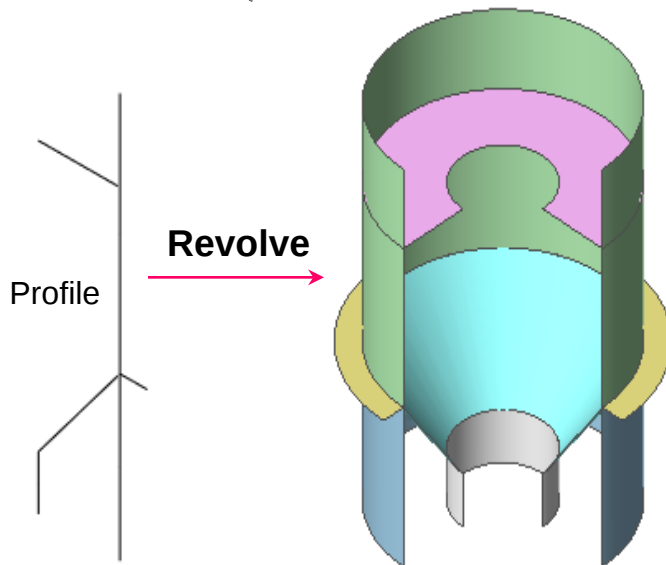
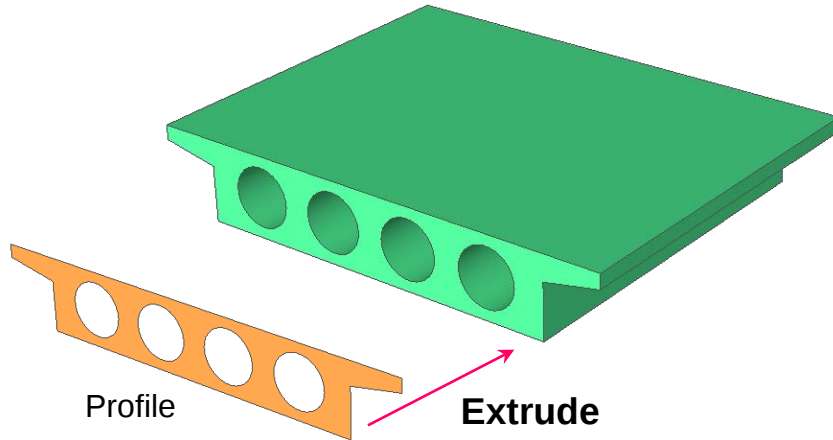
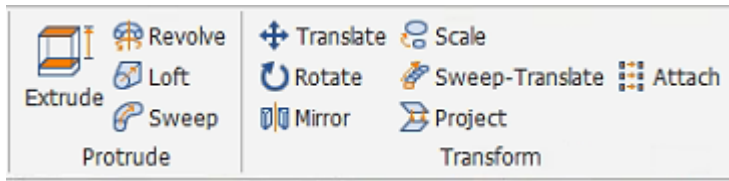
Surface Modeling



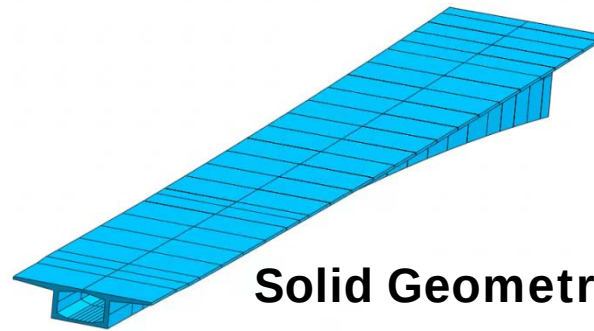
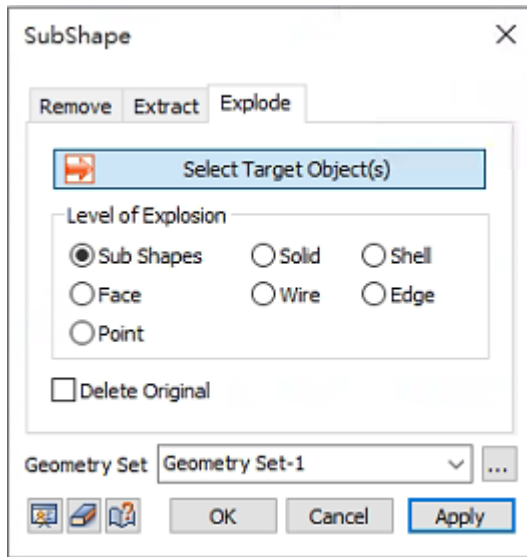
Solid Modeling



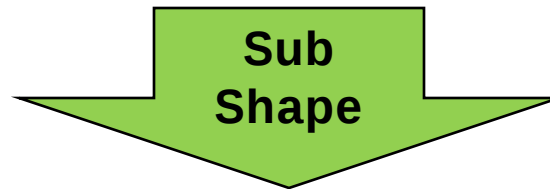
Advanced CAD -Protrude



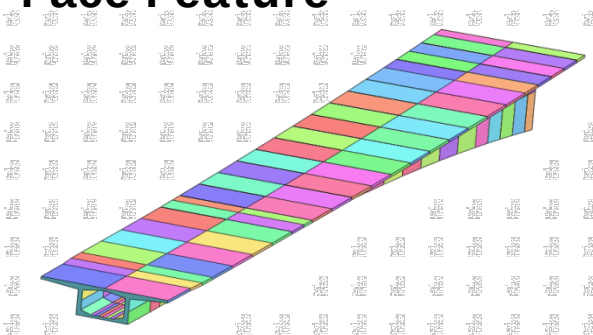
Advanced CAD –Sub Shape



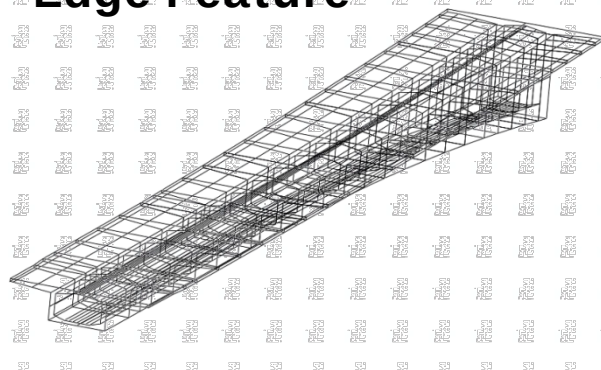
Solid Geometry



Face Feature



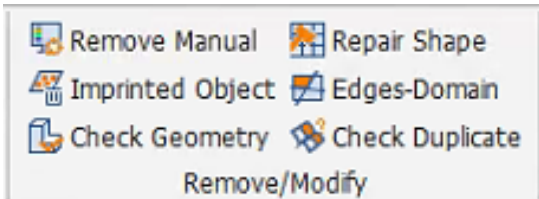
Edge Feature



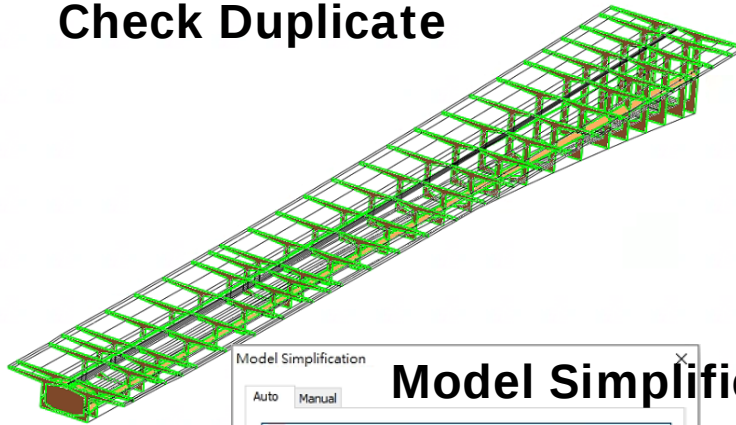
Point Feature



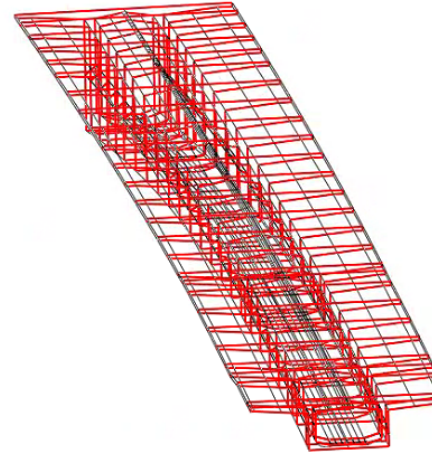
Advanced CAD –Remove / Modification



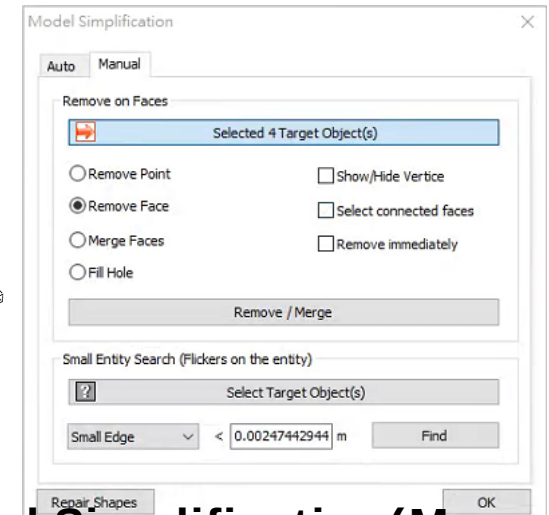
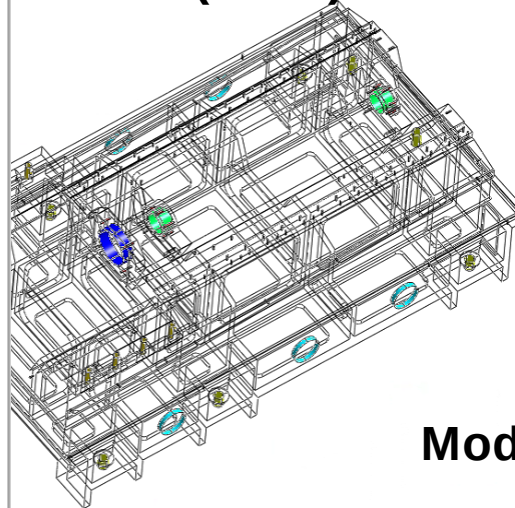
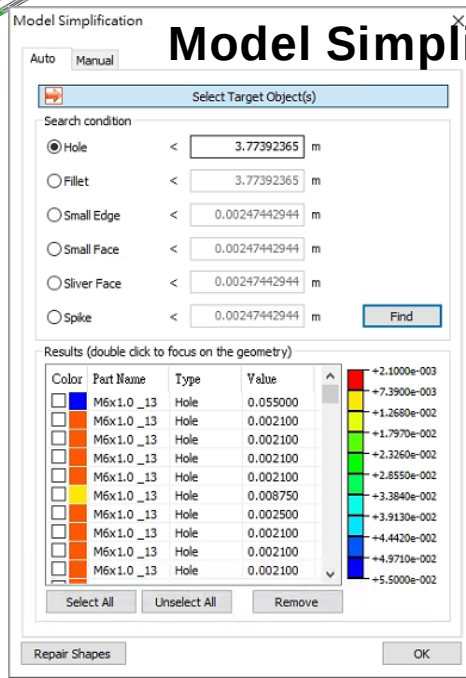
Check Duplicate



Check Shape



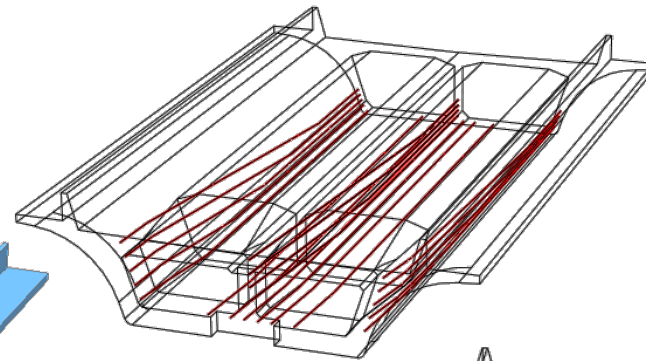
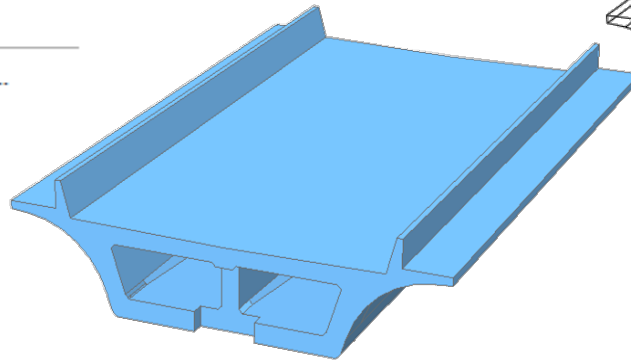
Model Simplification(Auto)



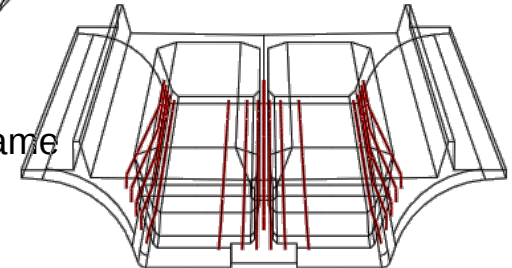
Model Simplification(Manual)

Geometry Graphic Display

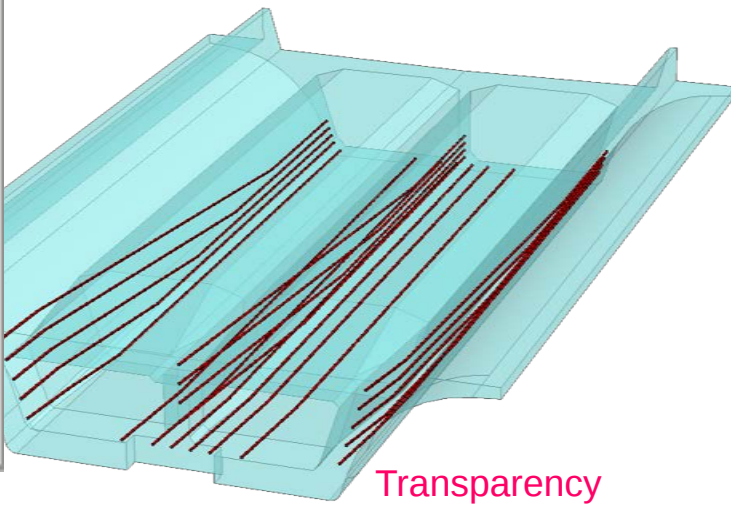
- Show All Geometries
- Hide All Geometries
- Shading+Line
- Shading
- Line
- Bounding Box
- Change Geometry Color...
- Random Color



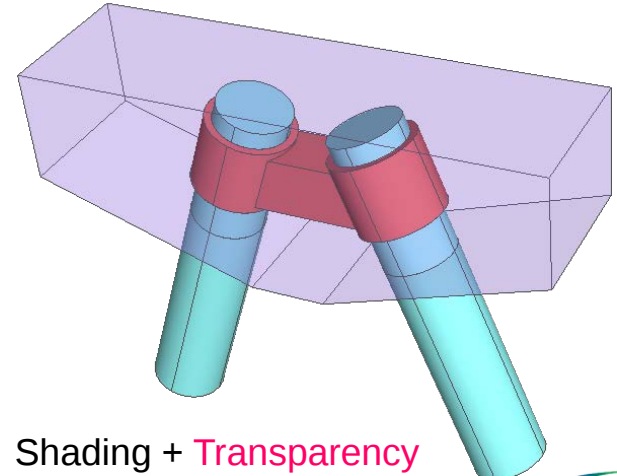
Wireframe



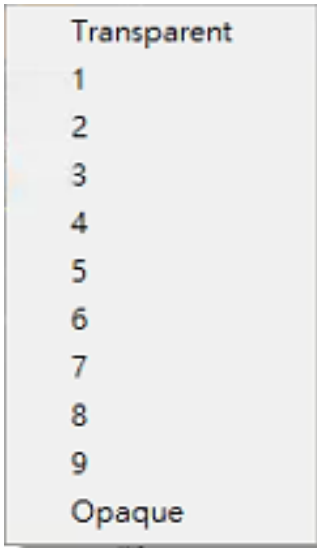
Shading with Edge



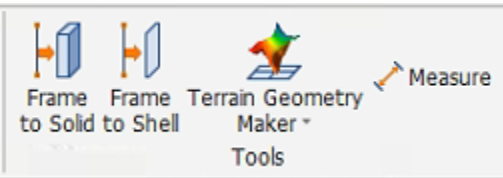
Transparency



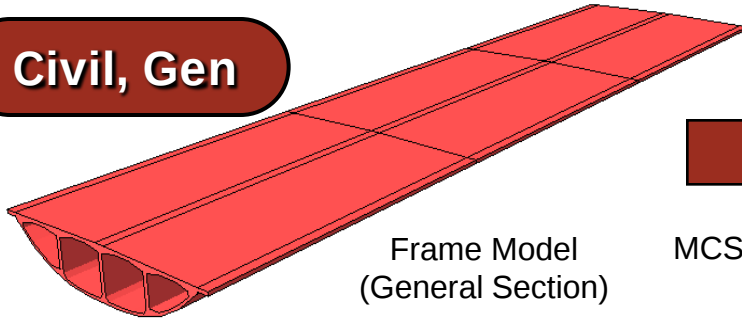
Shading + Transparency



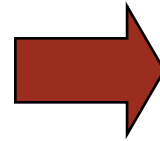
Gen & Civil Geometry Interface



Civil, Gen

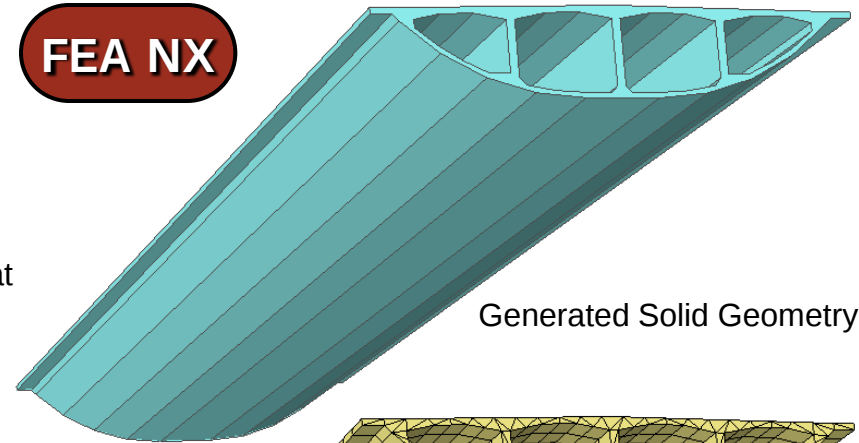


Frame Model
(General Section)

