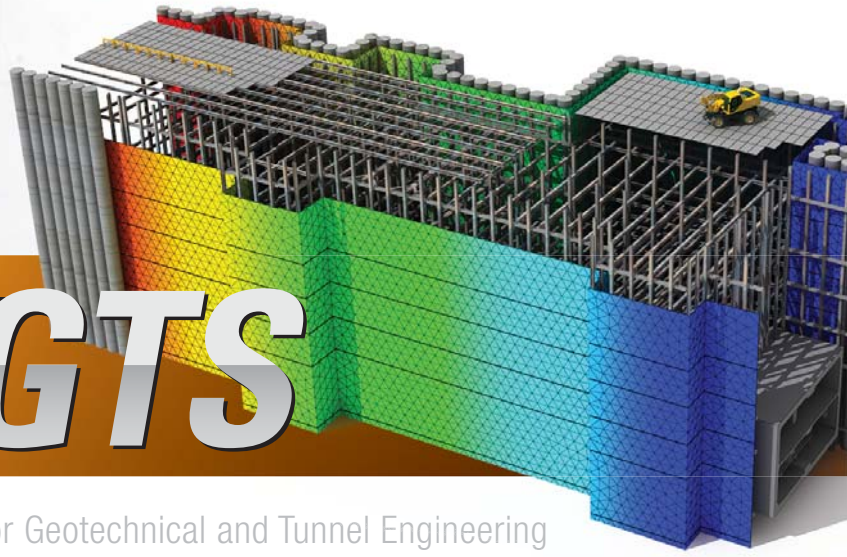
MIDAS

Geotechnical and Tunnel Analysis System

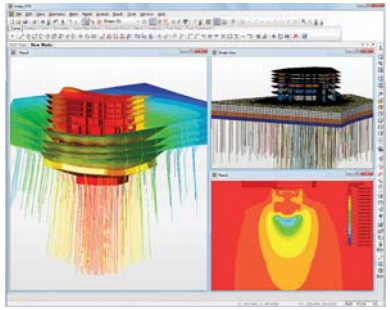
midas GTS



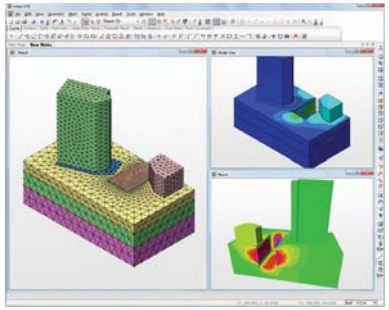
Next Generation Solution for Geotechnical and Tunnel Engineering

Next Generation Solution for Geotechnical and Tunnel Engineering

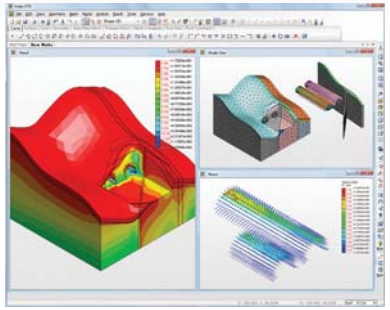
midas GTS is all-in-one FE analysis software dedicated to geotechnical engineering.
midas GTS provides a new paradigm for intuitive modeling, superb analysis capabilities and speed, visualization of modeling and results, and practical summarization of results.
Such unprecedented analysis environment will surely satisfy the needs of the demanding users.



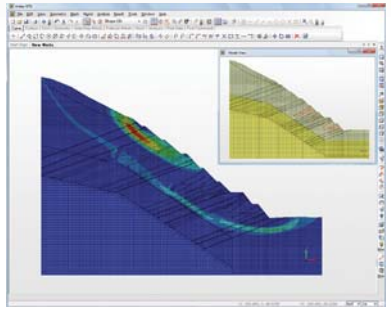
Foundation



Excavation



Tunnel



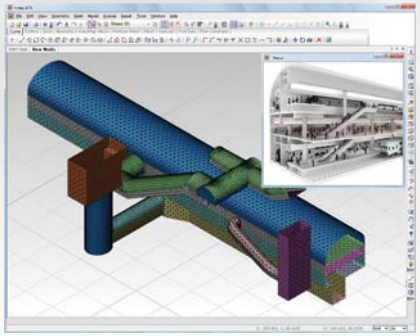
Slope Stability

- Static Analysis (Linear, Nonlinear)
- Construction Stage Analysis (Drain, Undrained)
- Seepage Analysis (Steady state/ Transient, Saturated/ Unsaturated)
- Semi-Coupled Analysis
- Consolidation Analysis
- Slope Stability Analysis (SRM, SAM)
- Eigenvalue Analysis
- Equivalent Linear Analysis (1D,2D**)
- Response Spectrum Analysis
- Time History Analysis (Linear, Nonlinear**)

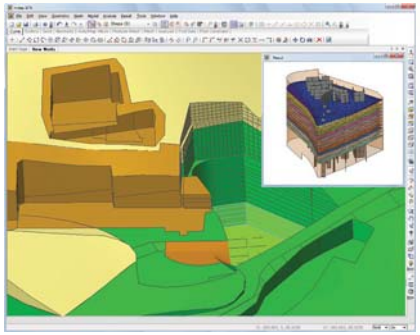
** : in development

** : in development

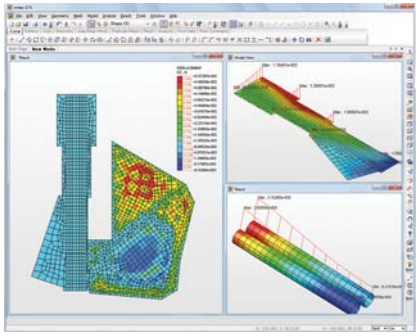
midas GTS



New subway complex, United States



Odeon Tower, Monaco



Sichuan Subway Station, China

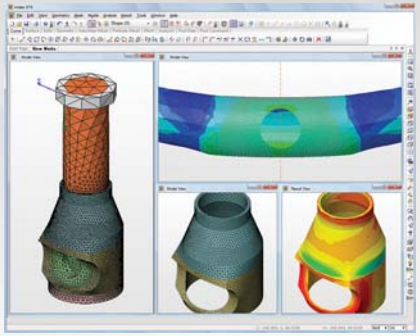
Powerful pre/post-processors

Reliable Solver

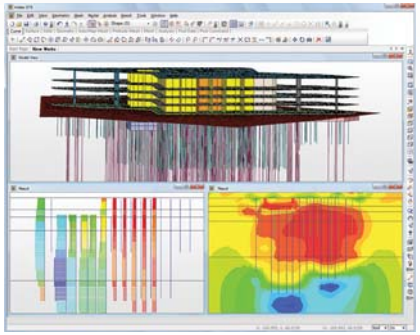
User-friendly Interface

Technical Support

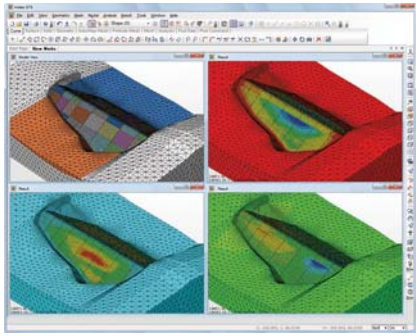
Development guided by user's feedback



Shaft construction on the existing tunnel, United Kingdom



Dubai Tower, Qatar



Buhang Dam, Korea

Why midas GTS?

Geotechnical and Tunnel Analysis System

All-in-one FE analysis software

Dedicated to geotechnical engineering

Q 1. What is midas GTS?

A midas GTS is Fully Integrated 2D/3D Finite Element Analysis Software.

midas GTS is a Fully Integrated 2D/3D Finite Element Analysis Software dedicated to geotechnical engineering applications including Tunneling, Mining, Foundations, Excavations, Soil-Structure Interaction, Settlement Analysis, Seepage (groundwater flow) Analysis, Consolidation Analysis and much more.

The pre/post-processors and solvers are Fully Integrated which means no need to acquire different modules for performing analyses such as Foundation, Tunneling, Excavation, Ground Water Flow Analysis and etc.

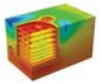
midas GTS technology balances power and simplicity to empower geotechnical engineers who are seeking a reliable platform while revolutionizing how people understand and incorporate actual projects into finite element software.

midas GTS is designed to become an integral part of your professional service which will ultimately add significant value to your engineering innovations and make a positive impact on your organization's performance.

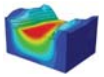
Powerful and accurate solver + Enhanced pre/post engine

Deep Foundations and Soil-Structure Interaction

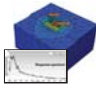
Unconventional Tunnel Intersections



Excavations, Embankments and Slope Stability



Groundwater Flow and Coupled Analyses



Vibration Analysis for Earthquake, Blasting

and more...