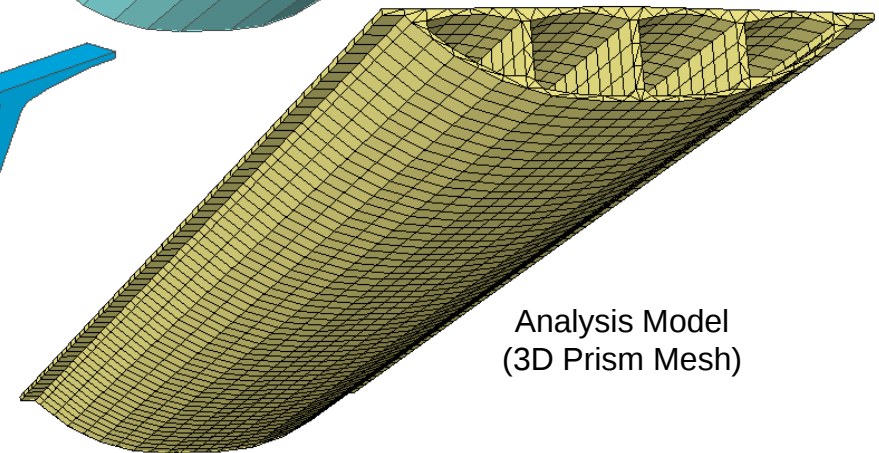


MCS Format

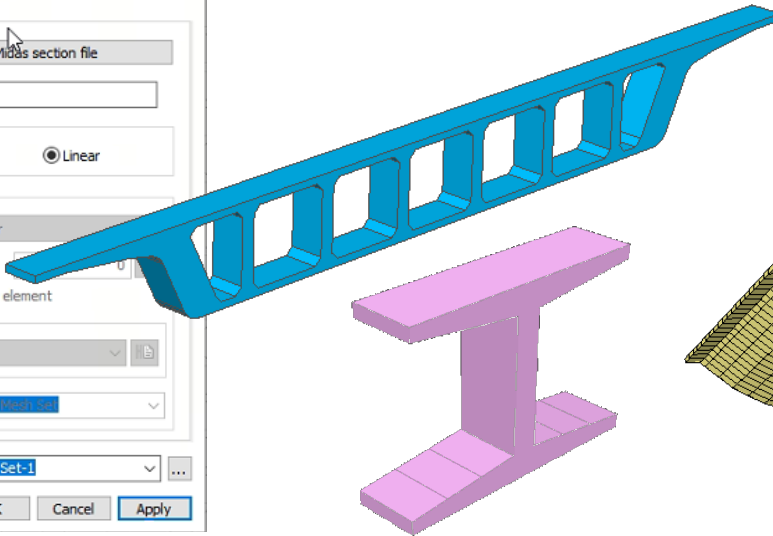
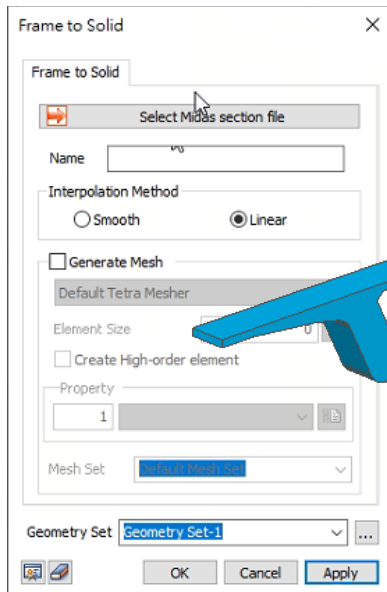
FEA NX



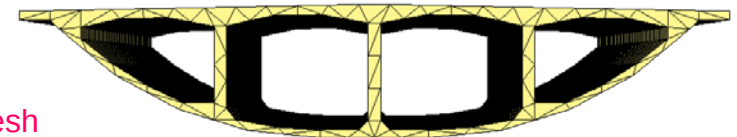
Generated Solid Geometry



Analysis Model
(3D Prism Mesh)



Frame→Solid Wizard automatically generates **Solid Geometry** & **Mesh** by importing **Frame Model** (*.MCS) from **Civil** and **Gen**.



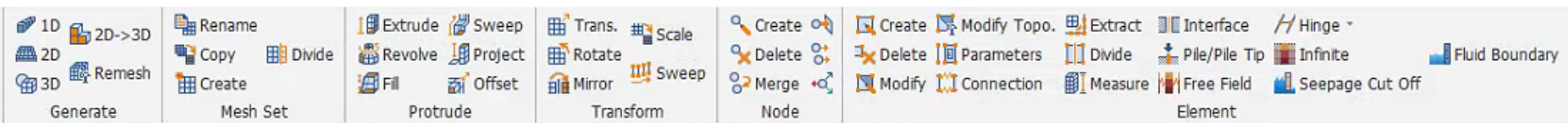
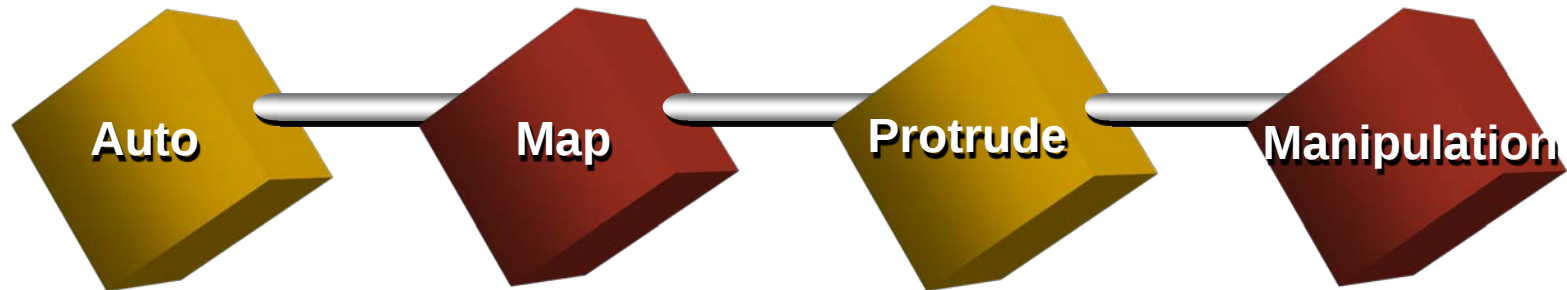
Contents

1. Overview
2. Geometry Modeling
- 3. Mesh Generation**
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Element Types

Category	Elements		Order
Structural	1D	Truss	1 st , 2 nd
		Beam	1 st , 2 nd
	2D	Plane Stress (Quad / Tria)	1 st , 2 nd
		Plane Strain (Quad / Tria)	1 st , 2 nd
		Axisymmetry (Quad / Tria)	1 st , 2 nd
		Plate (Quad / Tria)	1 st , 2 nd
		Shell (Quad / Tria)	1 st , 2 nd
	3D	Hexa / Penta / Tetra	1 st , 2 nd
Nonstructural	Connection	Elastic Link	-
		Rigid Link	-
	Nodal Mass	Point	-
		Matrix	-
	Interface	3D Point	-
		2D	1 st , 2 nd
		3D (Quad / Tria)	1 st , 2 nd
Reinforcement	Embedded Truss / Beam		1 st , 2 nd
	Tendon		1 st
Heat Transfer	1D, 2D, 3D, Cooling Pipe, Thermal Link		1 st , 2 nd

Mesh Tools



- Solid
- Surface
- Edge
- Planar Area
- 4-Curve Area
- 2D → 3D

Type

- Quadrilateral
- Triangle
- Combined

- Solid
- Surface
- ...

- Extrude
- Revolve
- Project
- Fill
- Sweep

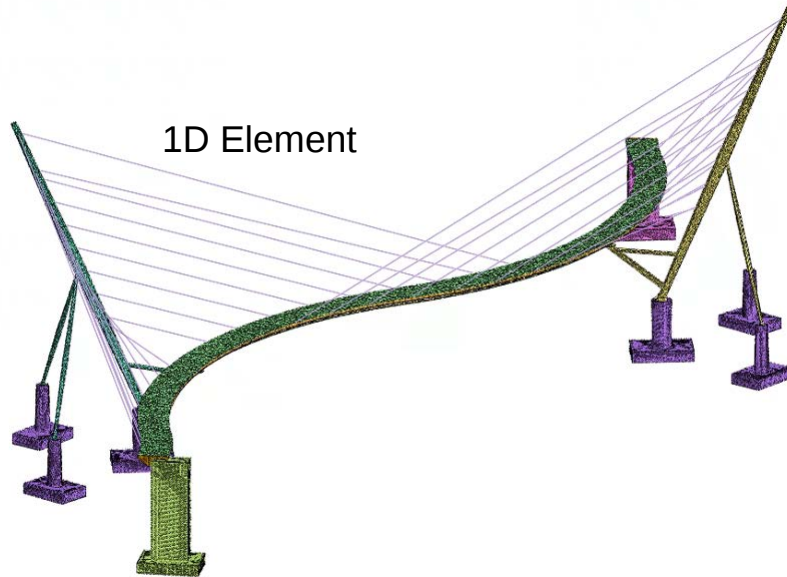
Object

- Geometry
- Element
- Node

- Create
- Extract
- Connection
- Change Para.
- Divide
- Check
- Quality
- Merge
- Transform
- ...

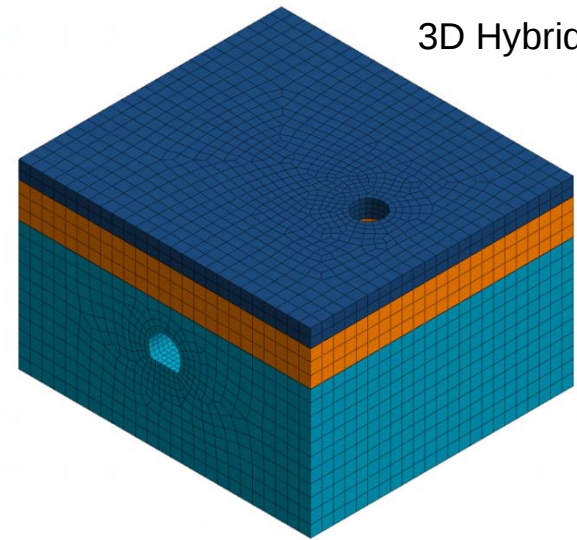
Various of methods for generating **Reinforcements** and **Interface Elements** are provided. (auto & manual)

Hybrid Element Types

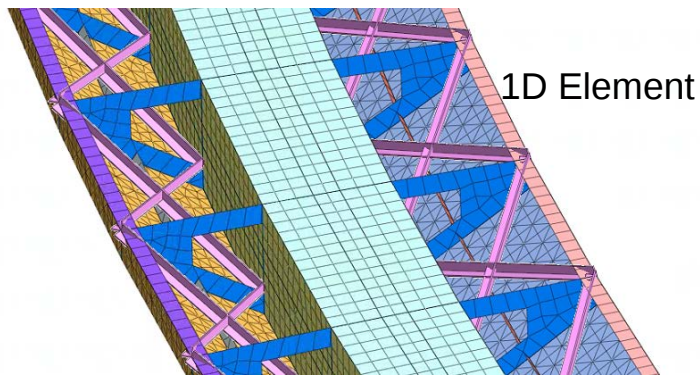


1D Element

3D Tetrahedral Element

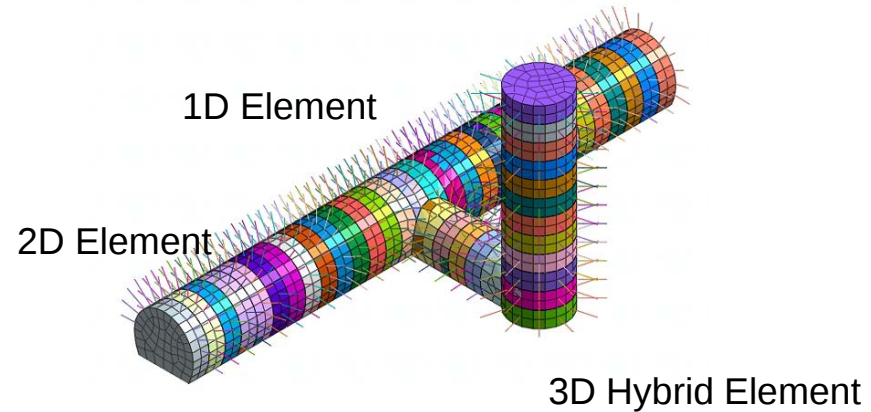


3D Hybrid Element



1D Element

2D Element



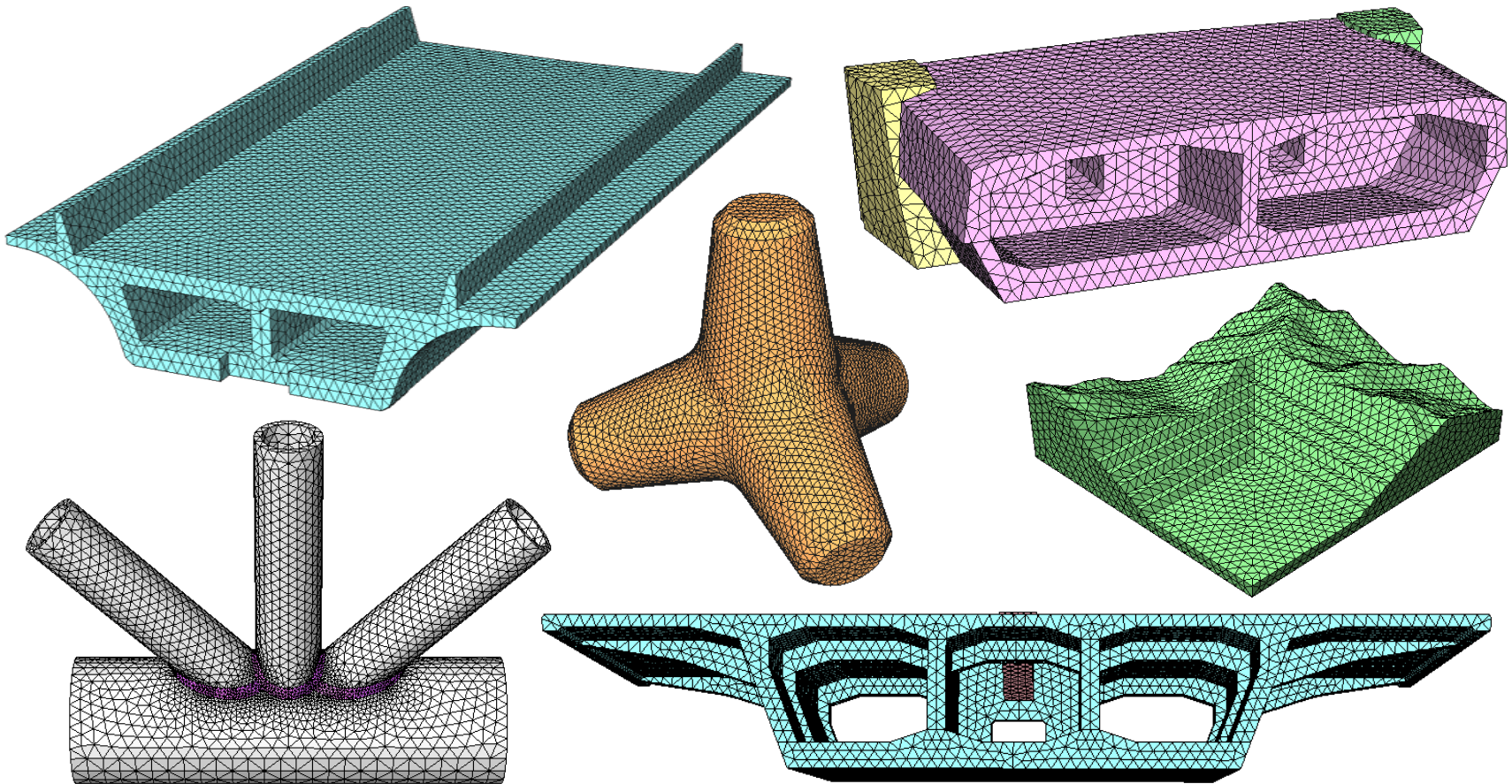
1D Element

2D Element

3D Hybrid Element

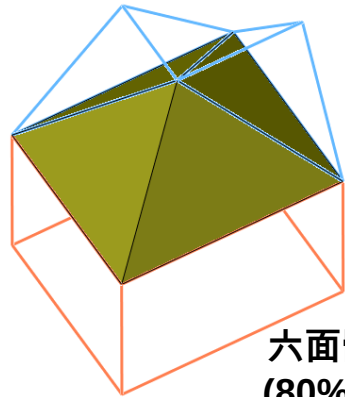
Automatic - Tetra Mesher

- FEA's Tetra Mesher auto-generates tetrahedral solid mesh with variable sizes in smooth transition. (200,000 Tetra's/min)
- FEA's Tetra Mesher is capable of including holes, curves and points that are present in/on solids.