Why midas GTS?

Geotechnical and Tunnel Analysis System

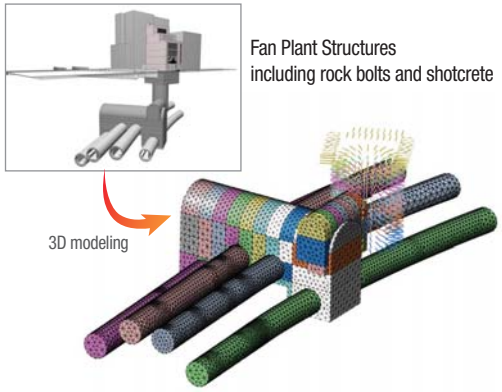
Optimal solution for simulating

3D complex geotechnical models

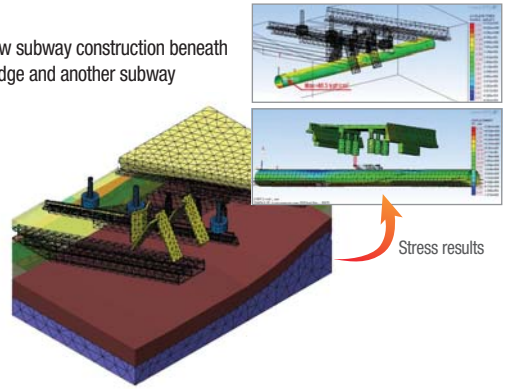
Q 2. Can complex 3D geometry be modeled?

A Yes, all the essential modeling tools are available.

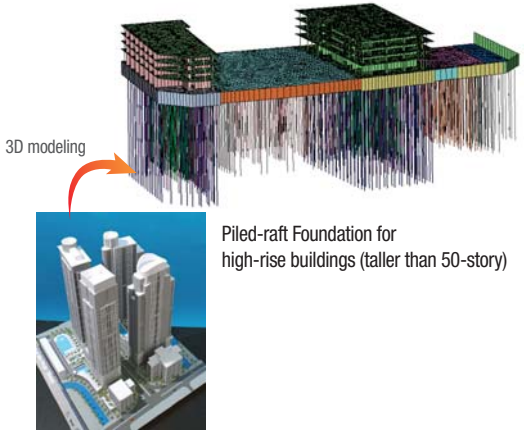
midas GTS offers **Intuitive GUI Environment** which allows for creation of **complex geometry** in the least amount of steps based on **CAD** formats.
Different element types (e.g. embedded truss, beam, plate, interface and solid elements) including structural elements can be composed in **one model file**.



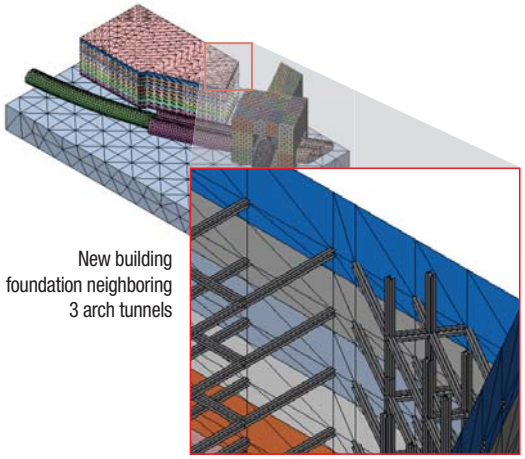
Fan Plant Structures
including rock bolts and shotcrete



New subway construction beneath
bridge and another subway



Piled-raft Foundation for
high-rise buildings (taller than 50-story)



New building
foundation neighboring
3 arch tunnels

Temporary structures

Why midas GTS?

Geotechnical and Tunnel Analysis System

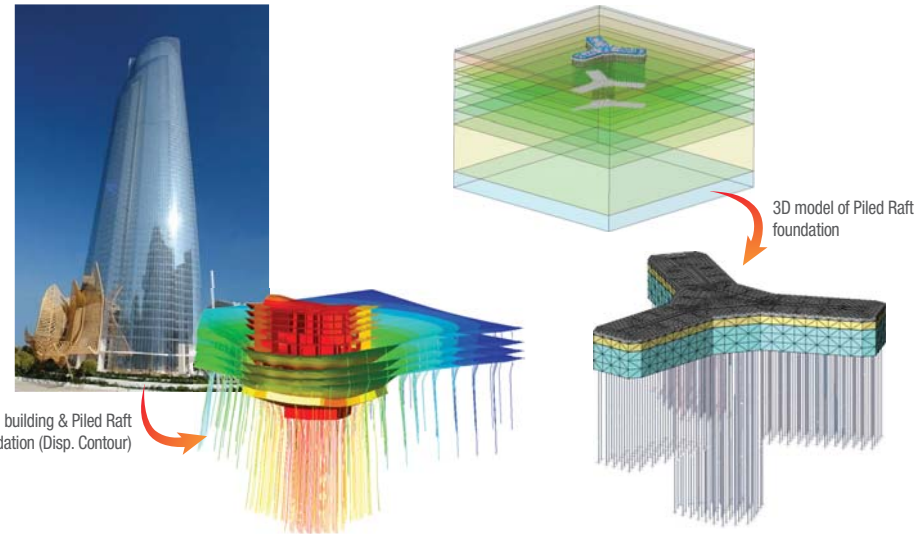
Foundation analysis with

Freely-defined piles & Soil-structure Interaction

Q 3. Can different pile diameters and pile group behavior be modeled and analyzed?

A Yes, midas GTS can consider it using beam elements.

Existence of super pile elements to model large scale piled raft foundation systems based on embedded element techniques and considering full soil structure interaction effects.

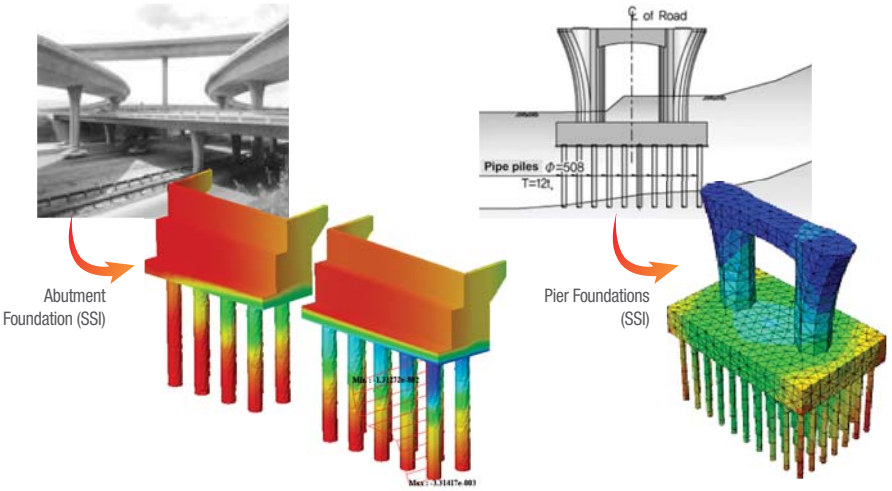


Q 4. Can complex 3D Soil-Structure Interaction (SSI) be simulated?

A Yes, various types of interface elements for SSI are provided.

Existence of various types of interface elements to simulate soil-structure interaction regardless of geometry complexity and interface position.

- Soil-pile friction captured by nonlinear interface behavior
- Pile group interaction captured by full 3D modeling



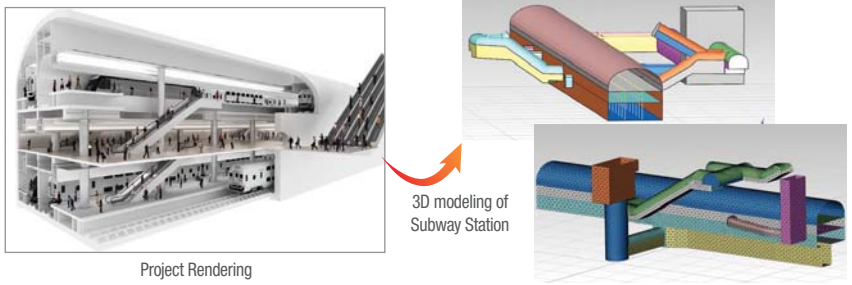
Complex tunneling methods &
Various types of tunnel structures

Q 5. Can unconventional Tunnel Intersections be modeled?

A Yes, tunnels with unconventional connection galleries can be modeled with the essential tools provided.

All types of T-type/Y-type interconnections, curved tunnels, shaft-lateral-main tunnel connections, tunnel entrances, even subway stations can be easily modeled in detail.