Automatic - Hybrid Mesher

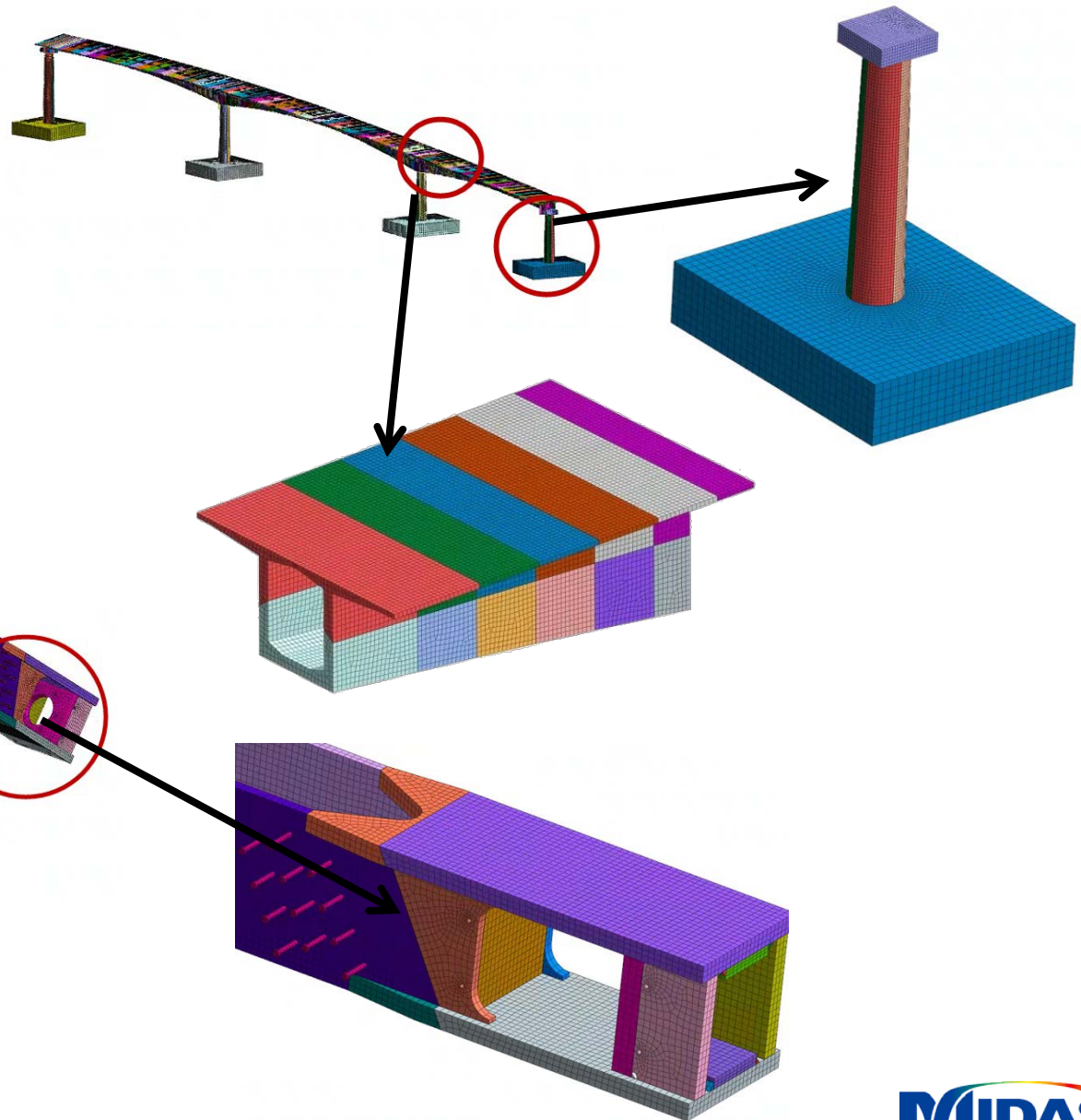
Hybrid Mesher



四面體元素
(5%~10%)

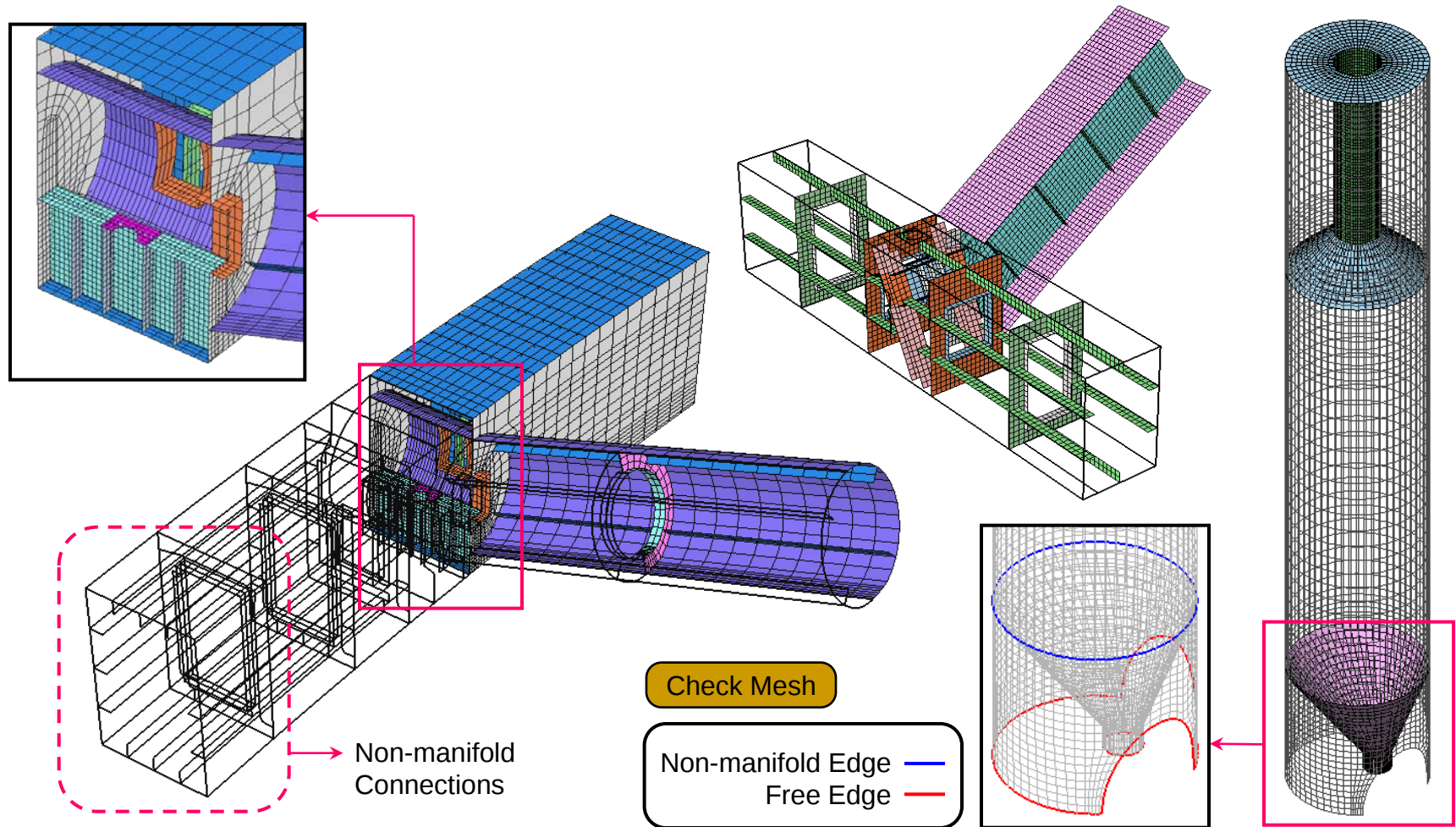
五面體元素
(5%~10%)

六面體元素
(80%~90%)



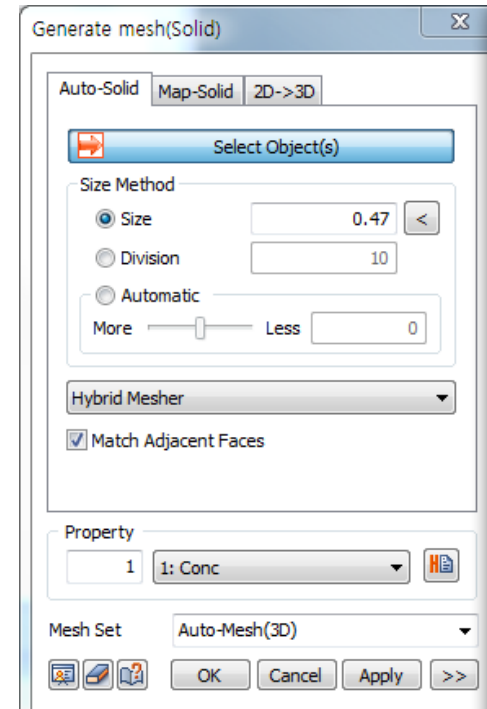
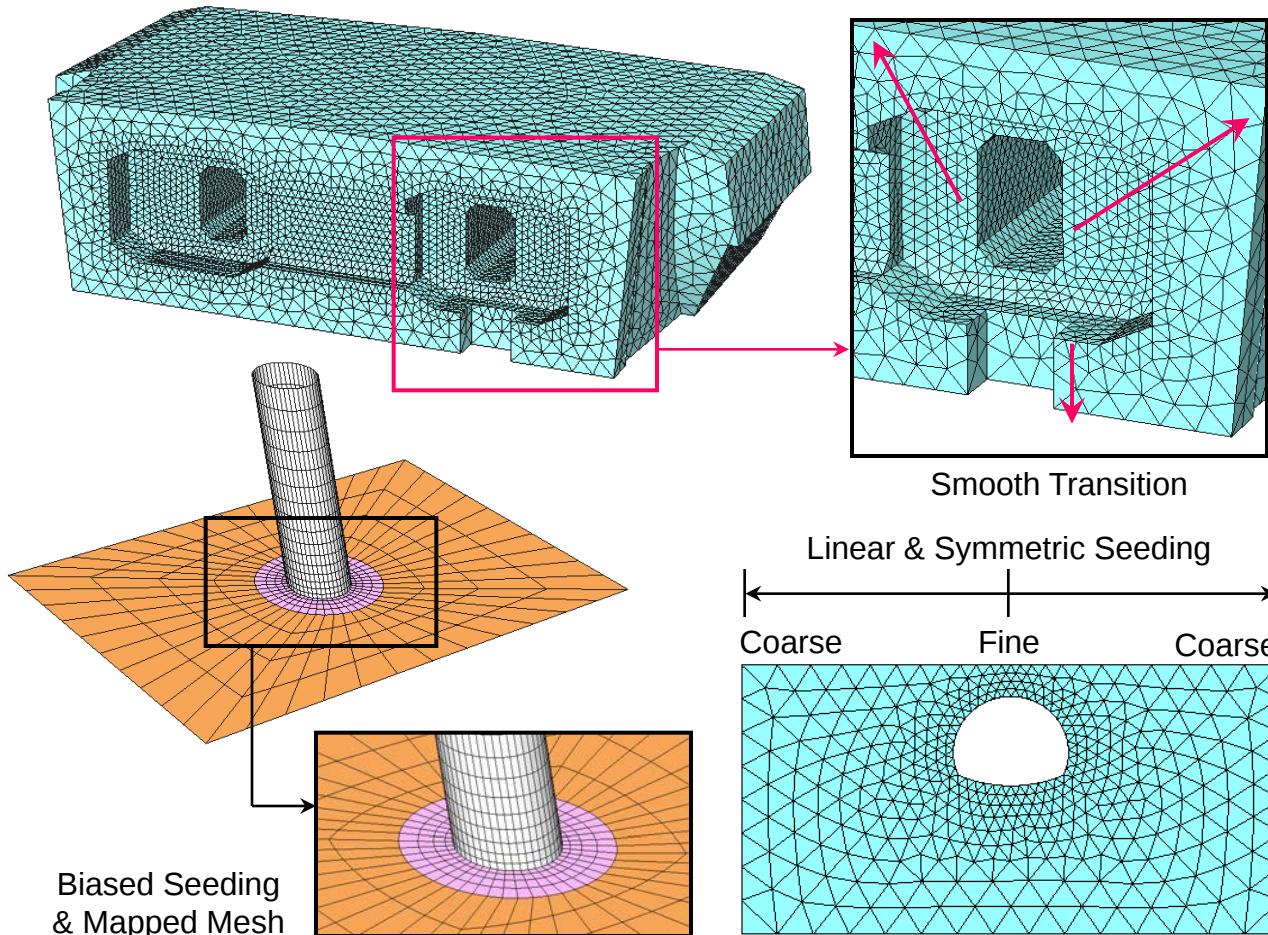
Automatic - Surface Meshing

- FEA provides a number of Modeling and meshing functions for **non-manifold surface** models.

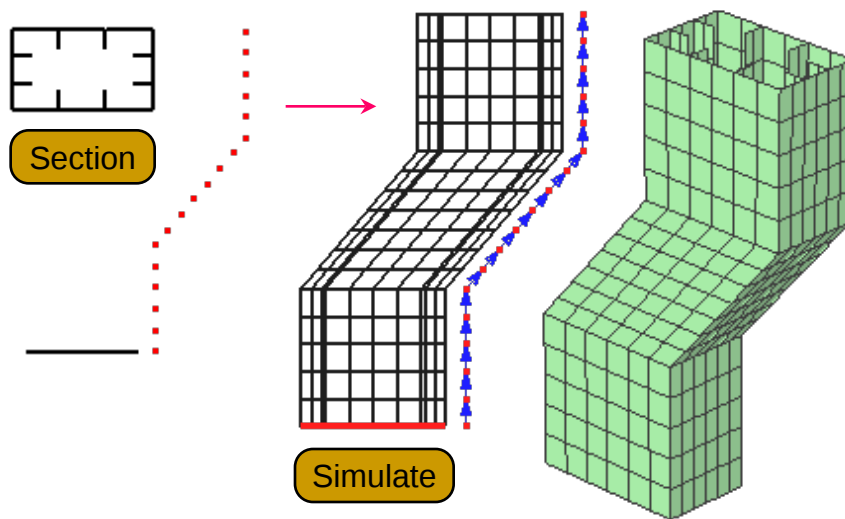
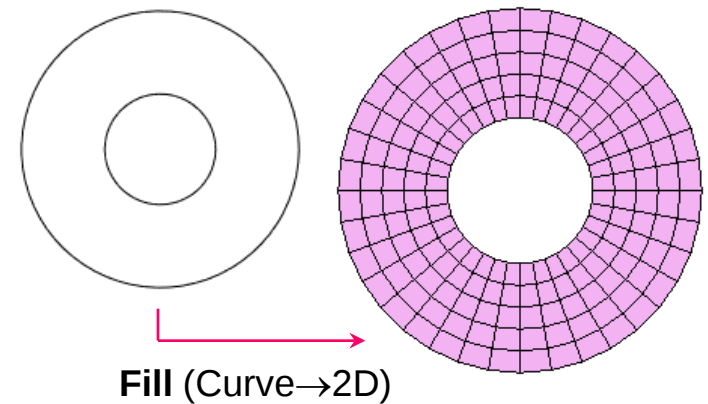
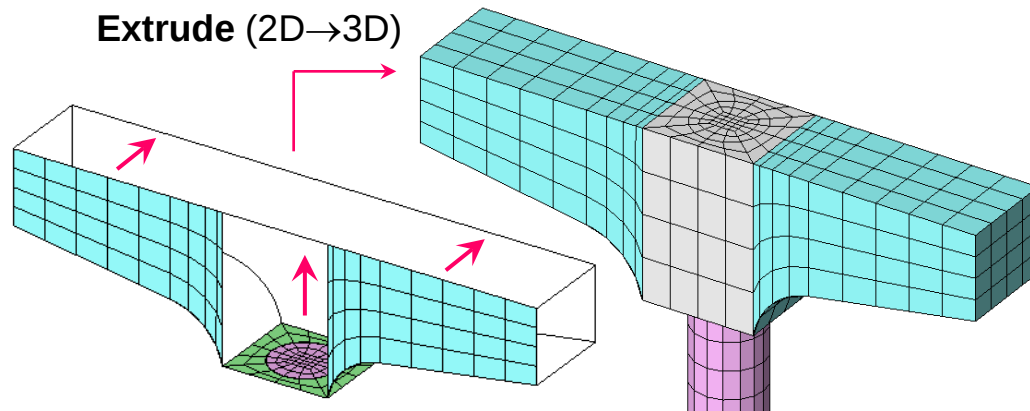


Manual - Size Control

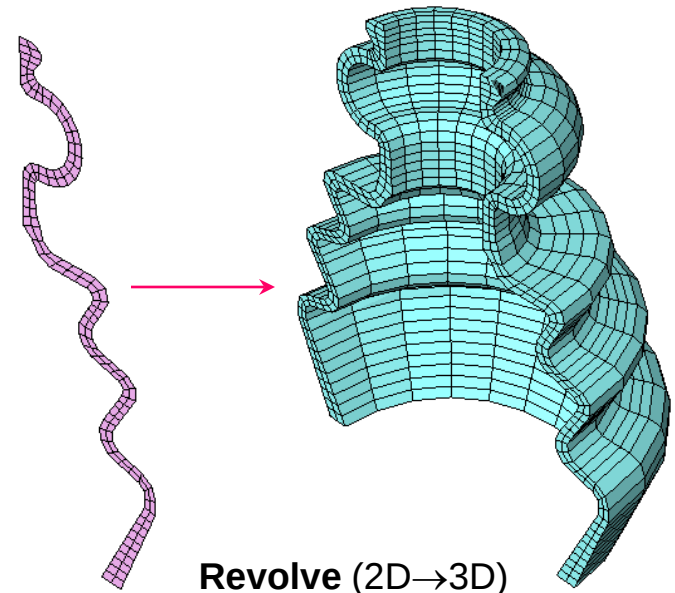
- FEA provides various size control methods and **adaptive seeding function** based on **user-specified mesh size** and **geometric characteristics**.



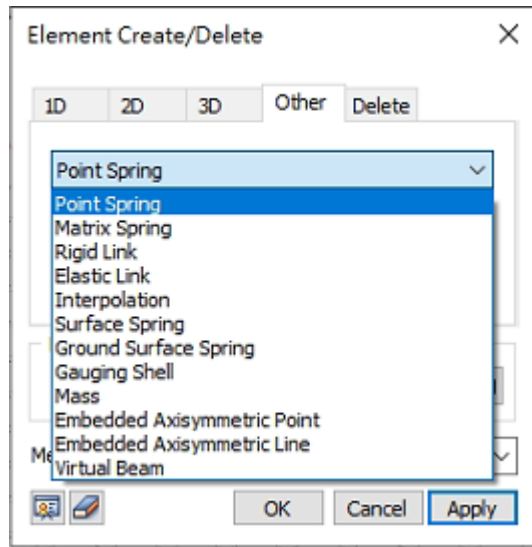
Manual - Mesh Protrusion



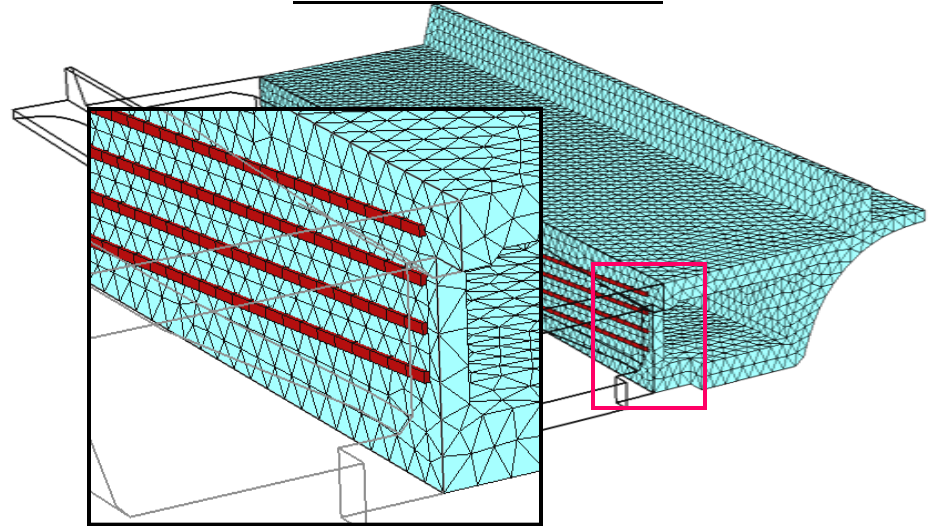
Extrude thru Node Sequence (Curve→2D)