3D Modeling of unconventional tunnel interconnections

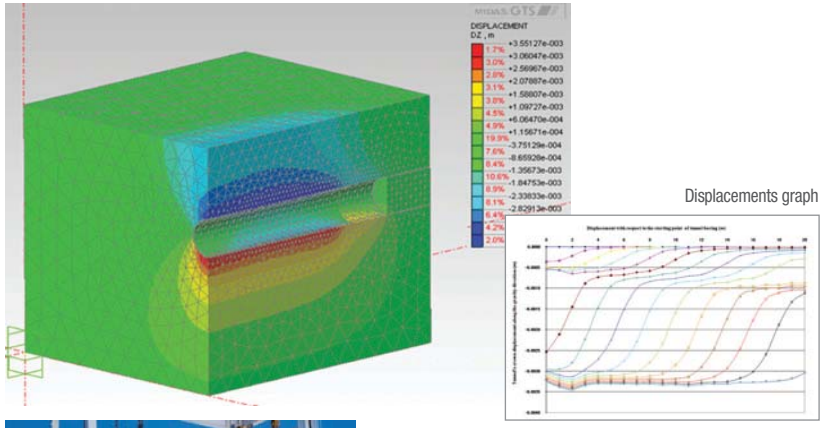


Project Rendering

Q 6. Can Shield TBM be modeled?

A Yes, TBM modeling, considering excavation sequences, is available.

Automated and realistic construction stage definition for sequential activation and deactivation of excavation segments, structural parts, loads and boundary conditions.



Displacements graph

Construction field - Shield TBM

Why midas GTS?

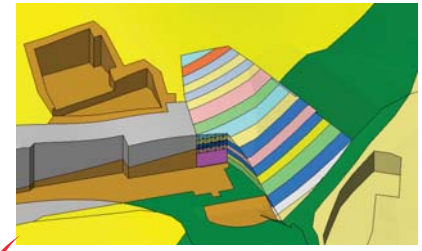
Geotechnical and Tunnel Analysis System

Accurate simulation of staged excavation &
Groundwater flow with realistic site condition

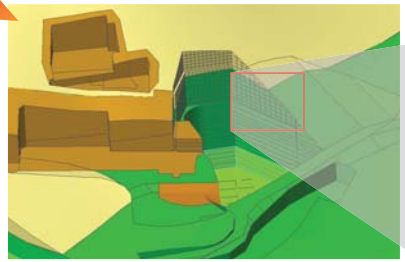
Q 7. Is Staged Excavation supported in midas GTS?

A Yes, midas GTS supports 3D excavation and dedicated tools.

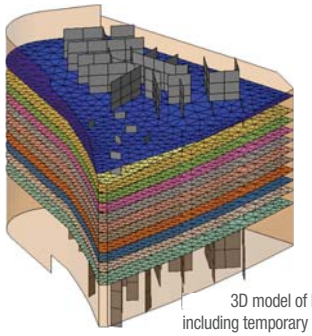
Simulate 3D excavation in real time construction sequence Including dewatering procedure. Structural support systems including anchors and diaphragm walls can be generated automatically.



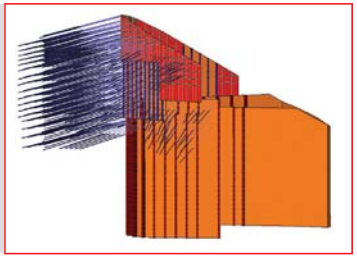
Before excavation



After staged excavation



3D model of basement including temporary structures



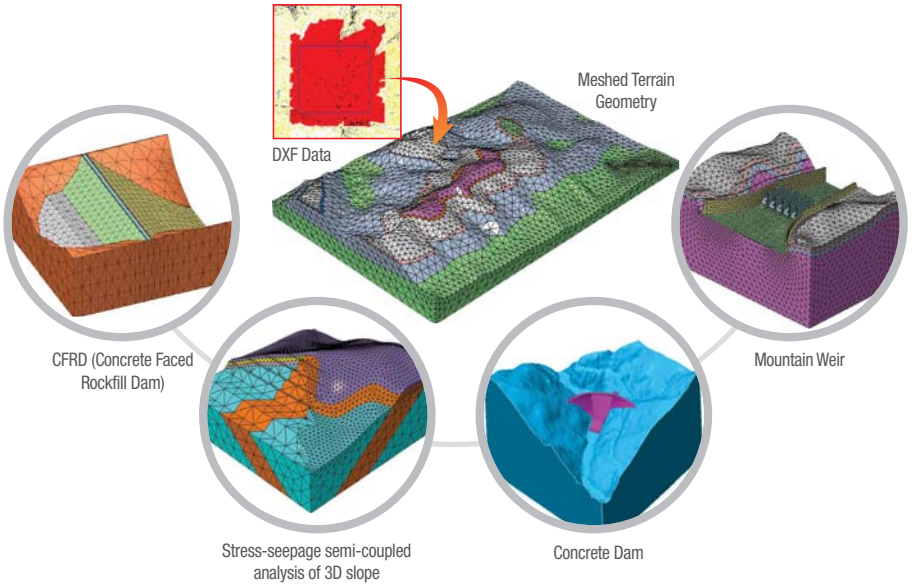
3D model of anchors

Q 8. Can Groundwater Flow be considered in midas GTS?

A Yes, various hydraulic boundary conditions are available to consider groundwater flow behavior.

Stress-seepage semi-coupled analysis & expanded application of Darcy's law (saturated / unsaturated) are considered in midas GTS.

Furthermore, a detailed terrain geometry can be modeled based on built-in tool TGM (Terrain Geometry Maker) to incorporate digital maps into the model.



Why midas GTS?

Geotechnical and Tunnel Analysis System

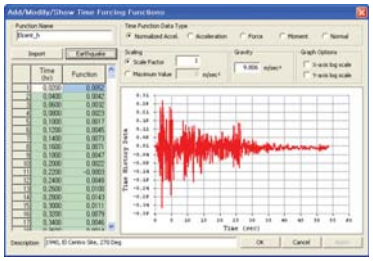
Advanced analysis capabilities &

Supporting 64 bit O/S & multi-core CPUs

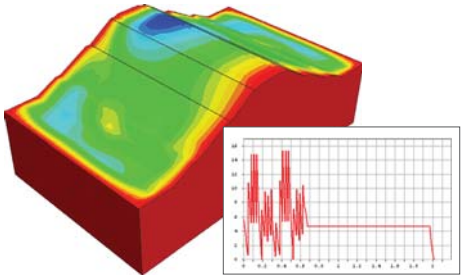
Q 9. Can Dynamic Analysis be performed in midas GTS?

A Yes, 3D Dynamic Analysis is available with integrated seismic wave database.

Dynamic analysis can be performed for 1D, 2D and 3-dimensional models including built in 1D and 2D equivalent linear dynamic analysis features.



Built in seismic database

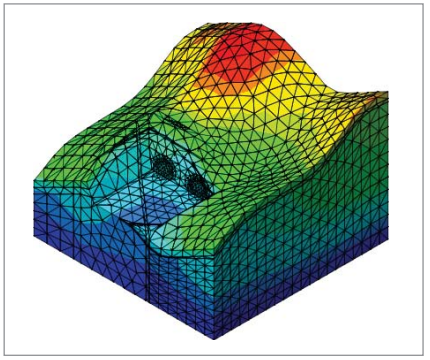


Dynamic effects of high speed train

Q 10. Does midas GTS support 64 bit O/S?

A Yes, midas GTS supports 64-bit OS & multi-core parallel system.

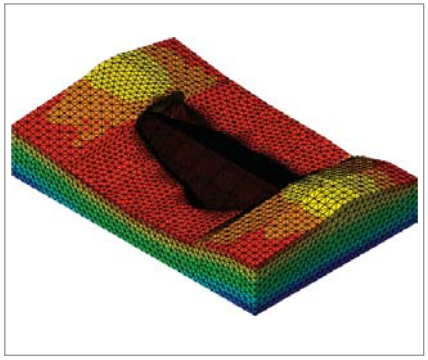
GTS offers robust and advanced kernel - supporting 64-bit OS & multi-core parallel system in nonlinear, construction-stage and seepage analysis.



3D model of tunnel entrance

# Nodes	# Element
Approx 320,000	Approx 170,000

- Displacement plot time: 0.5 sec
- Stress plot time: 0.7 sec



3D model of earth dam

# Nodes	# Element
Approx 360,000	Approx 200,000

- Displacement plot time: 0.5 sec
- Stress plot time: 0.7 sec

Why midas GTS?