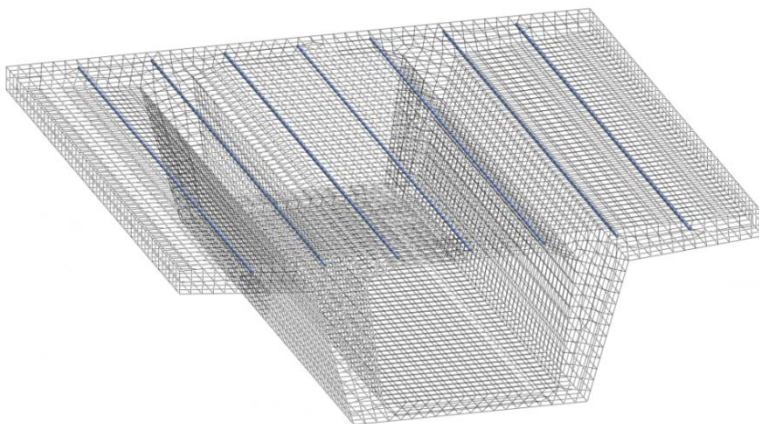
Manual - Other Element



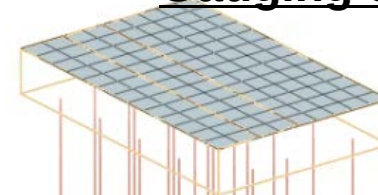
Tendon Element



Embedded (Beam/Truss) Element



Gauging Shell



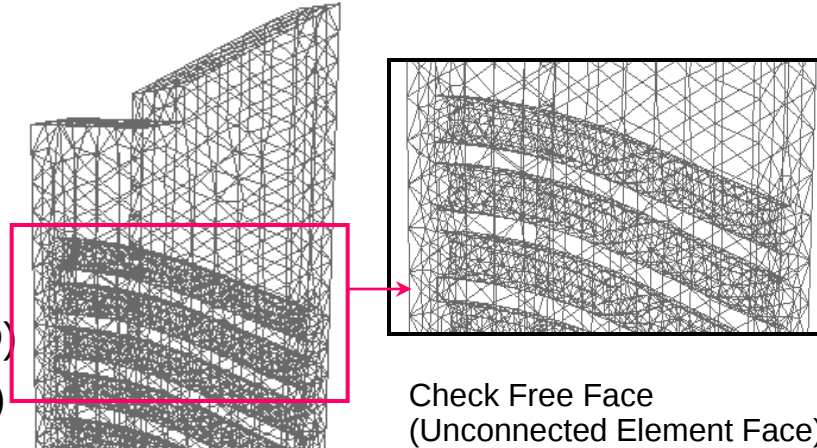
Pile Element

Pile Tip

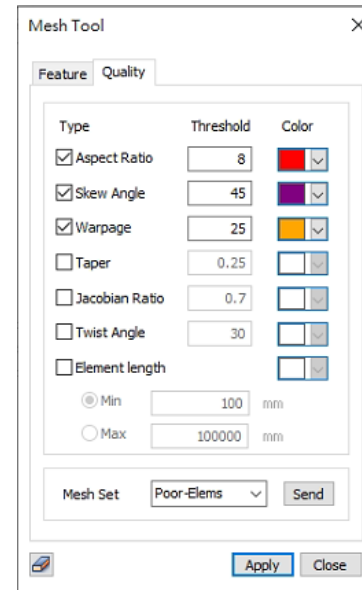
Check Mesh Topology and Quality

■ Check & Verify

- Feature Edges
- Free Faces
- Non-manifold Edges
- Clamped Element
- Overlapped Element(2D)
- Penetrated Element(2D)

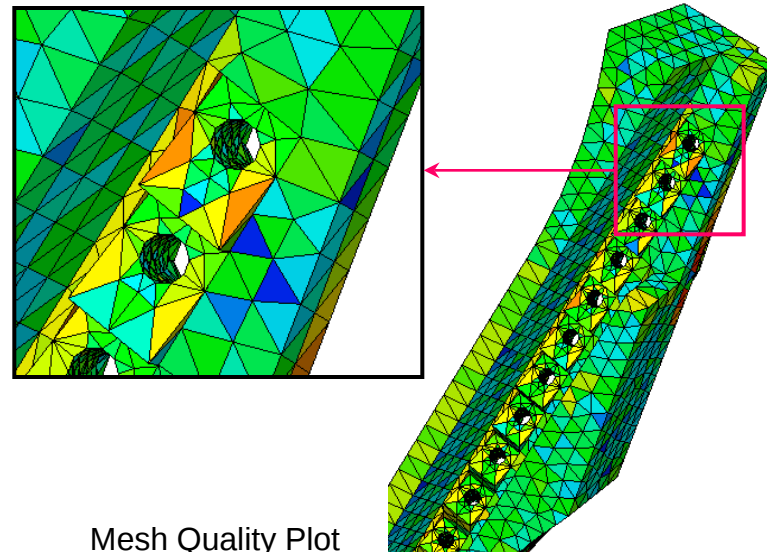
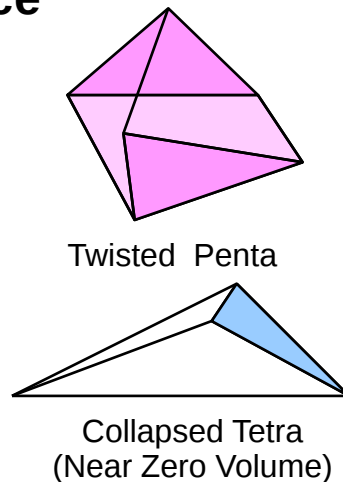


Check Free Face
(Unconnected Element Face)



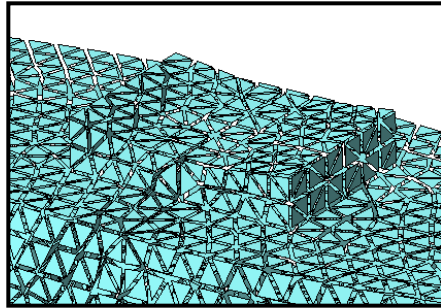
■ Quality Assurance

- Aspect Ratio
- Skew Angle
- Taper
- Warpage
- Jacobian Ratio
- Twist
- Length

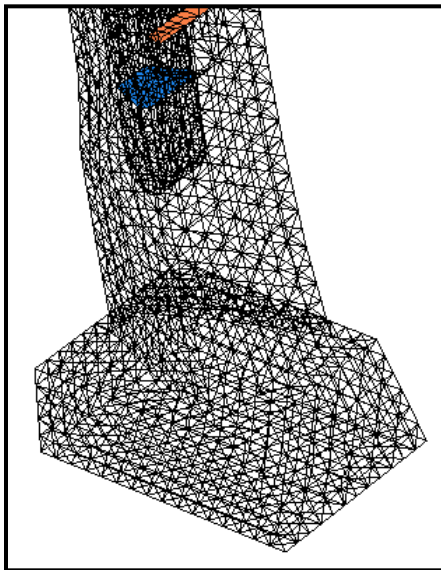


Mesh Quality Plot

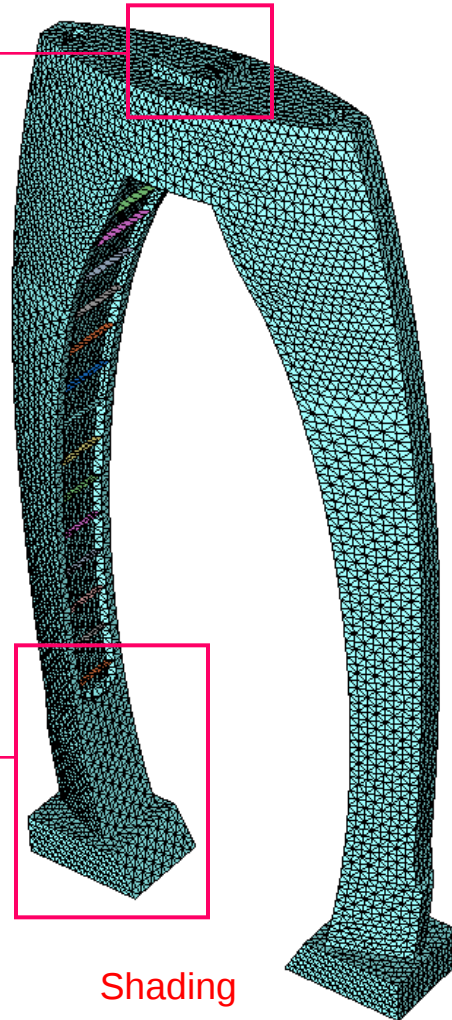
Mesh Graphic Display



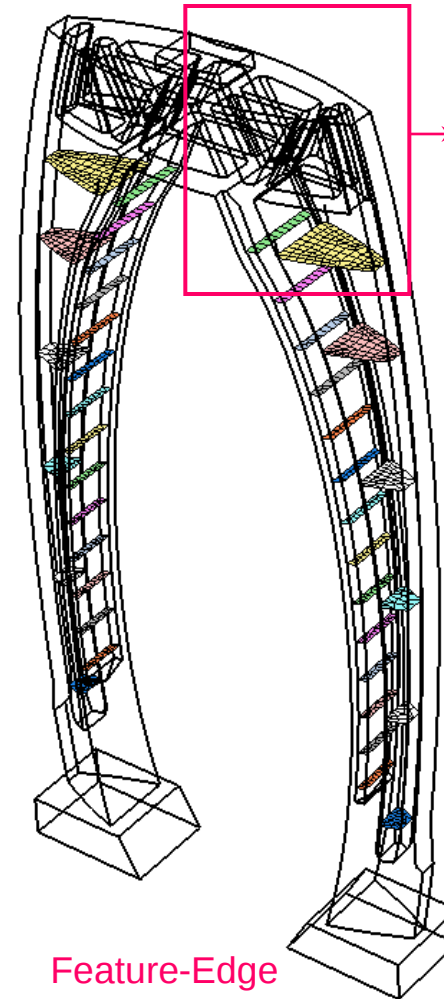
Shrink



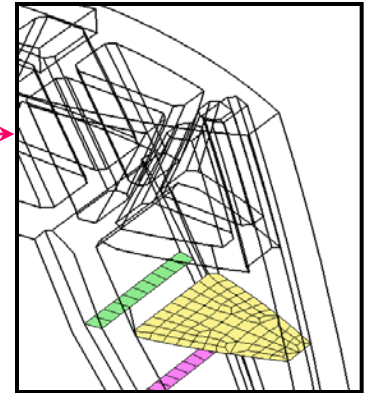
Wireframe (Free-Face)



Shading



Feature-Edge



Feature-Edge

- Show All Meshes
- Hide All Meshes
- Shading+Wireframe Edge
- Shading+Feature Edge
- Shading
- Wireframe Edge
- Free-Face Wireframe Edge
- Feature Edge
- Mesh Set Color
- Element Type Color
- Property Color
- Material Color
- Front-Back Color
- Change Mesh Color...
- Random Color

Display Mode (Mesh)

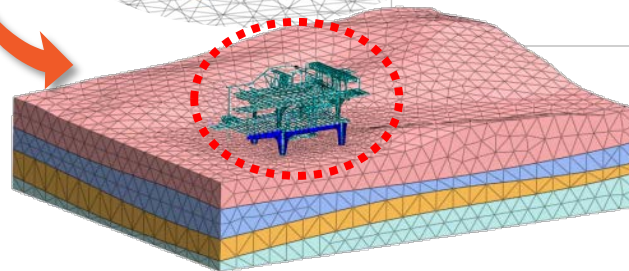
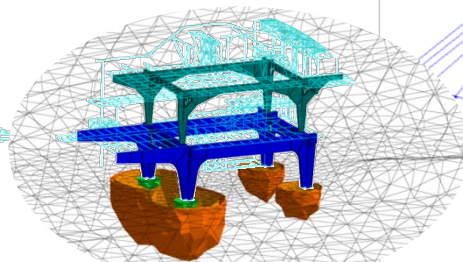
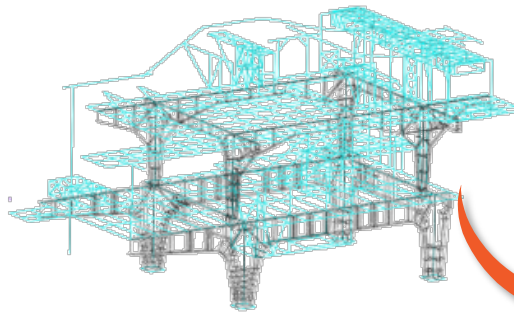
Interface with other MIDAS Software

Civil

Bridge structure foundation
/ Ground coupled analysis

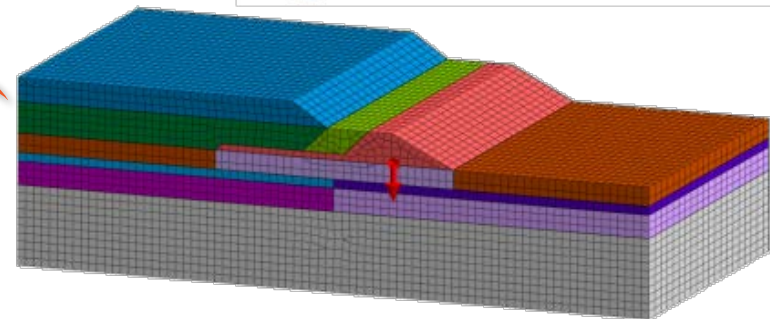
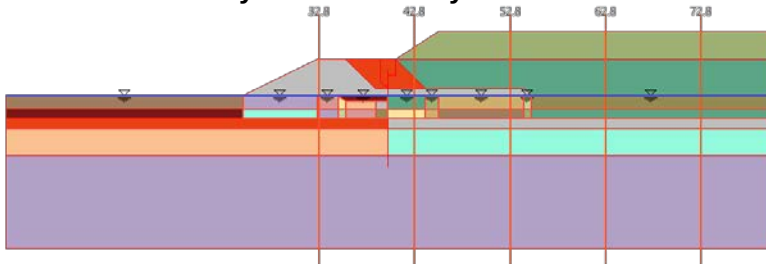
Gen

Architectural structure foundation
/ Ground coupled analysis



SoilWorks

2D FE ↔ 3D Analysis connectivity



FEA FEA NX Neutral Format...
Save Neutral File

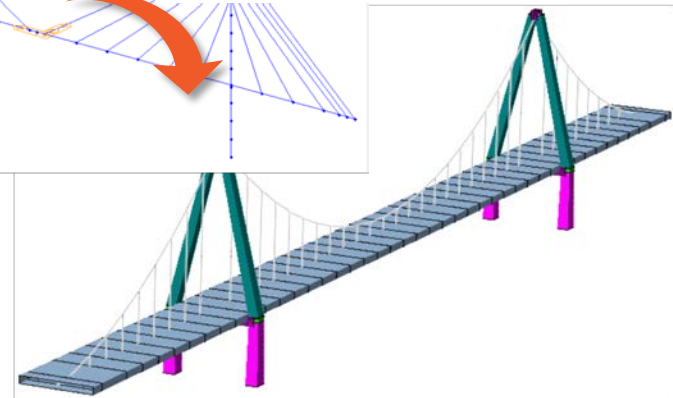
midas Civil...
Export the midas Civil file.

midas Gen...
Export the midas Gen file.

Export Nodal Results(*.txt)
Export nodal results File

Execute midas Convert...
Import/Export model data between LIRA-SAPR/SCAD SW and
GTSNX...

FEA Export Nastran Input File...
Export Nastran Input File



Contents

1. Overview
2. Geometry Modeling
3. Mesh Generation
4. Analysis
5. Post-processing
6. Application

FEA NX Analysis Module Classification

■ Standard module

- Static Analysis
- Construction Stage Analysis
- Reinforcement Analysis

■ Dynamic Analysis Module

- Buckling Analysis
- Eigenvalue Analysis
- Response Spectrum Analysis
- Time History Analysis(Linear/Nonlinear)

■ Thermal Analysis Module

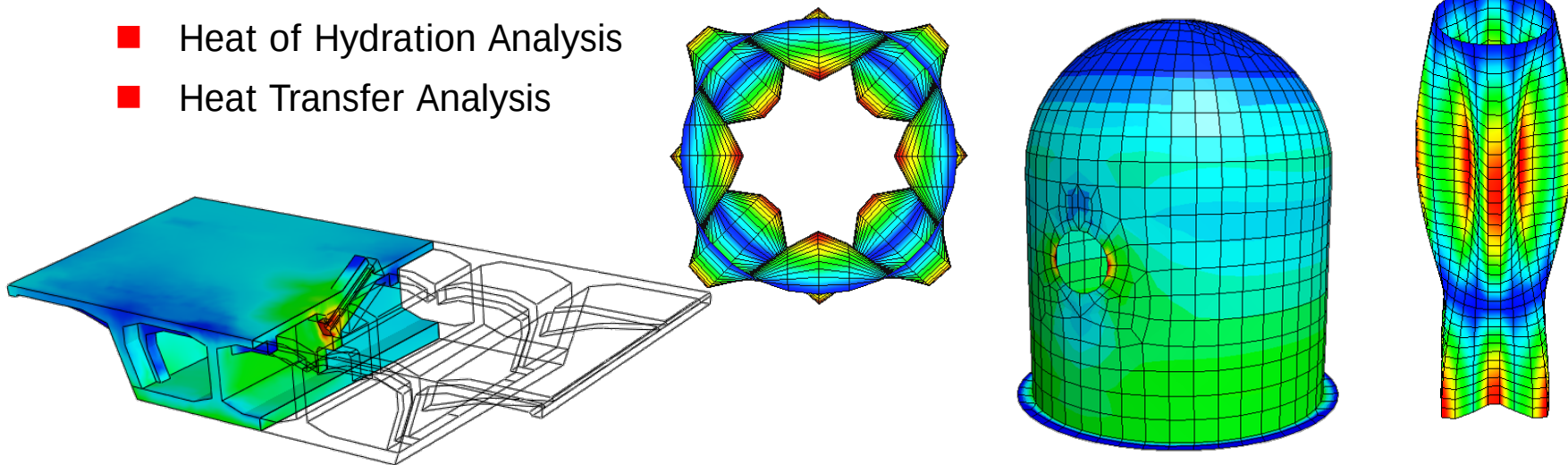
- Heat of Hydration Analysis
- Heat Transfer Analysis

■ Geotechnical Analysis Module

- Slope Stability Analysis
- Seepage Analysis
- Consolidation Analysis
- Coupled Analysis(Fully/Semi)

■ Advanced Nonlinear Analysis Module

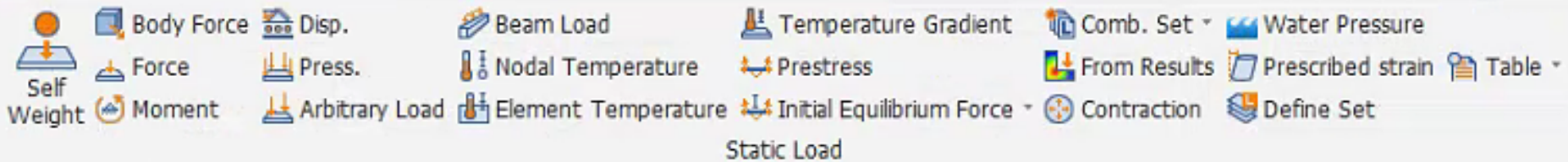
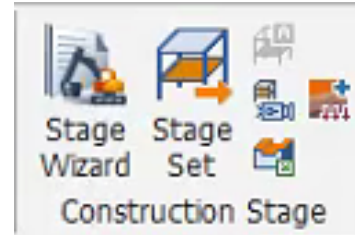
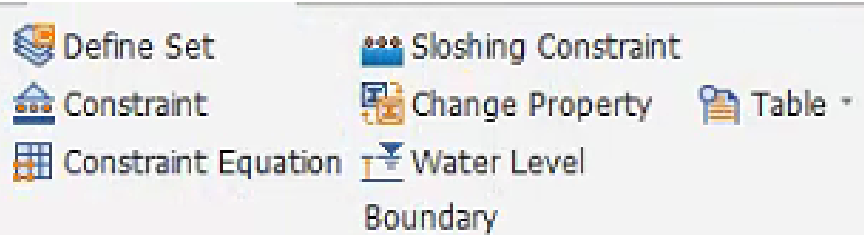
- Static Contact Analysis
- Nonlinear Analysis(Material/Geometric)
- Concrete Crack Analysis



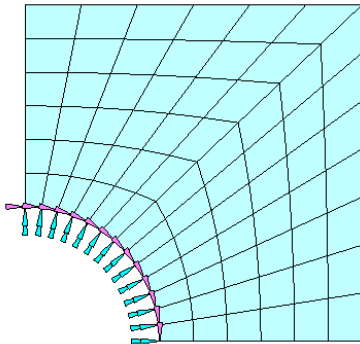
Standard module-1

■ Standard module

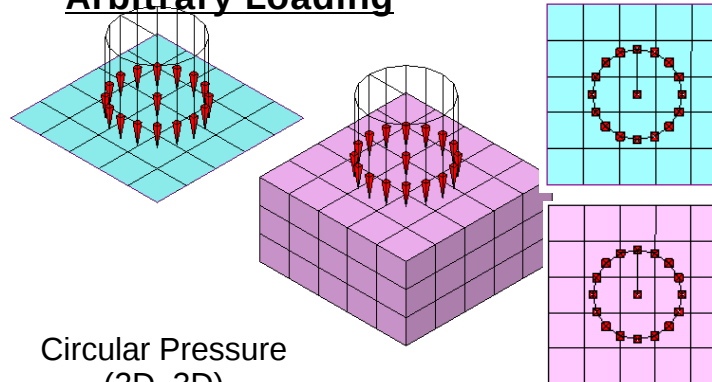
- Static Analysis
- Construction Stage Analysis
- Reinforcement Analysis



Constraint based-on CSys.