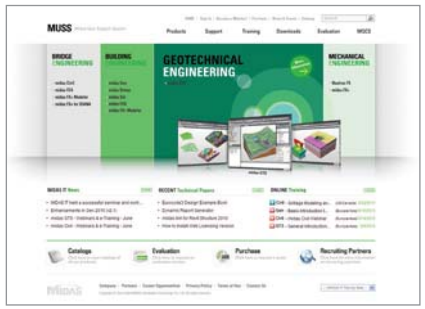
Geotechnical and Tunnel Analysis System

Outstanding training &
Worldwide events

Q 11. Are there any training programs or technical documents regarding midas GTS?

A Yes, MIDAS provides FREE online seminars & training programs in addition to an extensive tutorial database.
Both MIDAS and partner companies provides local events such as user conferences & seminars, and on-site training programs.

MIDAS User Support System



Join our FREE online training at
www.MidasUser.com

- MIDAS Online Training
- Free Trial Version available
- Tutorials (Basic, Advanced)
- News & Events (new release and etc.)
- Q&A board
- and more...

MIDAS Online Training

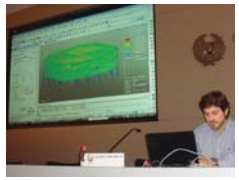
- **Free**
  Our MIDAS Webinar Service is provided to all participants at no cost!
- **Interactive**
  It allows full participation between the audience and the presenter, providing Q&A sessions.
- **Customized**
  By submitting your areas of interest prior to the session.

MIDAS events world-wide (conferences & seminars)


Italy


United Kingdom


The Netherlands


Spain


Japan


China


India

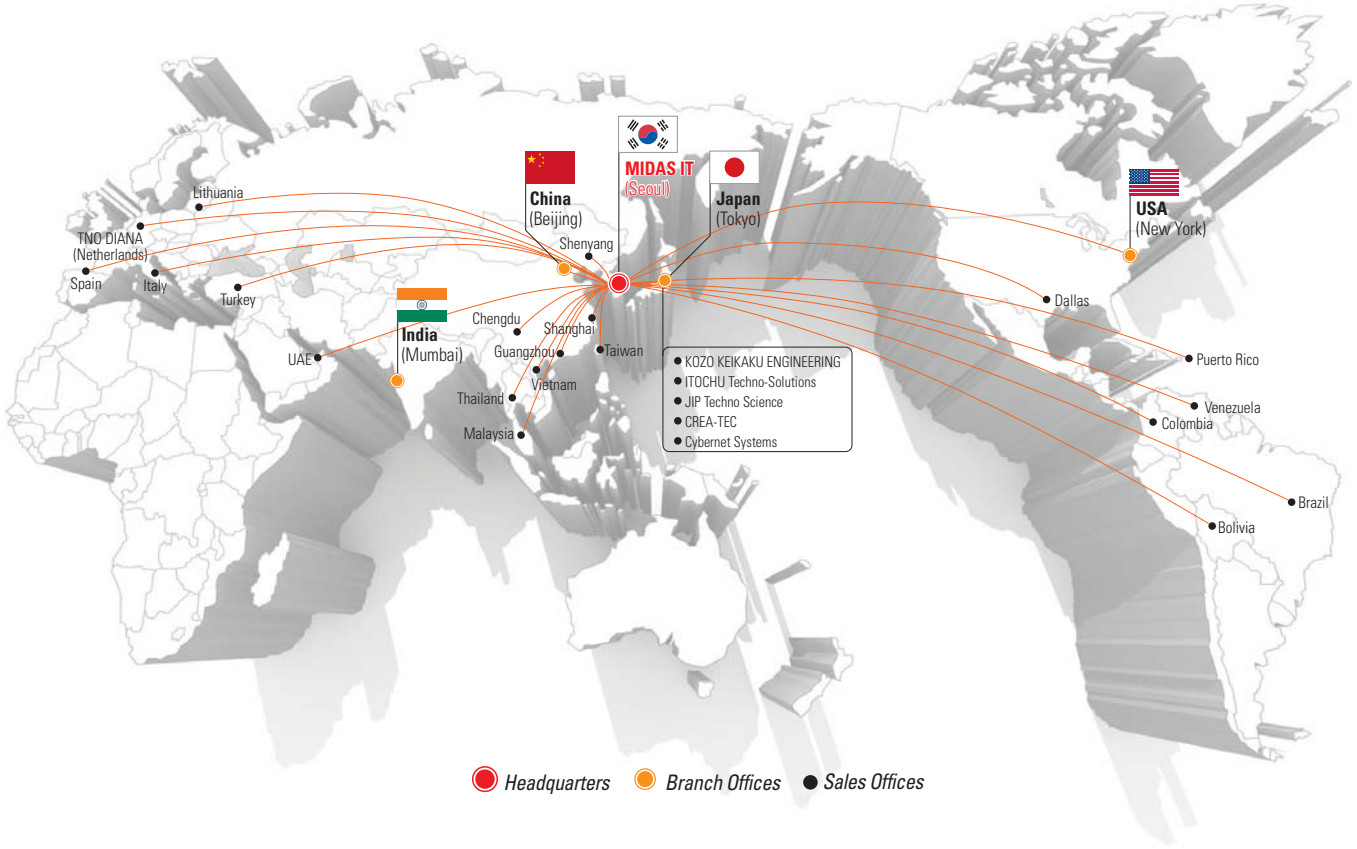

Indonesia


Korea

Easy-access to
World-wide MIDAS Support Center

Q 12. How does MIDAS provide technical support?

A There are over 4 branch offices and 24 partners world-wide, including MIDAS Support & Development, who are qualified and ready to provide dedicated technical support via e-mail, phone and remote assistance.



Q&A Service

The GTS Q&A service provides prompt reply within 24 hours of a customer's inquiry related to the technical matters from the program's use. Also, for the security of a customer's project, personalization service is provided.

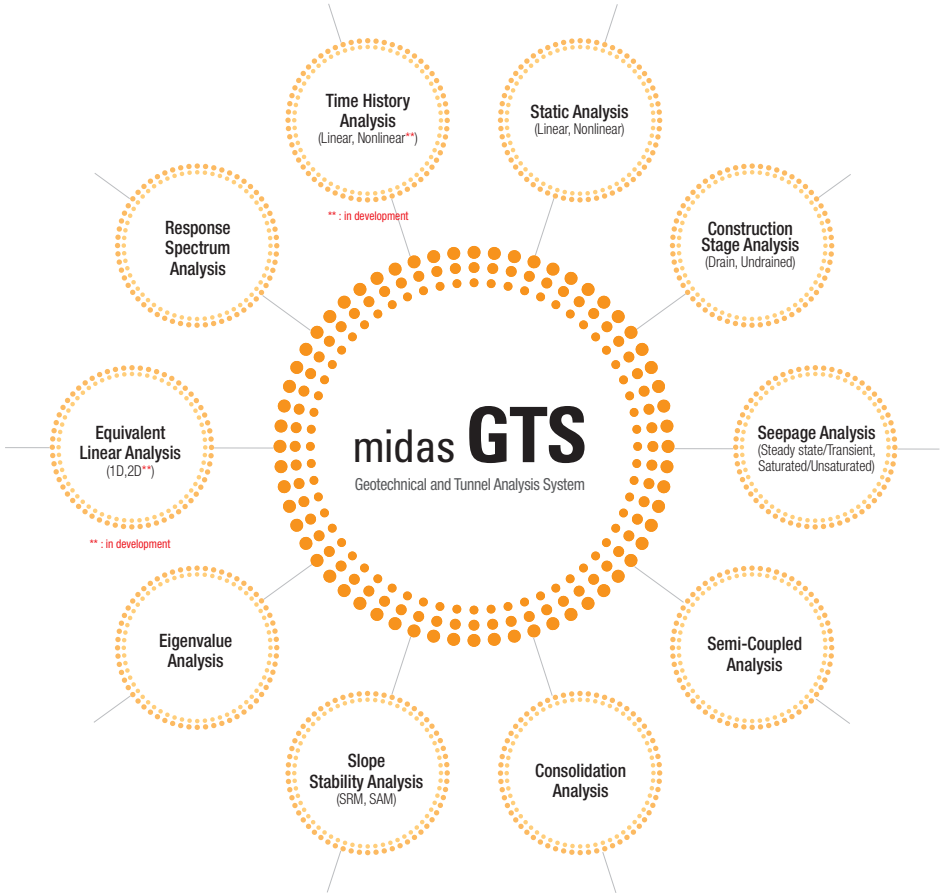
Remote Technical Support Service

The GTS remote technical support service actively responds to the customer's inquiry by sharing a customer's PC screen in real-time with the technical support representative to resolve the inquired problems.

midas **GTS**

"Next generation Solution for
Geotechnical Engineering"

Analysis Capabilities



Application Areas

Unconventional Tunnel Intersections

- Complex subsurface strata and terrain modeling.
- Tunnel entrances, T-type/Y-type interconnections, Shaft-lateral-main tunnel connections, Subway stations...
- Tunnel modeling wizard for fast pre- and post- processing
- Dedicated lining analysis module

Deep Foundations

- Soil-pile friction captured by non-linear interface behavior
- Pile group interaction captured by full 3D modeling
- 3D model size optimized for piled raft foundations using dedicated embedded pile elements

Excavations, Embankments and Slope Stability...

- Non-linear static analysis based on construction stages
- Water level definition in drained or undrained conditions
- Factor of Safety and failure analysis using c-Φ reduction method

Groundwater Flow and Coupled Analyses

- Steady state and transient seepage for tunnels, dams, slopes...
- Expanded application of Darcy's law from saturated to unsaturated range (van Genuchten and Gardner equations or user-defined curves)
- Stress-seepage semi-coupled analysis for the analysis of water-front systems, dewatering...
- Fully coupled consolidation analysis

Vibration Analysis for Earthquake, Blasting...

- Eigenvalue, response spectrum and time history analysis
- Earthquake history database and seismic wave autogeneration

Framework

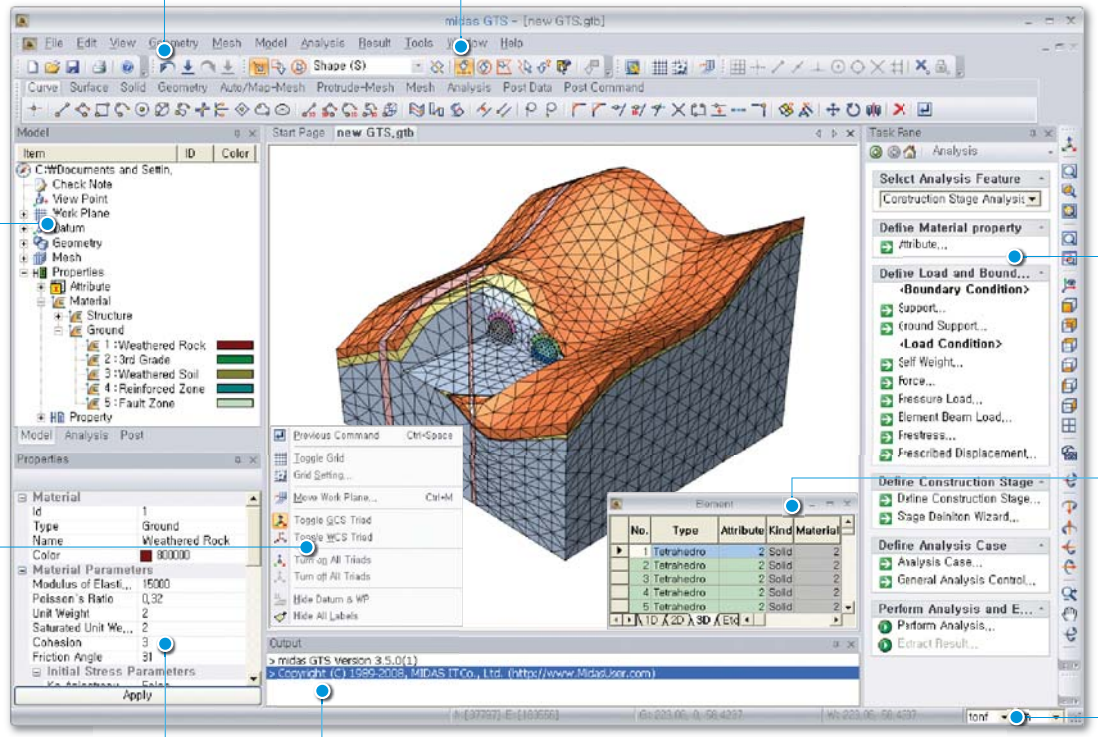
The framework of GTS is a window based environment modified with an innovative pre/post processor empowering numerical modelers with the freedom to maneuver in 2D/3D environments and effectively organize/manage large scale projects in easy to use folders.

Undo/Redo
Undo/Redo history

Works-Tree
Tree Structure including 3 different tabs for easy navigation

Context Menu
Provides more GUI control options

Property Window
Verify/modify the parameters pertaining to the selected item from works tree



Tool Bars
Main tool bars consisting of icons based on various operations

Task Pane
Customizable window including work flow from modeling to analysis

Table Window
Table input and output compatible with MS-Excel

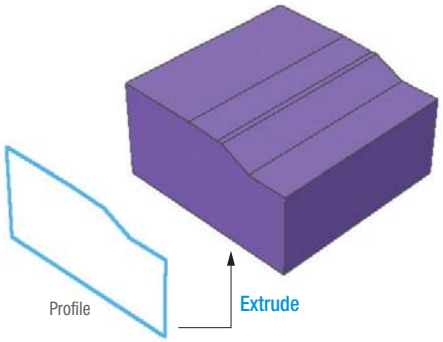
Unit System
Real time unit conversion

Output Window
Interactive window to monitor modeling and analysis process

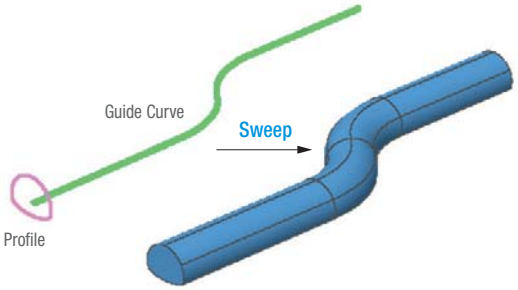
Geometry Modeling

GTS modeler is equipped with basic and advanced tools that are essential to accurate and quality modeling.

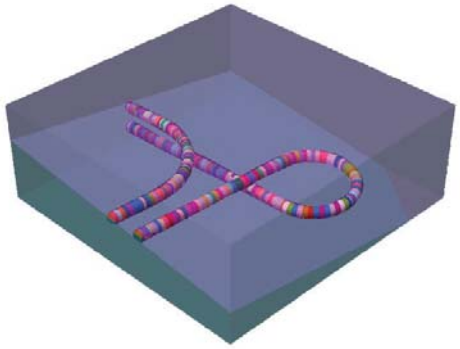
- Primitive Feature
  - Box, Cylinder, Sphere, Torus, Cone, Wedge
- Generator Feature
  - Extrude, Revolve, Loft, Sweep
- Modifier Feature
  - Fillet, Chamfer, Offset, Draft, Shell, Local Prism
- Trim, Divide by surface
- Boolean Operation
  - Fuse, Cut, Common
- Imprint curve, point
- Modeling various non-manifold shape



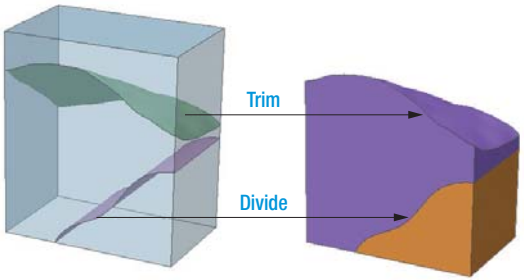
Extrude
(Create solid from wire)



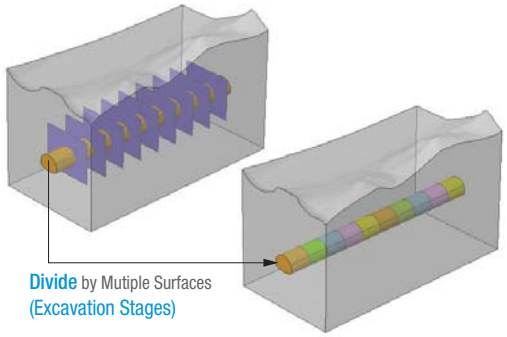
Sweep
(Extrude along guide curve)