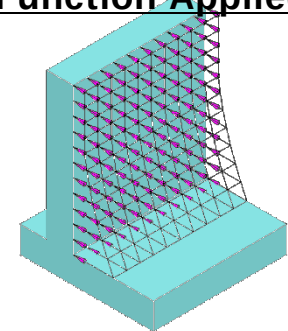


Arbitrary Loading



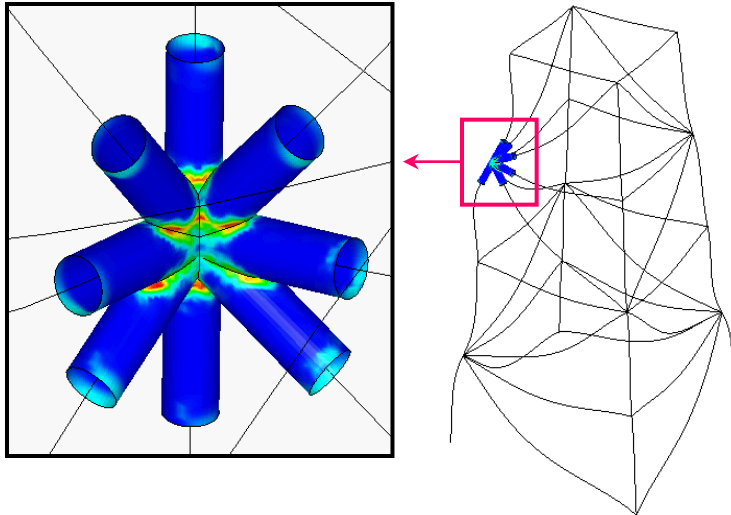
Circular Pressure
(2D, 3D)

Spatially Varying Pressure (Function Applied)



Standard module-2

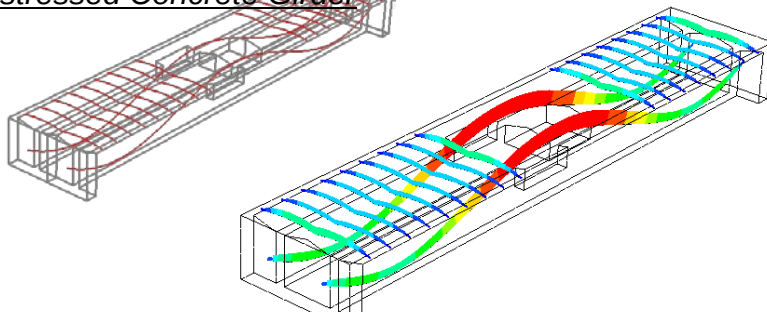
Linear Static Analysis



Stress Distribution of Jacket

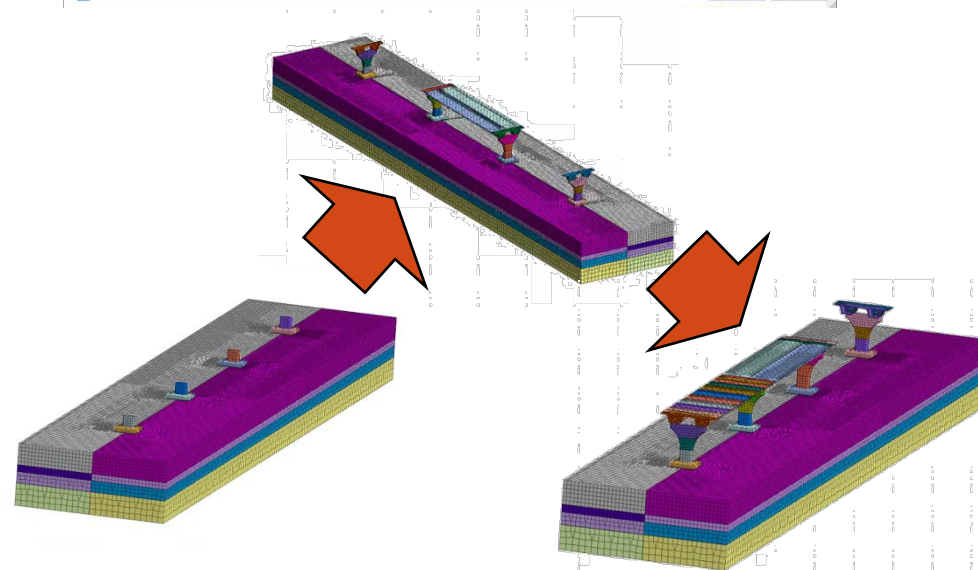
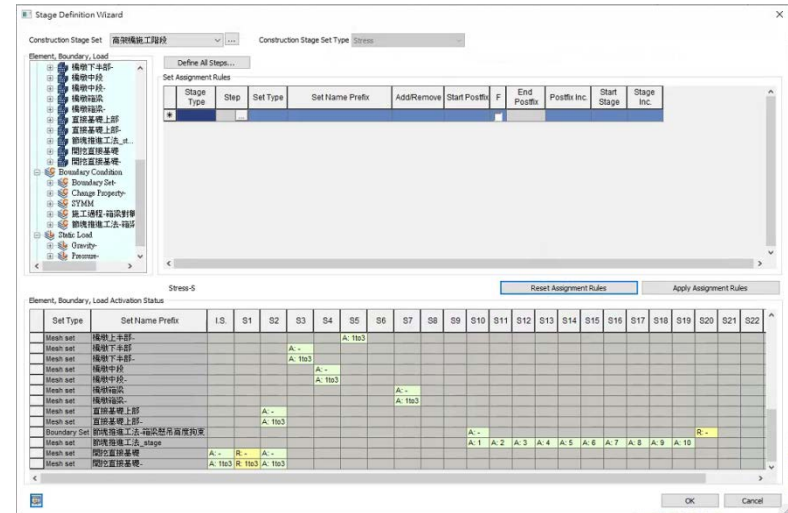
Reinforcement Analysis

2-Span Double-T Type
Prestressed Concrete Girder



Stress of Embedded Reinforcement

Construction Stage Analysis

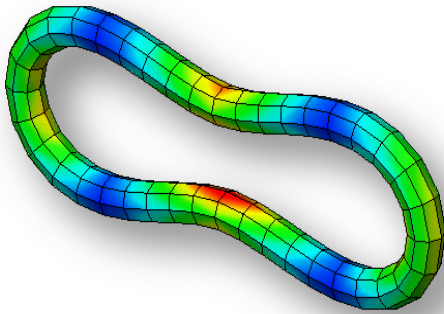


Advanced Nonlinear Analysis Module

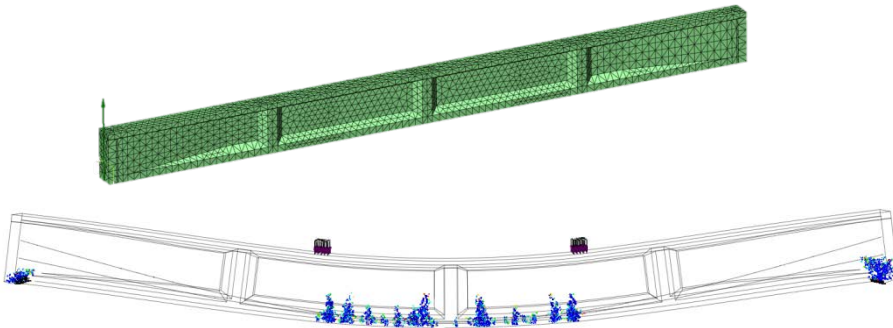
■ Advanced Nonlinear Analysis Module

- Static Contact Analysis
- Nonlinear Analysis(Material/Geometric)
- Concrete Crack Analysis

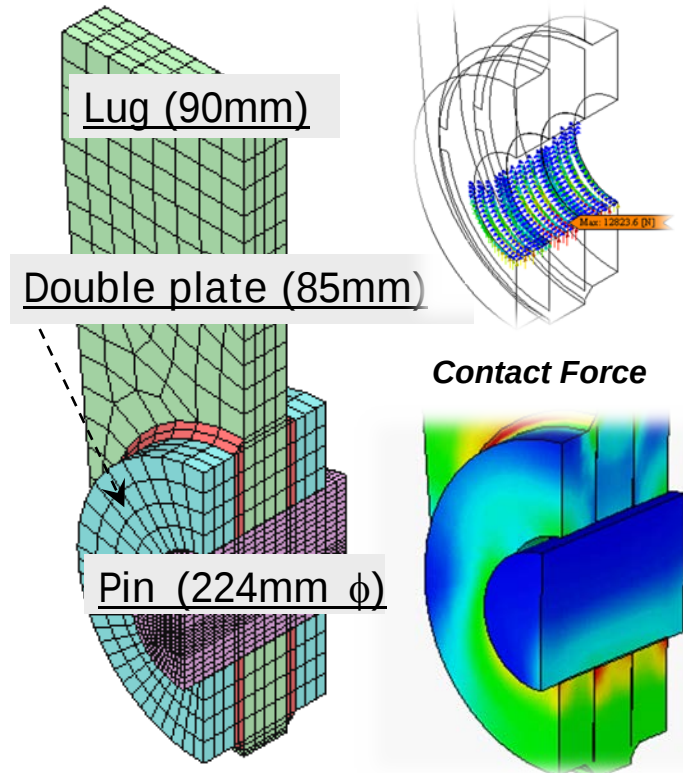
Geometry Nonlinear Analysis



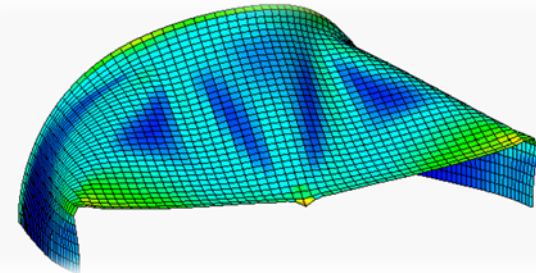
Concrete Crack Analysis



Static Contact Analysis



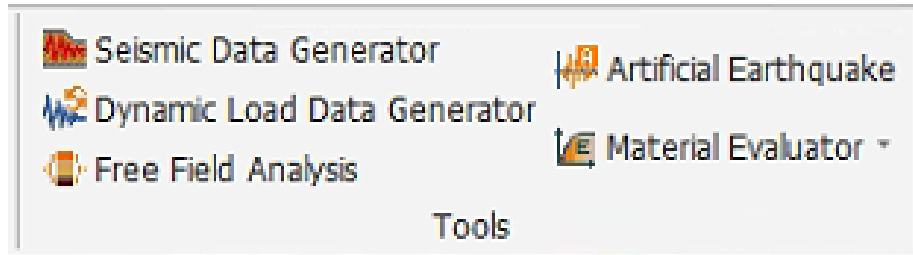
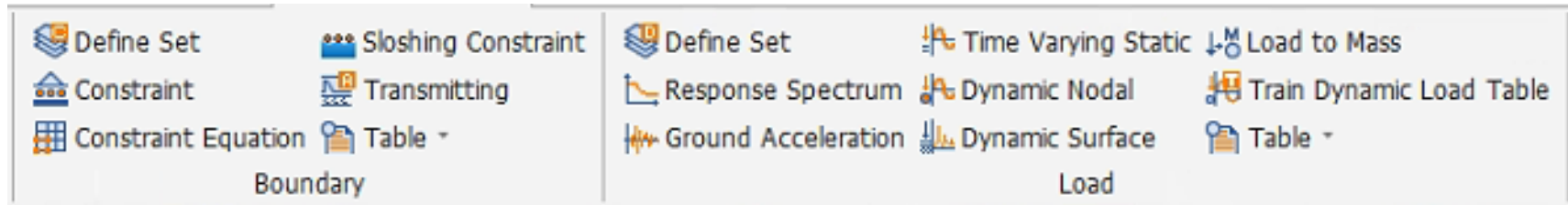
Material and Geometry Nonlinearity Analysis



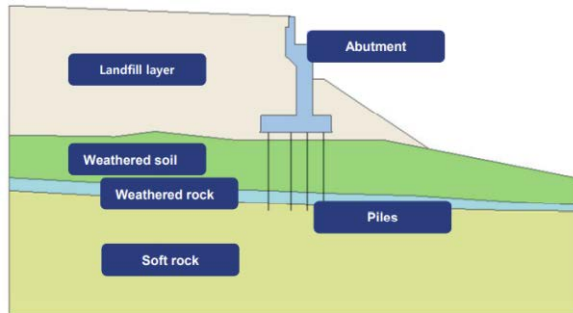
Dynamic Analysis Module-1

■ Dynamic Analysis Module

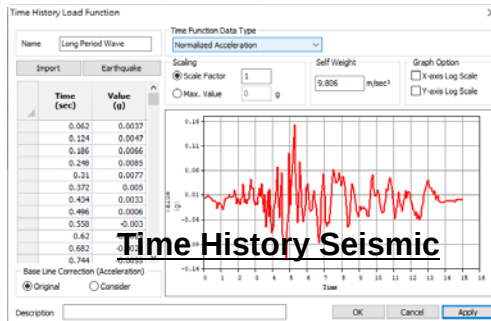
- Buckling Analysis
- Eigenvalue Analysis
- Response Spectrum Analysis
- Time History Analysis(Linear/Nonlinear)



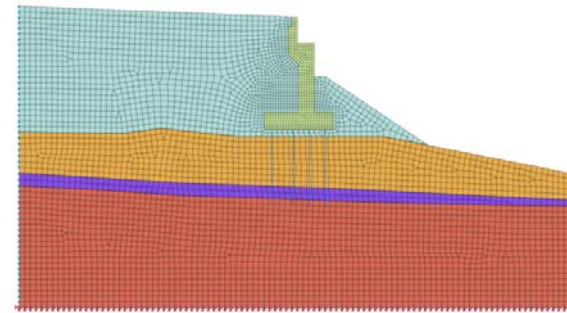
Dynamic Analysis Module-2



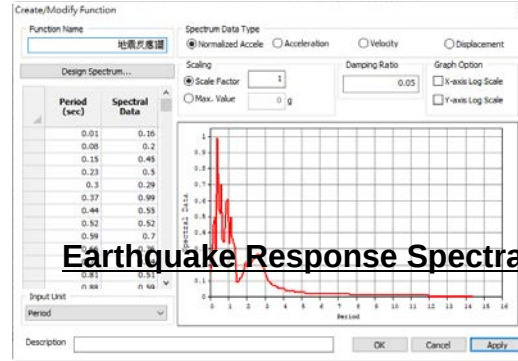
Time History Analysis (Linear / Nonlinear)



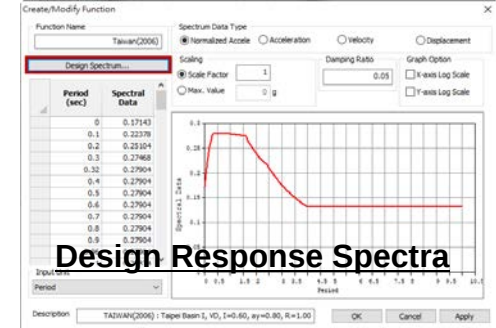
Time History Seismic



Response Spectrum Analysis

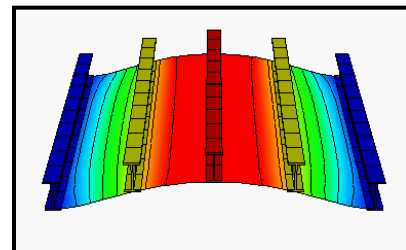
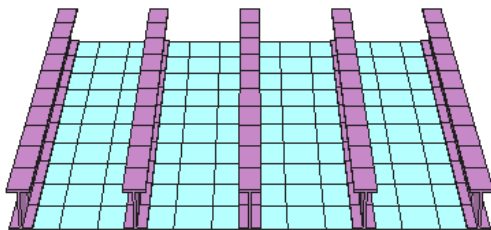


Earthquake Response Spectra



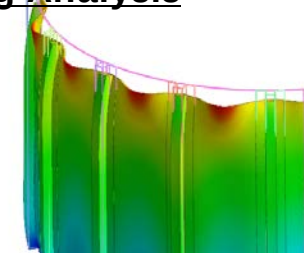
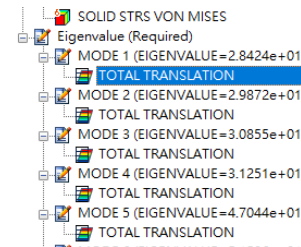
Design Response Spectra

Eigen value Analysis



1st Mode (64.58 Hz)

Buckling Analysis



n=1

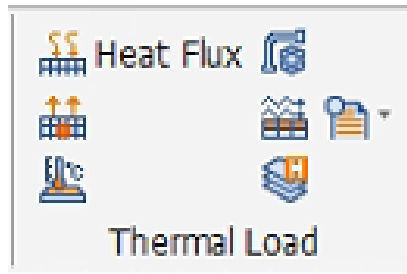
$$10000N \times 28.424 = 284240N$$

Simply Supported Stiffened Plate
(Plate + Beam)

Thermal Analysis Module

■ Thermal Analysis Module

- Heat of Hydration Analysis
- Heat Transfer Analysis



Heat Flux

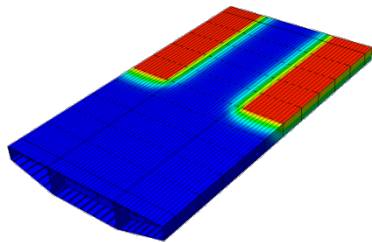
Heat Source

Temperature

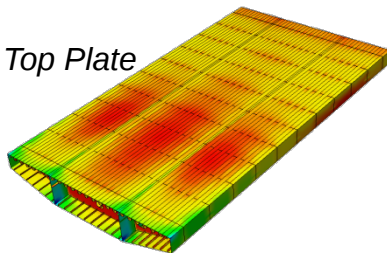
Pipe Cooling

Convection

Thermal Load

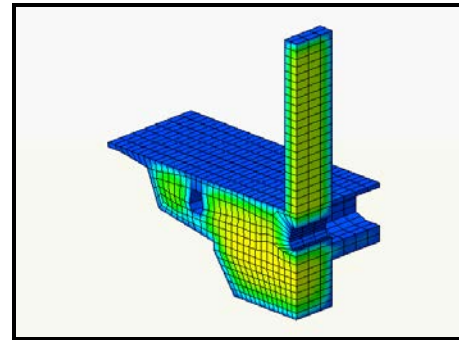


Temperature at Top Plate

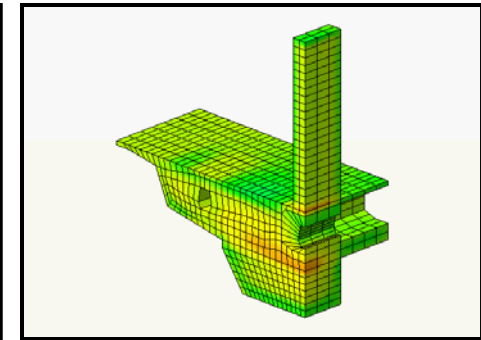


Guss Asphalt Pavement

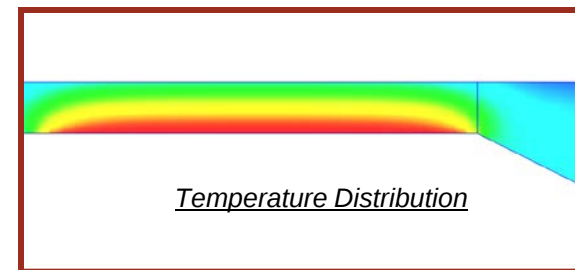
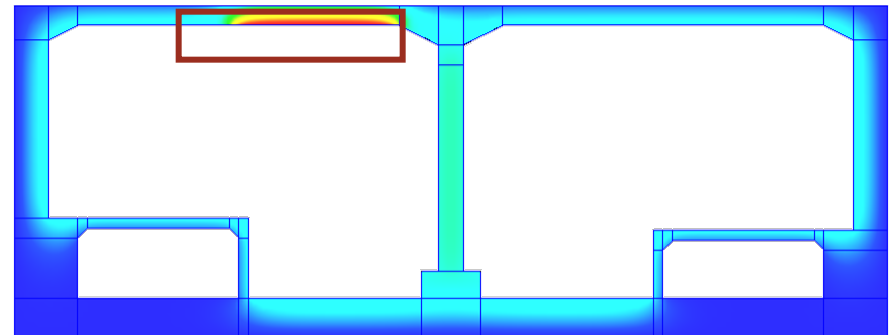
Pier Table (Construction Stage)



Temperature



Thermal Stress



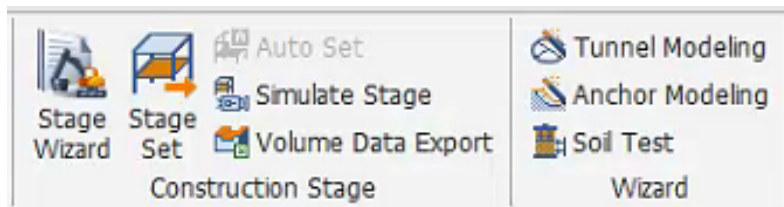
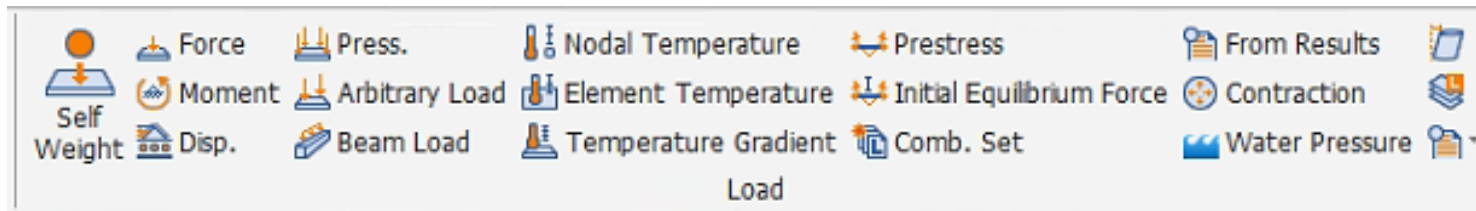
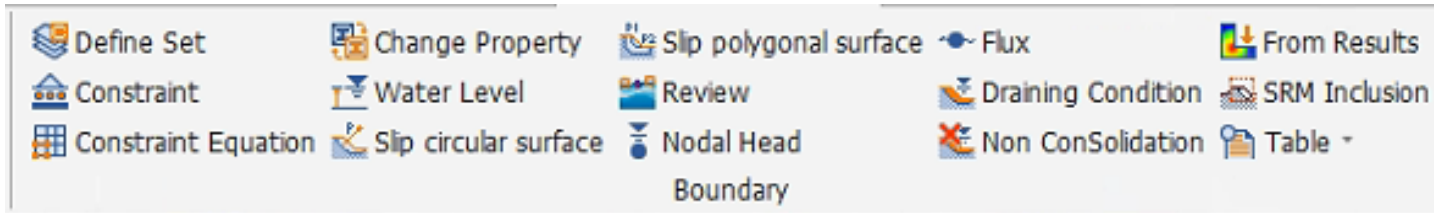
Temperature Distribution

Fire in a Subway Structure

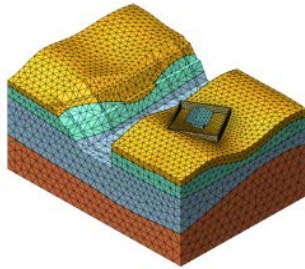
Geotechnical Analysis Module-1

■ Geotechnical Analysis Module

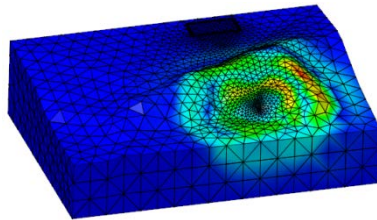
- Slope Stability Analysis
- Seepage Analysis
- Consolidation Analysis
- Coupled Analysis(Fully/Semi)



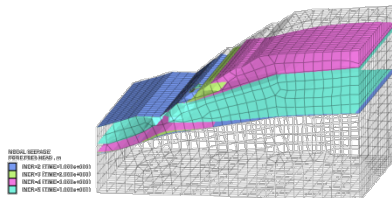
Geotechnical Analysis Module-2



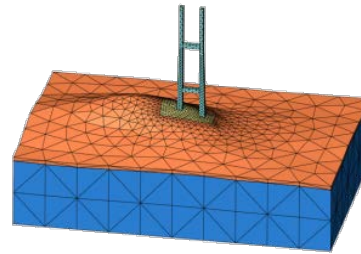
- Strength Reduction Method (SRM)
- Strength Analysis Method (SAM)
- Construction stages Slope stability (SRM/SAM)



- Eigenvalue/Reaction Spectrum analysis
- Linear Time History (mode/direct methods)
- **Nonlinear Time History analysis**
- 1D/2D Equivalency Linear analysis
- **Nonlinear time history + SRM Coupled**



- Steady state seepage analysis
- Transient seepage analysis



- Linear static analysis
- Nonlinear static analysis

Static Analysis

Slope Stability Analysis

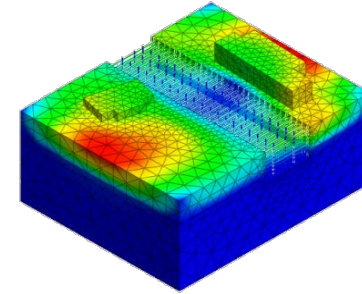
Dynamic Analysis

Seepage Analysis

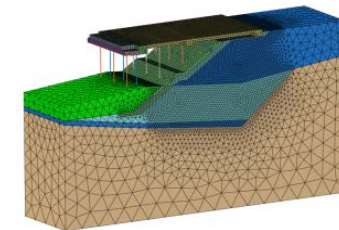
Stress-seepage fully coupled

Construction Stage Analysis

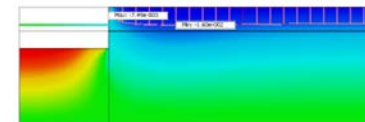
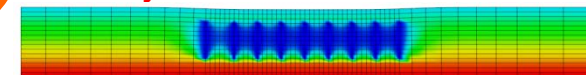
Consolidation Analysis



- Stress (drained/undrained) analysis
- Seepage analysis for each stage
- **Stress-seepage- slope coupled**
- Consolidation analysis for each stage
- **Fully coupled stress & seepage**



- Consolidation Analysis
- **Stress-seepage fully coupled analysis**



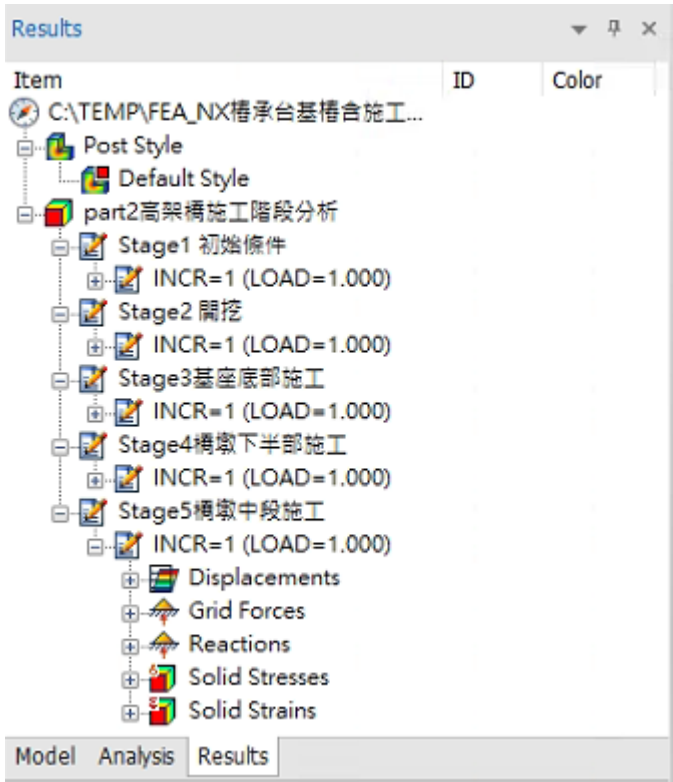
FEA
NX

Contents

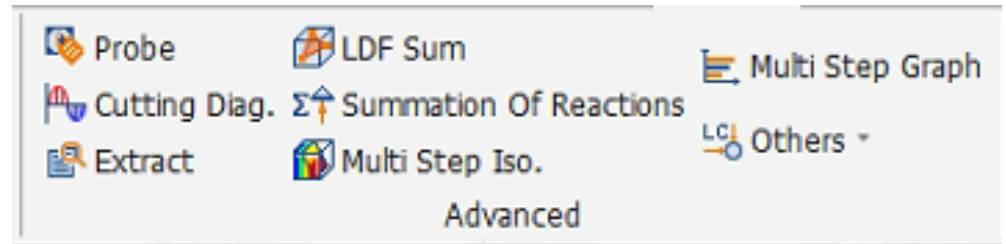
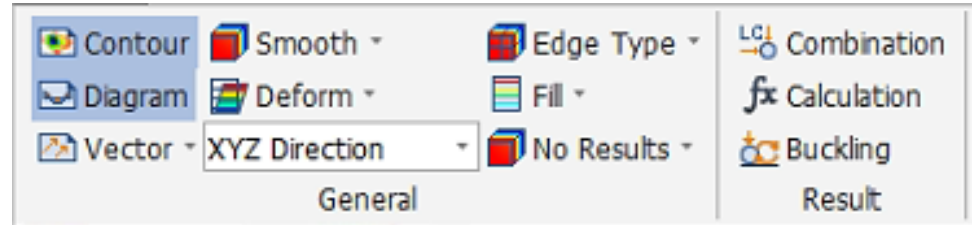
1. Overview
2. Geometry Modeling
3. Mesh Generation
4. Analysis
- 5. Post-processing**
6. Application

Post-processing

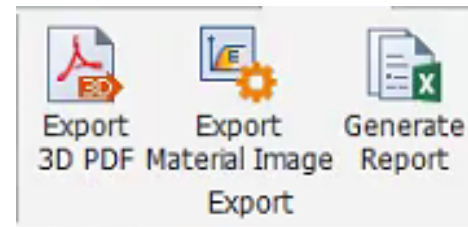
Results (Model Tree)



Results(Main Menu)



Tools(Main Menu)

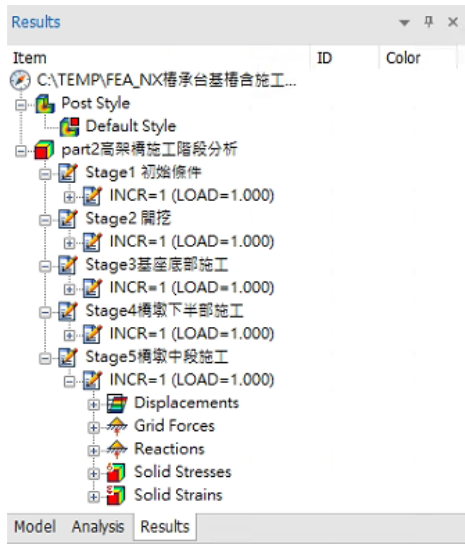


Clipping Plane & Iso-Value surfaces (Toolbar)

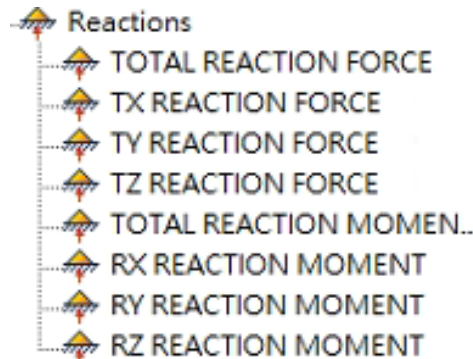
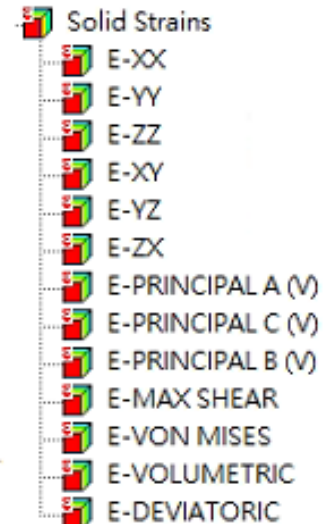
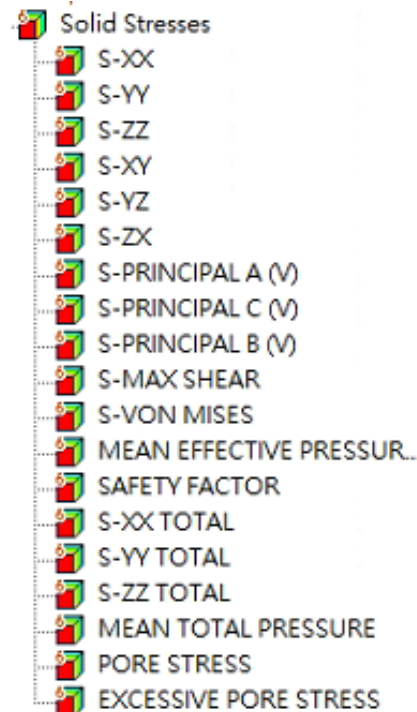
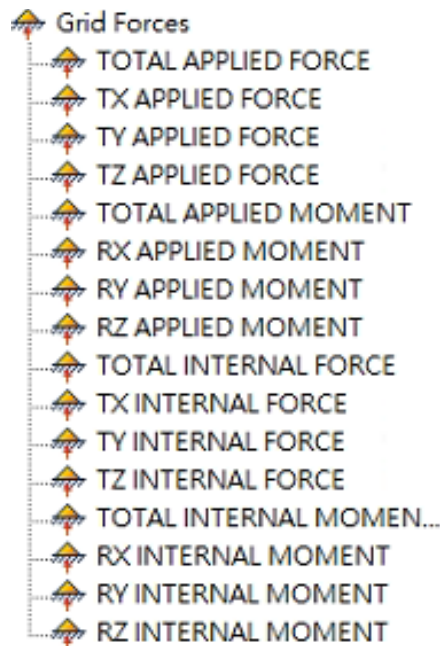
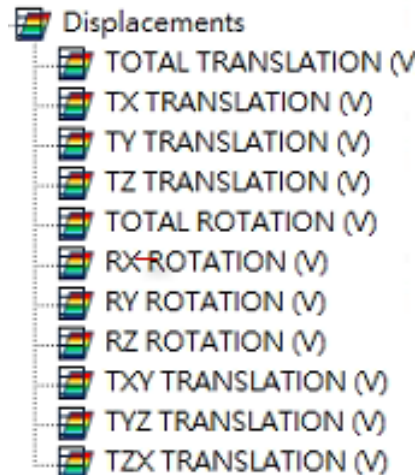
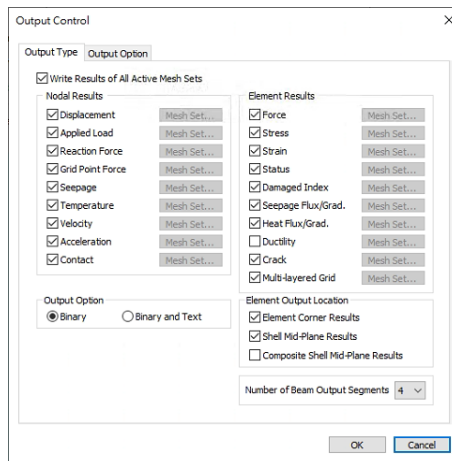


Model Tree Results

Results (Model Tree)