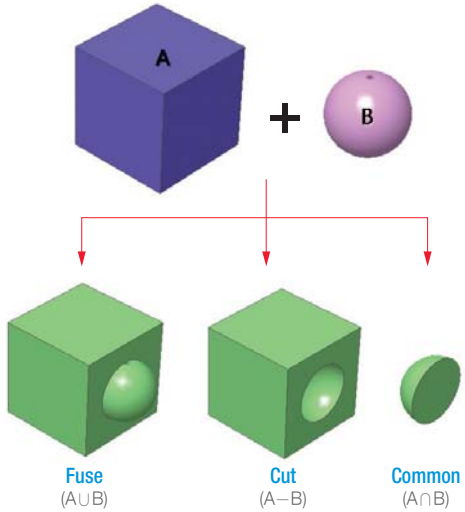
Extract curve and sweep



Trim / Divide



Divide by surface for defining construction stage

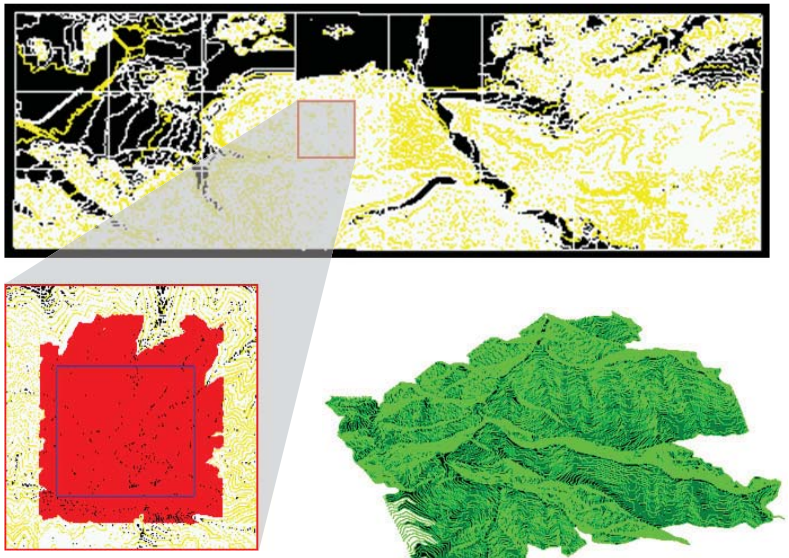


Boolean Operation
(Extrude along guide curve)

Geometry Modeling

TGM (Terrain Geometry Maker) converts topographic maps into editable surfaces in order to model the most realistic site conditions by capturing the geographical features of the terrain.

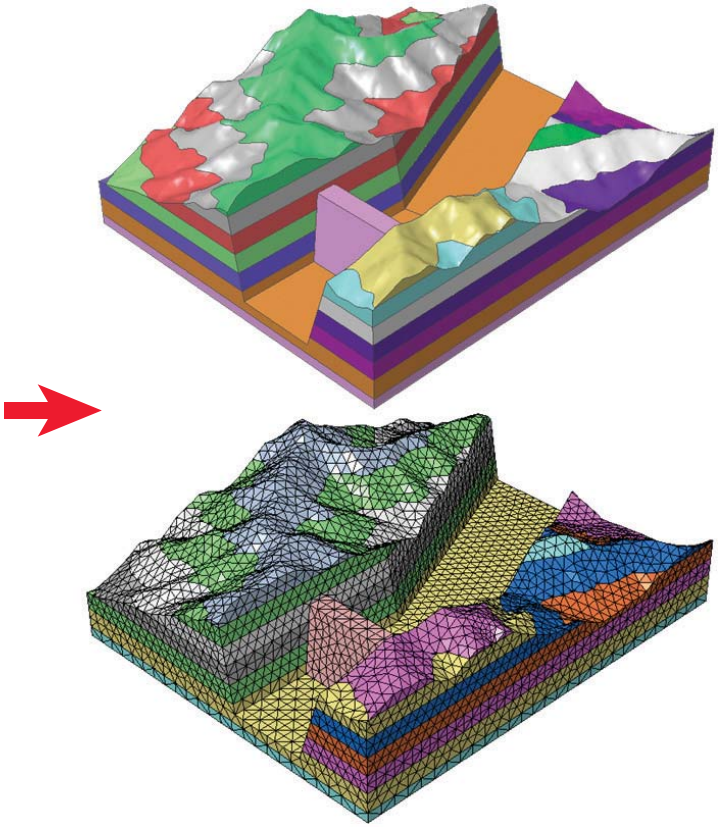
TGM (Terrain Geometry Maker)



DXF Data

3D Topographic map

Extracting surface from
3D topographic map

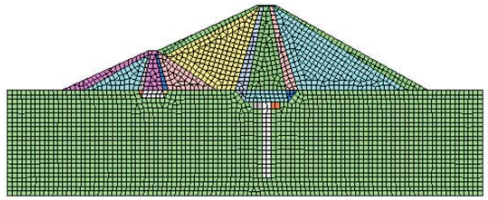


Applying the surface to
geometry of the model

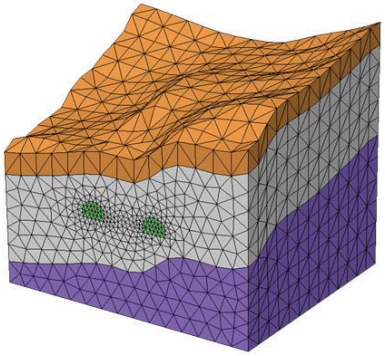
Mesh Generation

Most essential mesh generation tools for all levels of experience.

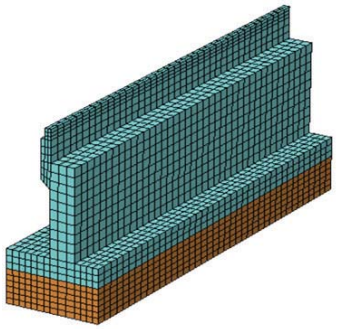
- Surface Auto-Mesher
  - Loop, Grid, Delaunay
- Solid Auto-Mesher
  - Delaunay (more than 200,000 elements per minute)
- Map-Mesher
  - Transfinite Interpolation, Sweeping
- Protrude Mesh (2D→3D)
  - Extrude, Revolve, Sweep, Project, Offset, Fill, Remesh
  - Edge / Face
- Advanced options
  - Include interior point and edge
  - Refinement factor
  - Adaptive seeding according to the geometry
  - Size control



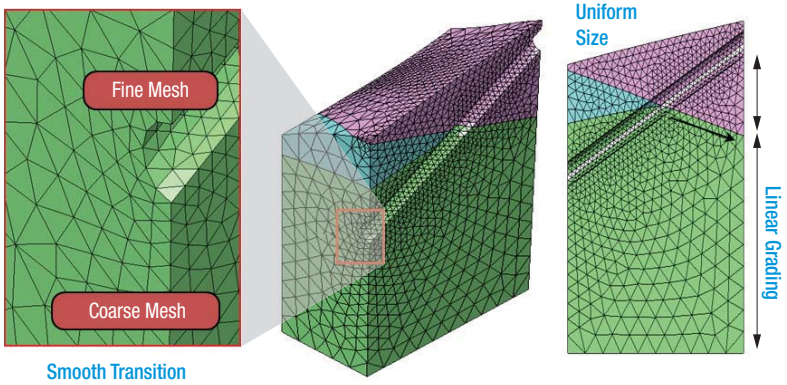
2D Auto Mesh



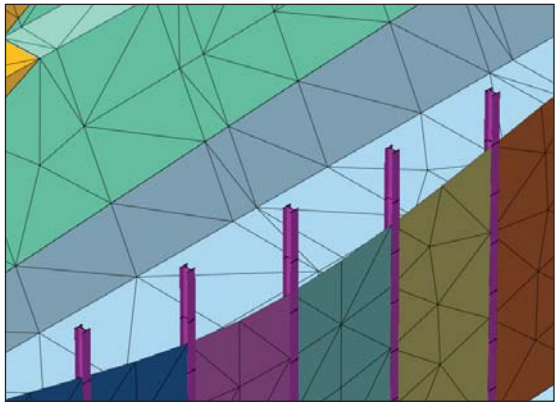
3D Auto Mesh



3D Map Mesh



Linear grading of mesh size
(Minimize quantity and maximize quality by size control)

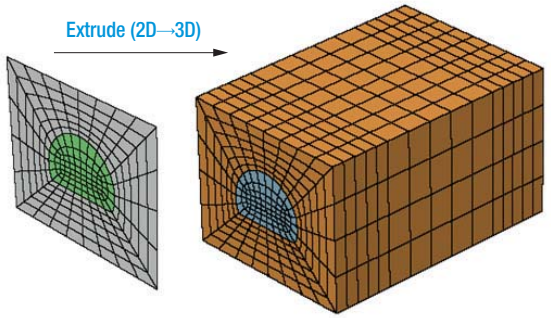


Combination of 1D,2D and 3D elements with section properties

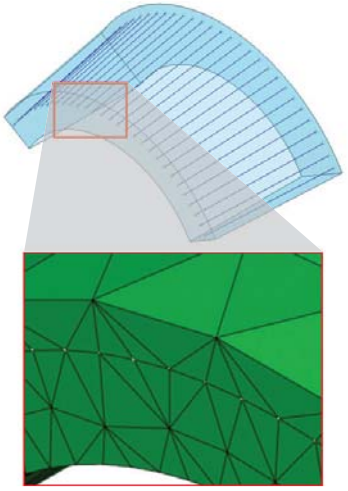
Mesh Generation

The intuitive mesh generator covers all geometric shapes and includes Qa/Qc functions for mesh quality verification and optimization process.