Output Control



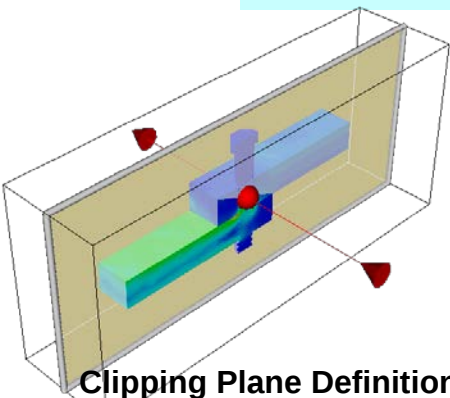
Toolbar



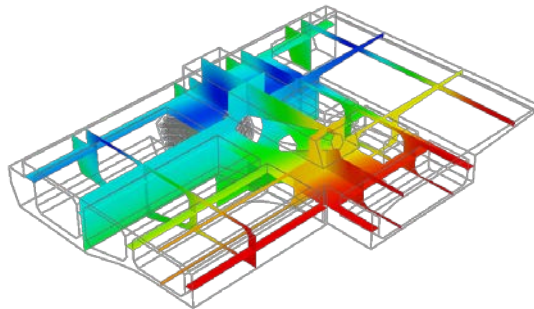
Clipping Plane

Iso-Value surfaces

Clipping Plane

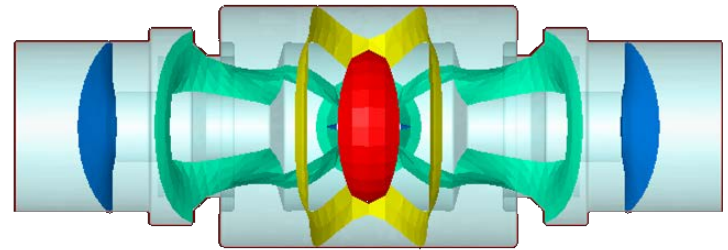


Clipping Plane Definition
by Mouse Dragging

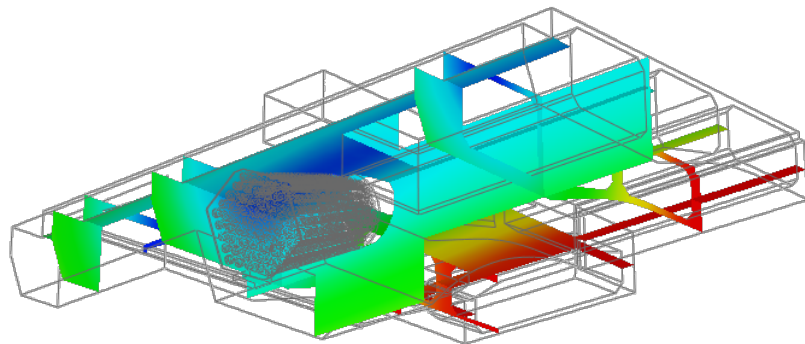


Multiple Slice Planes

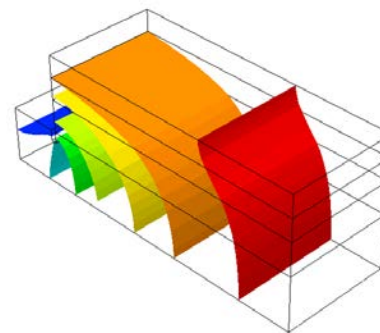
Iso-Value Surfaces



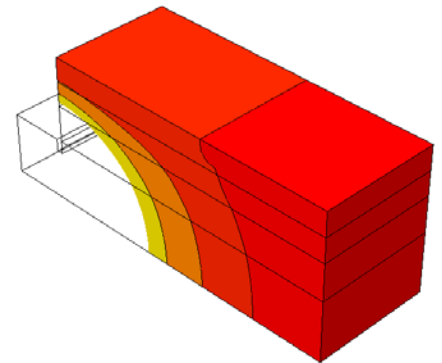
Iso-Surface in Transparent Solid Geometry



Slice Plot at Arbitrary Plane

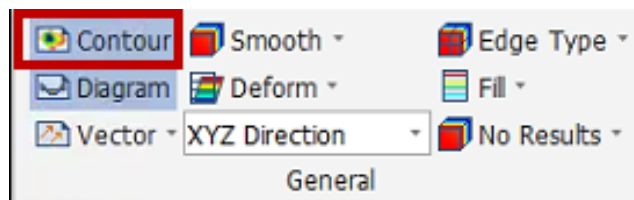


Multiple Iso-surfaces



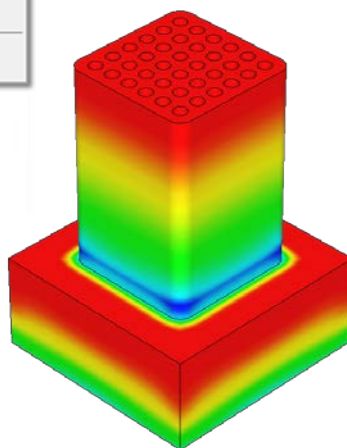
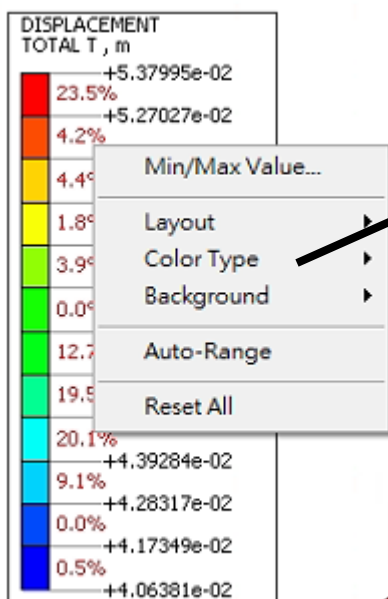
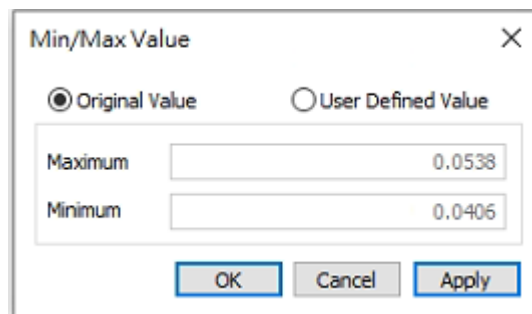
Capped Plot (Upper Part)

General Post-processing Tools-1

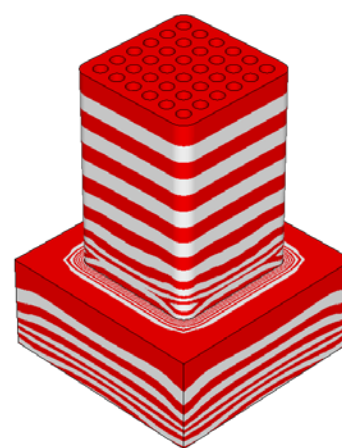


Contour(輪廓圖)

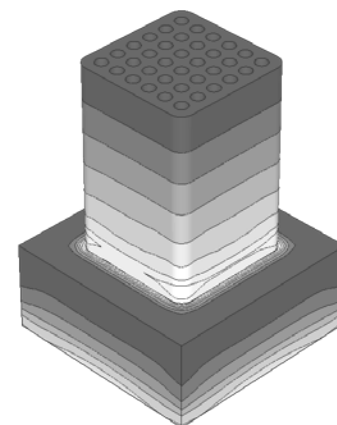
輪廓圖-自訂最/最小值



Gradient Contour

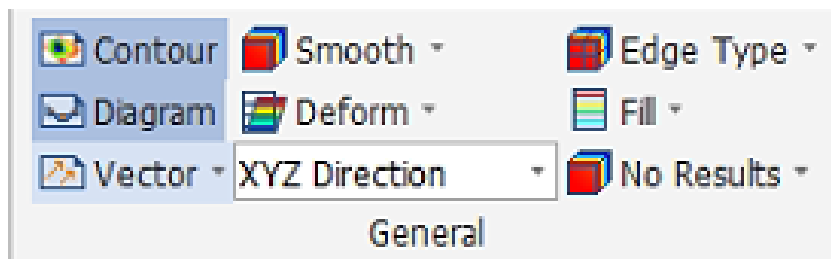


2-Color Contour

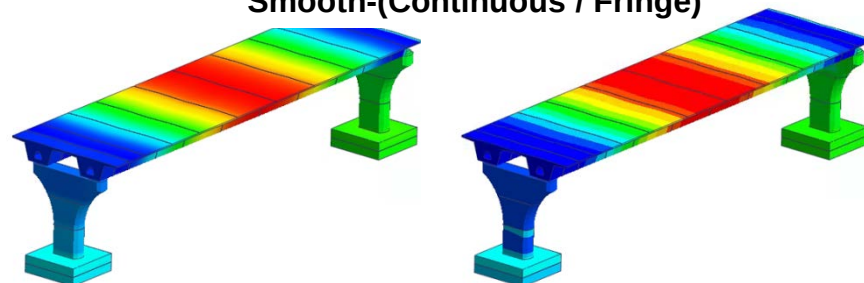


Gray Contour

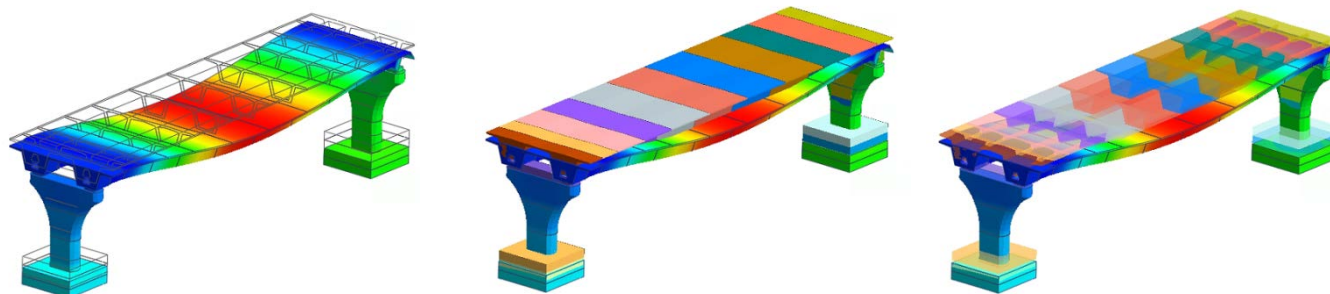
General Post-processing Tools-2



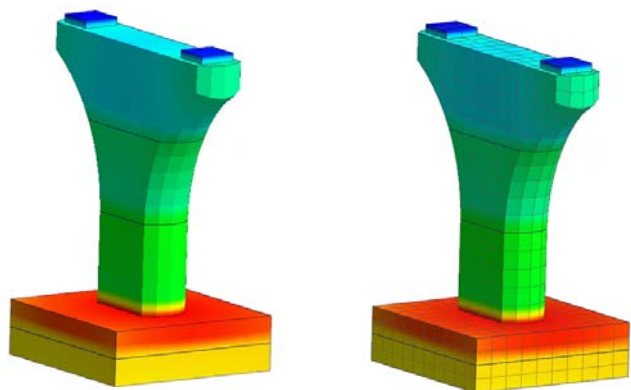
Smooth-(Continuous / Fringe)



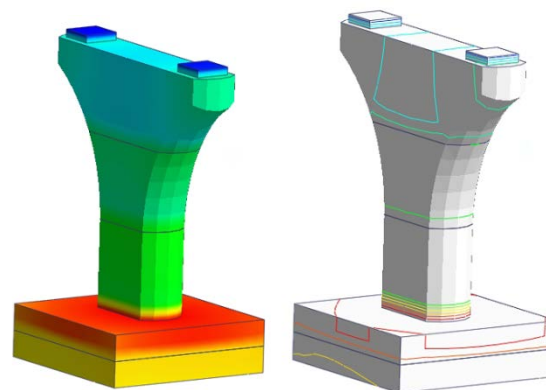
Deform- Deformed + Un-deformed (Feature/Shading/Transparent)



Edge Type (No Edge / Mesh Edge)

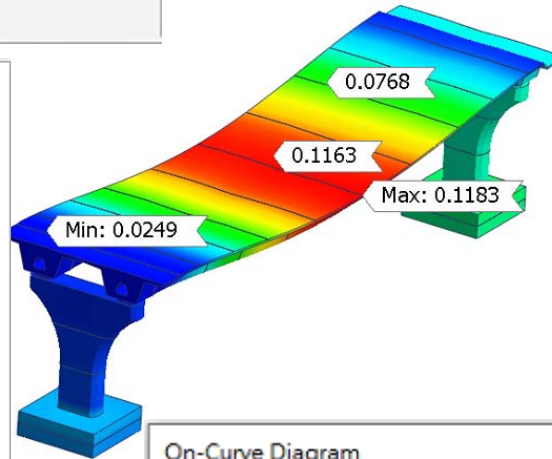
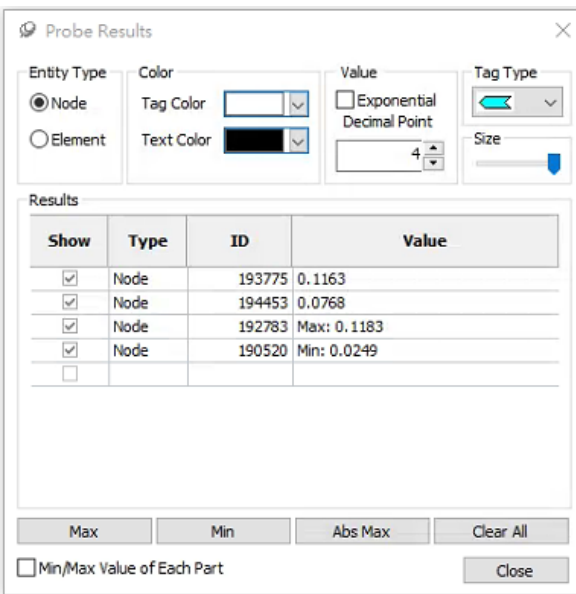
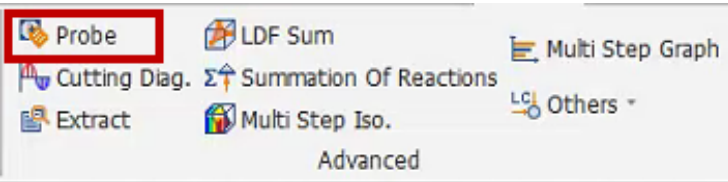


Fill (Solid / Line)

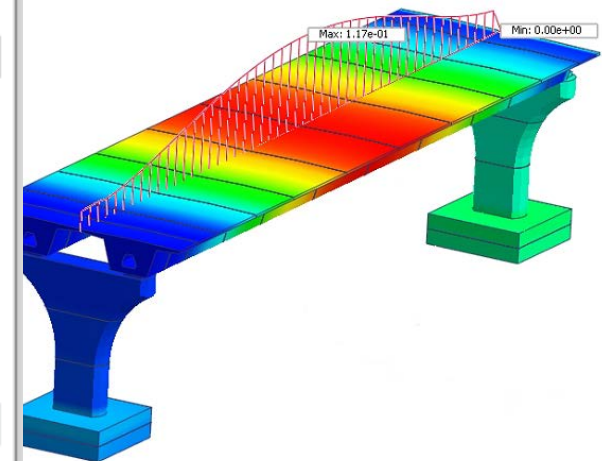
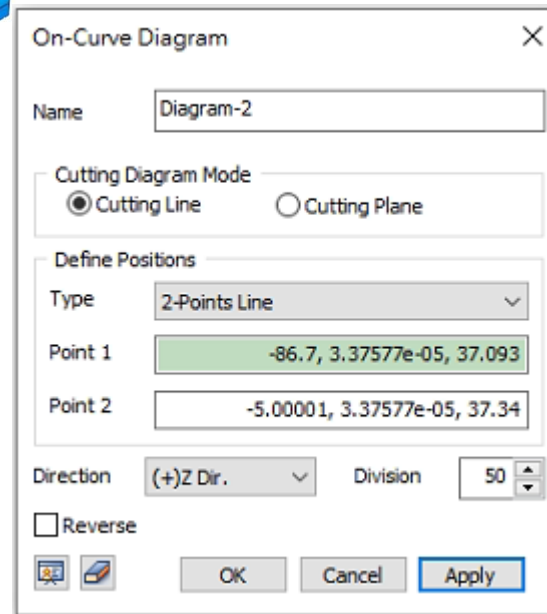
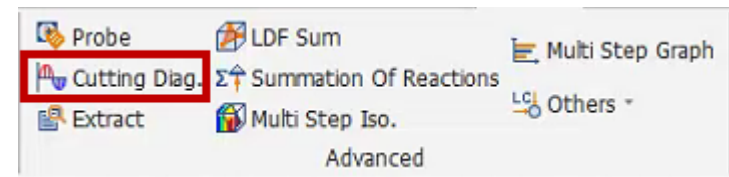


Probe Results and On Curve Diagram

Probe Results



On Curve Diagram

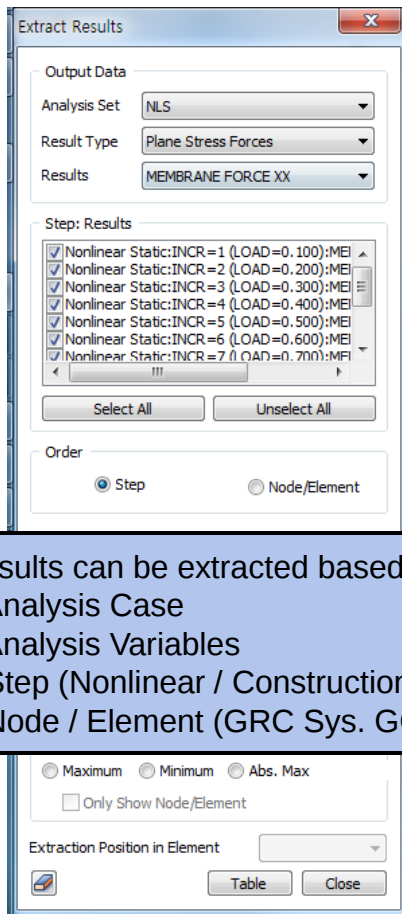


Result Extraction

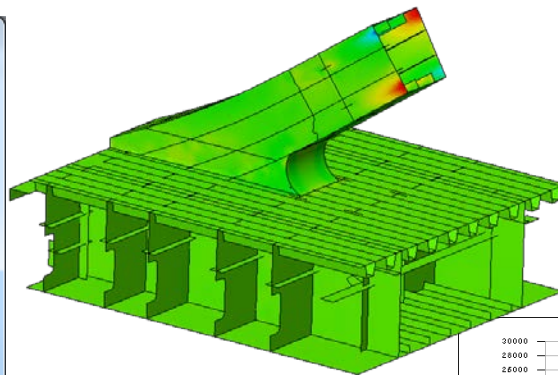


Nonlinear Analysis/Time Domain/Frequency Domain

No	Step	Step Value	Element:71 MEMBRANE FORCE XX Center (N/mm)	Element:173 MEMBRANE FORCE XX Center (N/mm)	Element:174 MEMBRANE FORCE XX Center (N/mm)	Element:175 MEMBRANE FORCE XX Center (N/mm)	Element:176 MEMBRANE FORCE XX Center (N/mm)
1	Nonlinear Static:INCR=1 (LOAD=0.100)	1.000000e-001	1.050656e+001	-4.951021e+001	-2.050049e+001	7.315966e+000	3.910260e+001
2	Nonlinear Static:INCR=2 (LOAD=0.200)	2.000000e-001	2.101312e+001	-9.902041e+001	-4.10098e+001	1.463193e+001	7.820520e+001
3	Nonlinear Static:INCR=3 (LOAD=0.300)	3.000000e-001	3.151968e+001	-1.485306e+002	-6.150147e+001	2.194790e+001	1.173078e+002
4	Nonlinear Static:INCR=4 (LOAD=0.400)	4.000000e-001	4.202623e+001	-1.980408e+002	-8.200196e+001	2.926386e+001	1.564104e+002
5	Nonlinear Static:INCR=5 (LOAD=0.500)	5.000000e-001	5.253279e+001	-2.475510e+002	-1.025024e+002	3.657983e+001	1.955130e+002
6	Nonlinear Static:INCR=6 (LOAD=0.600)	6.000000e-001	6.303935e+001	-2.970612e+002	-1.230029e+002	4.389580e+001	2.346156e+002
7	Nonlinear Static:INCR=7 (LOAD=0.700)	7.000000e-001	7.354591e+001	-3.465715e+002	-1.435034e+002	5.121176e+001	2.737182e+002
8	Nonlinear Static:INCR=8 (LOAD=0.800)	8.000000e-001	8.405247e+001	-3.960817e+002	-1.640039e+002	5.852773e+001	3.128208e+002
9	Nonlinear Static:INCR=9 (LOAD=0.900)	9.000000e-001	9.455903e+001	-4.455919e+002	-1.845044e+002	6.584370e+001	3.519234e+002
10	Nonlinear Static:INCR=10 (LOAD=1.000)	1.000000e+000	1.050656e+002	-4.951021e+002	-2.050049e+002	7.315966e+001	3.910260e+002