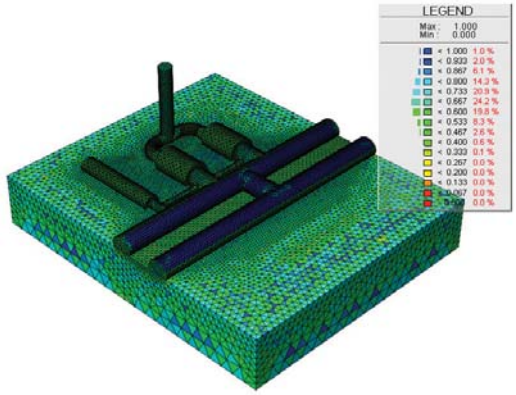
- Check mesh
  - Free Edge, Free Face, Non-manifold Edge
- Check quality
  - Aspect Ratio, Skew Angle, Taper, Warpage, Twist, Collapse, Jacobian Ratio
- Check and arrange element coordinate system
- Organize mesh set
  - Merge, New mesh set, Include/Exclude Items
- Arrange node ID



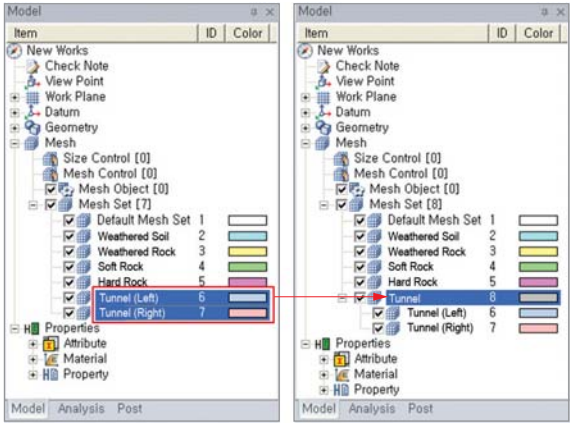
Extrude Mesh to 3D



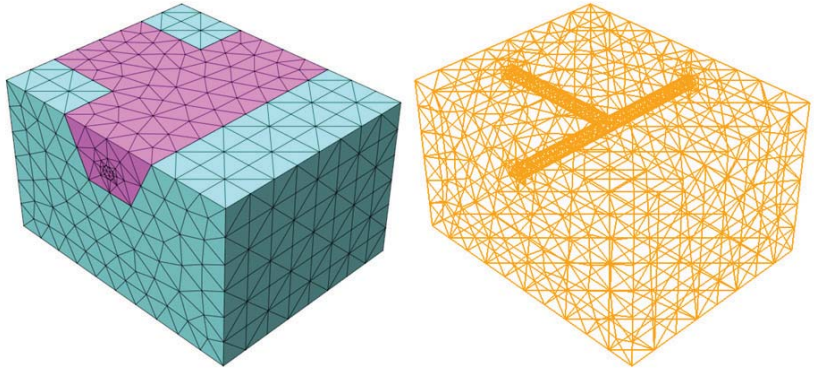
Mesh including interior edge



Check mesh quality on contour



Organize Mesh Set
(Classify by colors, Checkbox: show/hide, Explorer-based work tree)



Check mesh(Free Face)

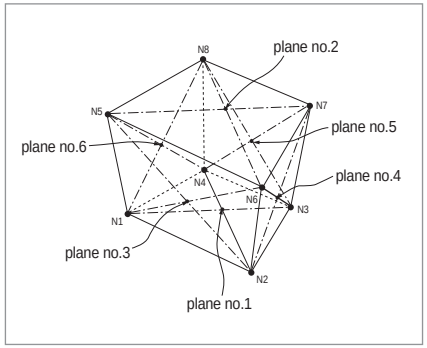
midas **GTS**

"Element library and Constitutive models
Reliable Solution for Geotechnical Engineering"

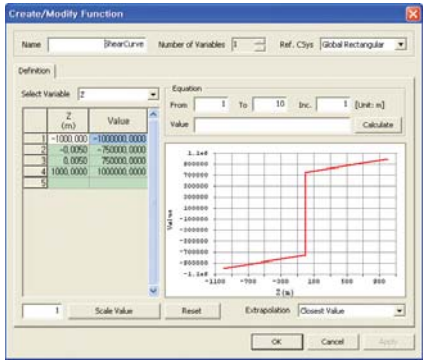
Element Library

The element library includes various elements for structural and ground modeling. These elements are classified into the following categories:

- **Geotechnical Element(s)**
  - Solid Element
  - Plane Strain Element
  - Axisymmetric Element
- **Structural Element(s)**
  - Truss Element
  - Embedded Truss Element
  - Beam Element
  - Plate Element
  - Plane Stress Element
- **Applied Element(s)**
  - Interface Element 1D/2D
  - Plate Interface Element
  - 3D Pile Element
  - Pile Tip Bearing Element
  - Geogrid Element
  - Elastic Link
  - Rigid Link
  - Point Spring
  - Matrix Spring



Solid Element

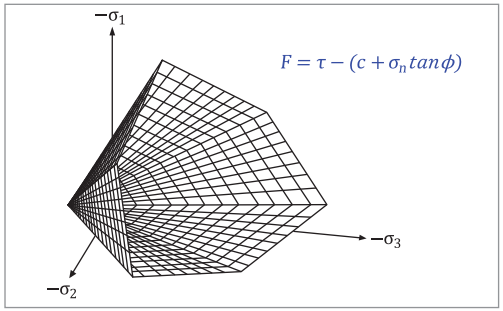


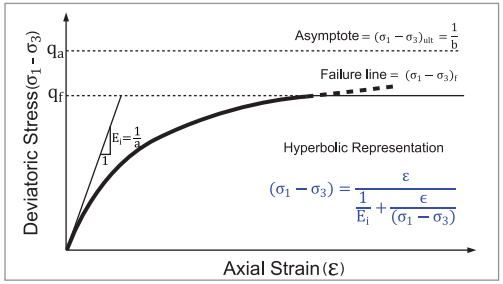
Pile tip spring function

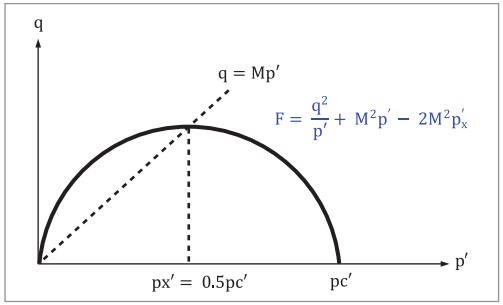
Constitutive Models

In addition to simulating isotropic and anistropic linear elastic material behavior, a comprehensive set of nonlinear constitutive models are included to represent the most realistic soil & rock behavior.

- **Linear Elastic**
- **Transversely Isotropic**
- **Tresca**
- **von Mises**
- **Drucker-Prager**
- **Mohr-Coulomb**
- **Modified Mohr-Coulomb**
- **Hoek-Brown**
- **Hyperbolic(Duncan-Chang)**
- **Strain Softening**
- **Modified Cam-Clay**
- **Jointed Rock Mass**
- **Jardine Model**
- **D-Min (Japan)**
- **User supplied material (Fortran)**







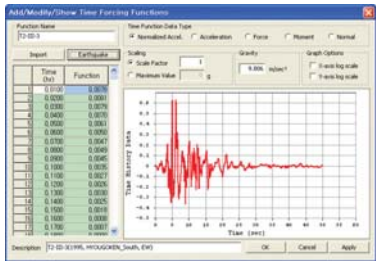
midas **GTS**

"Robust Solver, Faster Run-Times and Maximum Work Efficiency
Next Generation Solution for Geotechnical Engineering"

Load and Boundary Conditions

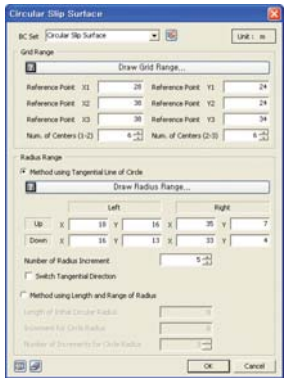
Application of practical load cases and boundary conditions includes robust graphical user interface for easy input navigation.