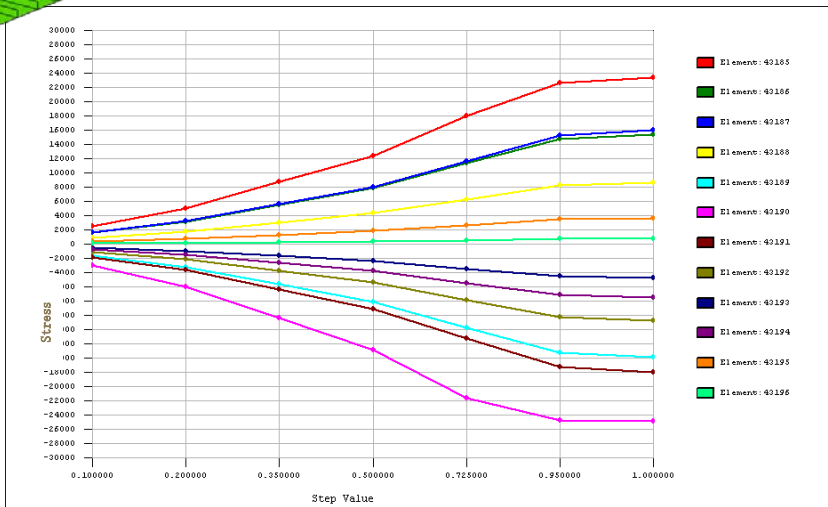
- Results can be extracted based on:
 - Analysis Case
 - Analysis Variables
 - Step (Nonlinear / Construction Stage Analysis)
 - Node / Element (GRC Sys. GCC Sys.)



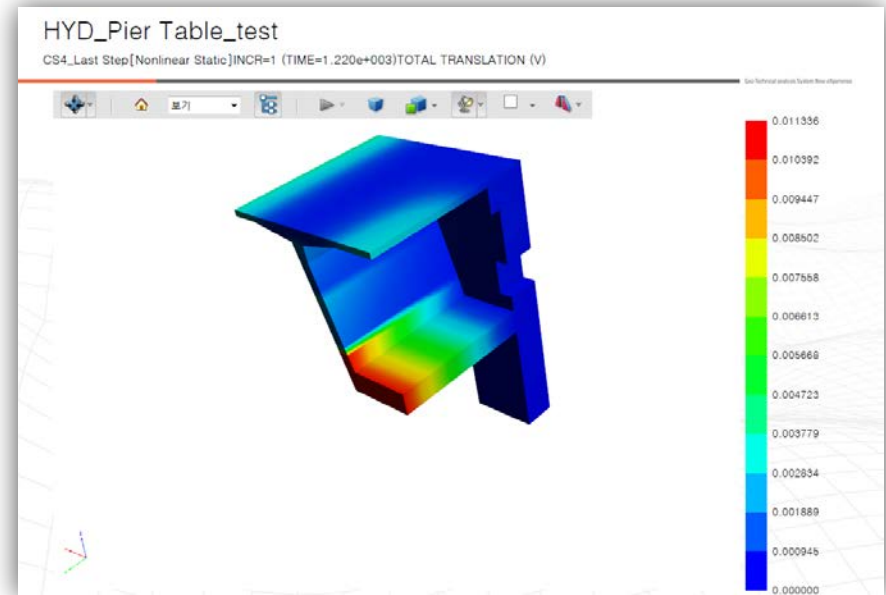
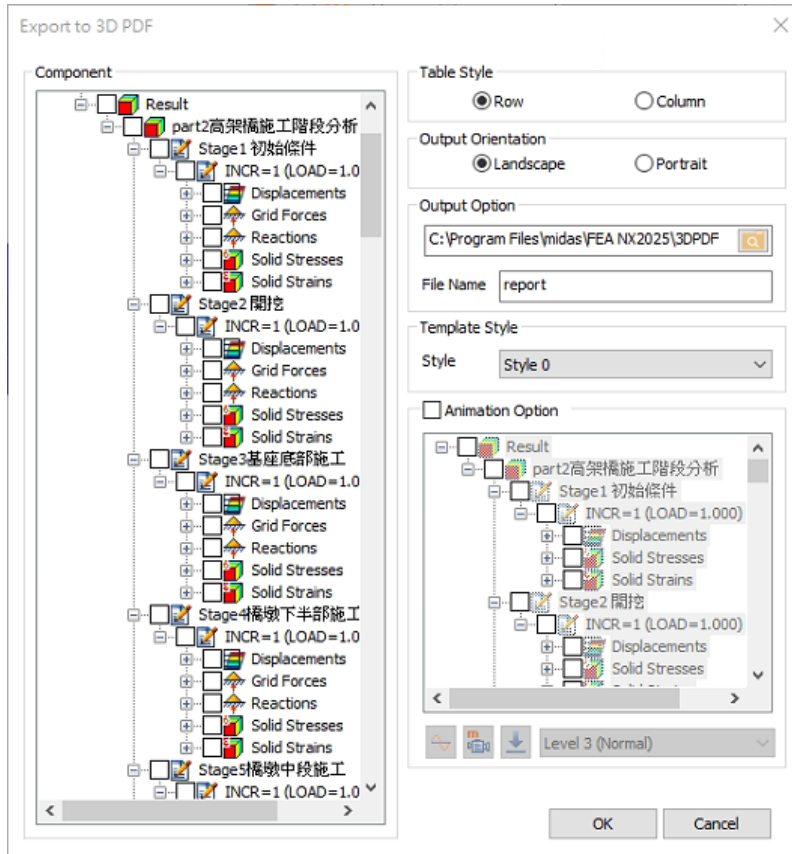
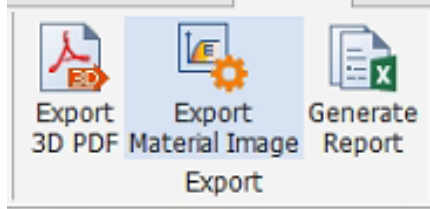
MS-Excel compatible Table



Graph (Stress vs. Time step)



Auto-Generated Report



註:自動生報告必須考慮對應PDF和Excel版本

Contents

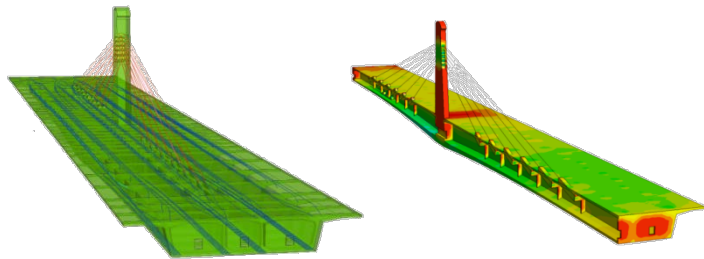
1. Overview
2. Geometry Modeling
3. Mesh Generation
4. Analysis
5. Post-processing
- 6. Application**

Success Story

Cable-Stayed Bridge(斜拉橋)



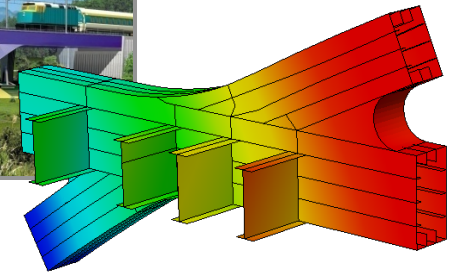
Woon-Nam Extradosed Bridge – Single Pylon



Railway Steel Arch Bridge(鐵路鋼拱橋)



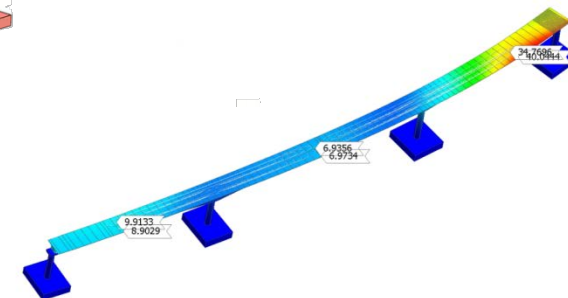
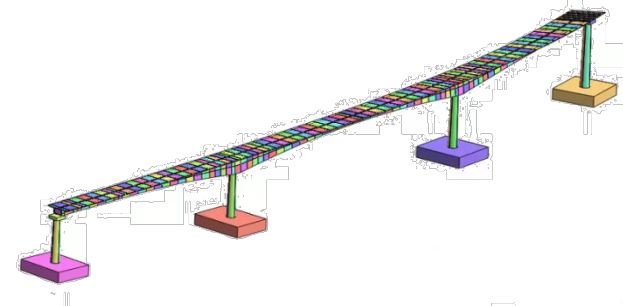
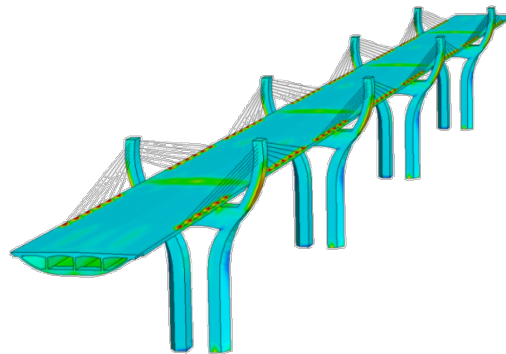
JECHON-DODAM RAILWAY
Steel Arch Bridge



Freeway viaduct(高速公路高架橋)



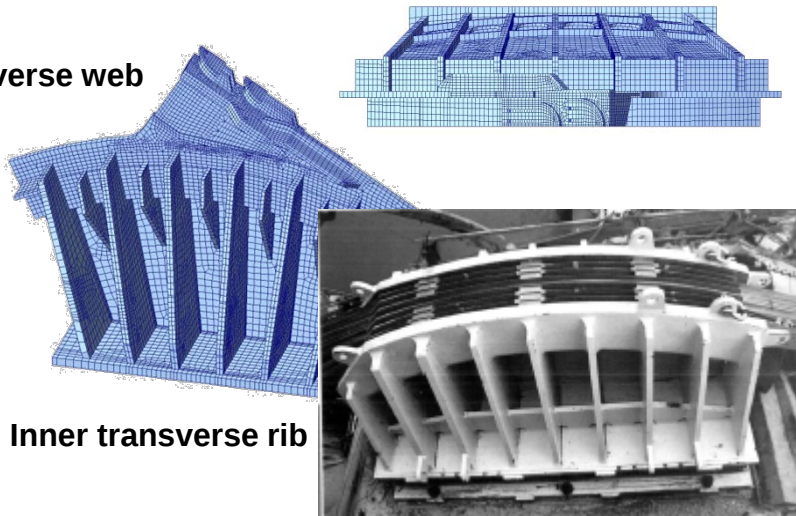
Geumga Extradosed Bridge



Success Story

Pylon Cable Saddle(塔架電纜鞍座)

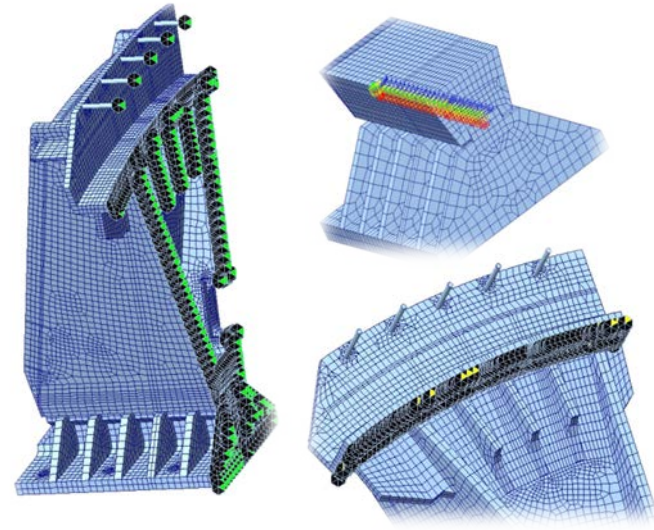
Transverse web



Inner transverse rib

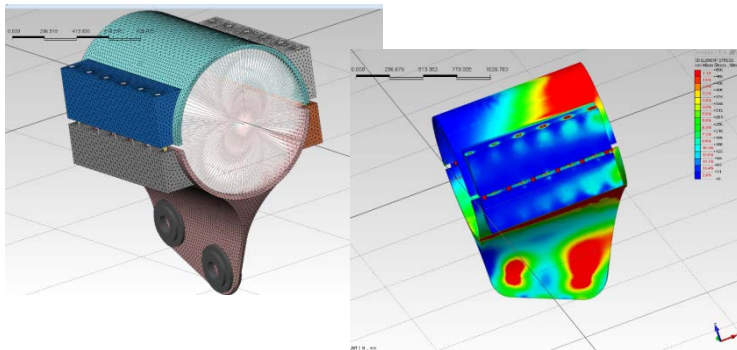
Pylon Cable Saddle (Leesoonsin Suspension Br.)

Splay Saddle(八字鞍)



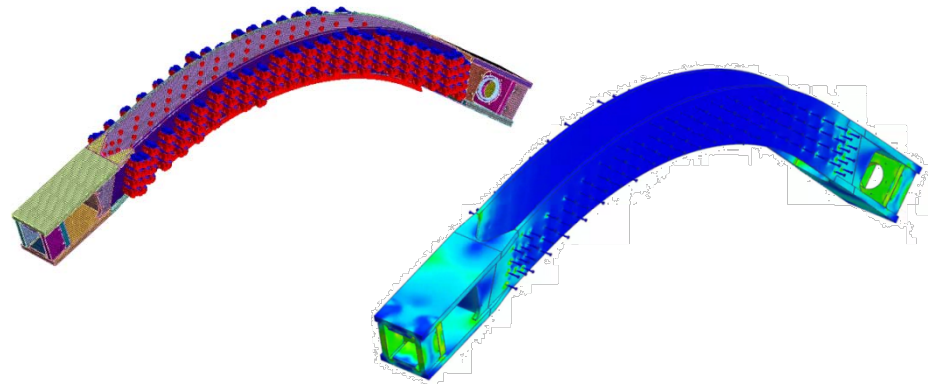
of Splay Saddle (New Millennium Suspension Br.)

Hanger Clamp(吊架夾)



Hanger Clamp (Bonny River Suspension Br.)

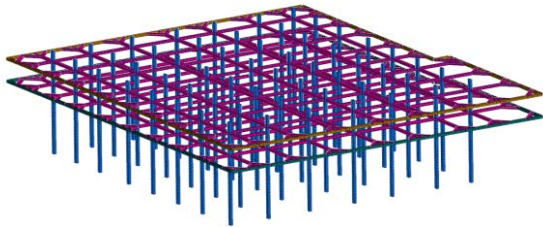
Saddle-shaped anchor box system(馬鞍形狀錨箱系統)



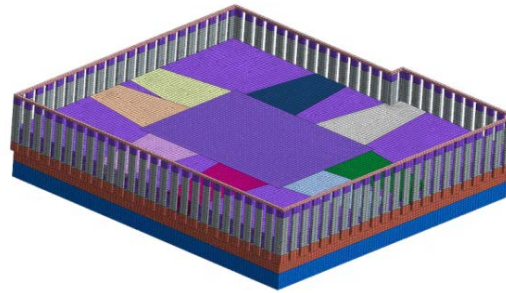
Success Story



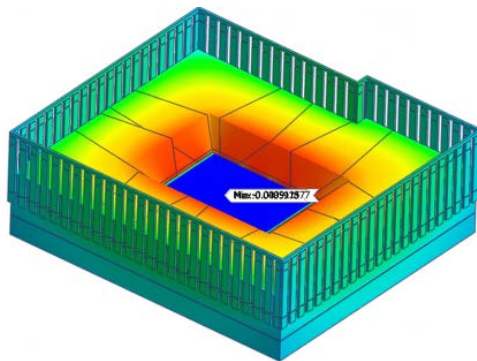
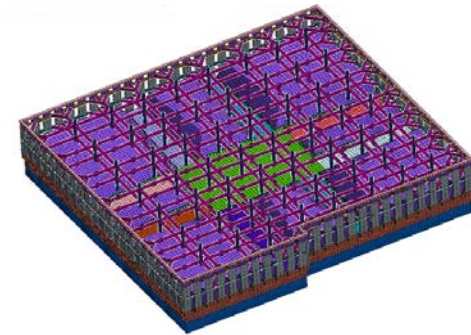
GEN+FEA NX 3D



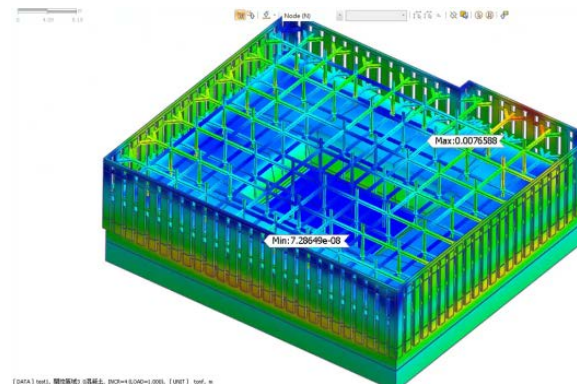
開挖面最大垂直位移 (m)



開挖面最大水平位移 (m)



開挖面最大垂直位移 (m)



開挖面最大水平位移 (m)