- **Load Conditions**
  - Self Weight
  - Force, Moment
  - Prescribed Displacement
  - Pressure Load
  - Line/Element Beam Load
  - Nodal/Element Temperature, Temperature Gradient
  - Prestress
  - Result From Other Case
  - Nodal Mass
  - Response Spectrum Analysis Data (Design Spectrum Data)
  - Time Forcing Function (54 Earthquake Acceleration DB included)
  - Ground Acceleration
  - Time Varying Static Load
  - Dynamic Nodal/Surface Load
  - Time History Result Function



Time Forcing Function

- **Boundary Conditions**
  - Support, Ground Support
  - Nodal Head
  - Nodal/Surface Flux
  - Seepage Face
  - Seepage Boundary Function
  - Unsaturated Property Function : Permeability, Water Content
  - Non-Consolidation Condition
  - Draining Condition
  - Circular/Polygonal Slip Surface
  - Change Material
  - Change Boundary Set

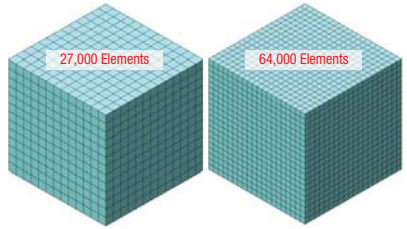


Circular Slip Surface

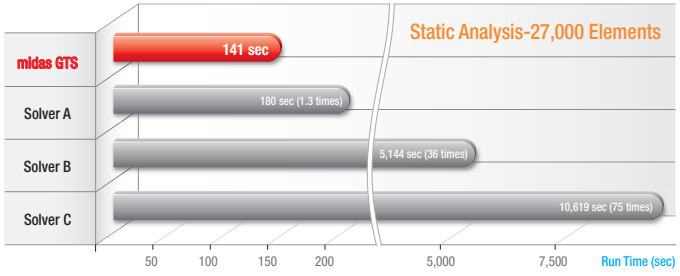
System Equation Solver Benchmark

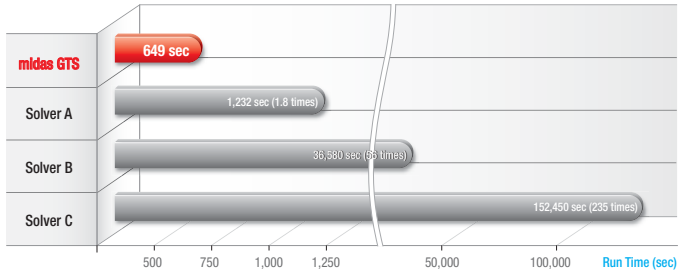
DIANA solver is driven by three direct solvers and one iterative solver, which are compatible with 32/64-bit architecture and multi-threading technology. The multi-frontal solver is one of the fastest solver for solving large solid models.

Element type	Solid Element (Hexa Mesh)
Analysis case (Static)	Stress analysis in situ condition
Number of Element	27,000 Elements, 64,000 Elements
Boundary Condition	Displacement Constraints
Load	Self weight



Multi-Frontal Sparse Gaussian Solver Bench Marking Test





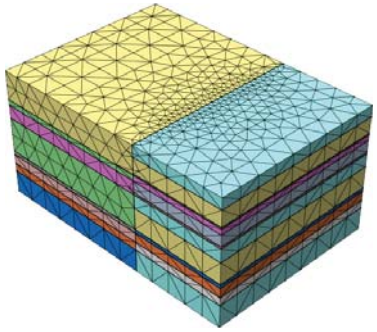
System-Windows 2000 Server, CPU-Intel XeonTM 2.80GHz Dual, RAM-4GB

midas **GTS**

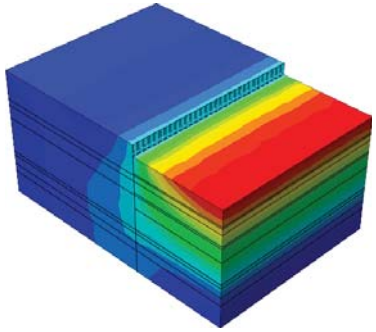
"Advanced 2D/3D Analysis Techniques
for Geotechnical Applications"

Construction Stage Analysis

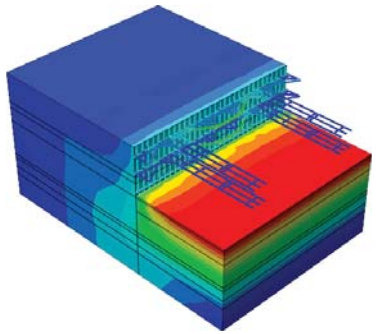
- Praticial interface to define large scale projects using construction stages for the following analysis types : seepage analysis, consolidation analysis, semi-coupled analysis, stress analysis
- Easily obtain in-situ ground conditions for various soil stratigraphy, Activate/Deactivate boundary conditions, loads, elements with Drag & Drop gestures or Construction Stage Wizard (automatic stage definition)
- Control time steps/load steps with user defined functions.
- Simulate and capture real construction stage sequence.
- Load distribution factor function (LDF) for excavation



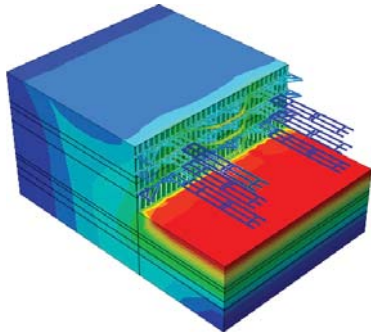
Initial Stage



1st excavation



3rd excavation

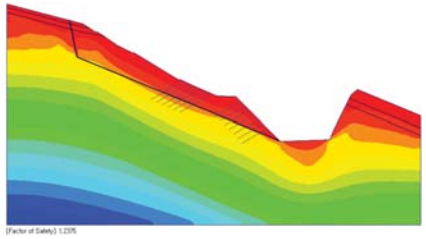


Last Stage

Slope Stability Analysis

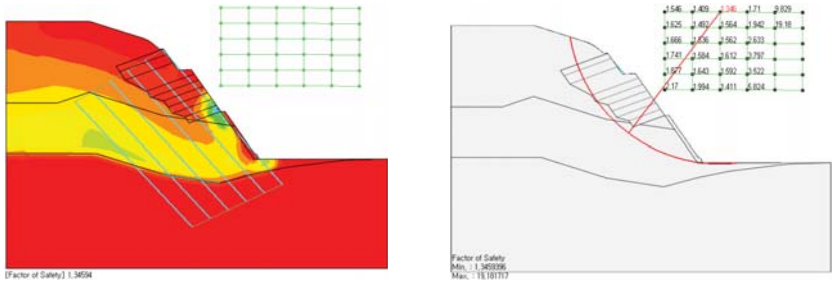
- Slope stability analysis evaluates the factor of safety using two types of methods. Strength Reduction Method (SRM) or Stress Analysis Method (SAM)

- Strength Reduction Method(SRM) 2D/3D
  - Reduction algorithm seeks failure by reducing the (c,phi) material parameters simultaneously
  - Control Maximum number of Steps/Iterations
  - Consider initial Water level using static value or user-defined function
  - Robust contour features displaying actual deformation



SRM(Strength Reduction Method)

- Stress Analysis Method using Limit Equilibrium Theory (SAM)
  - Perform stress analysis using finite element method
  - Extract min./max factor of safety factor and critical surface among the results of stress analysis obtained at the virtual sliding surfaces

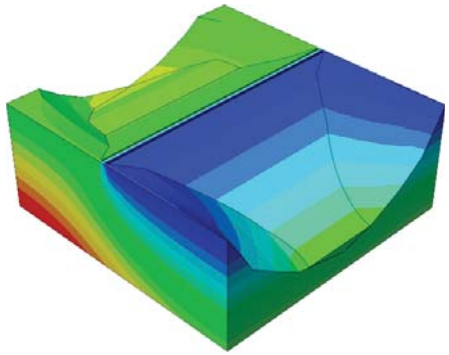


SAM(Stress Analysis Method)

Seepage Analysis

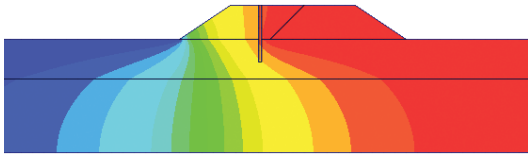
- Solving groundwater flow problems: Steady-State Analysis / Transient Analysis

- Steady State Analysis
  - Apply total / pressure head conditions and nodal flux using static conditions or user-defined functions
  - Apply seepage face conditions to porous materials using total head values or user-defined functions



Steady State Analysis

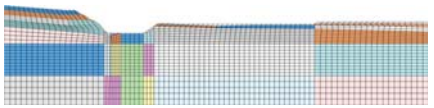
- Transient State Analysis
  - Internal and external boundaries change over time
  - The volumetric water content is required
  - Water content in unsaturated soil and porosity are required to estimate the flow rates



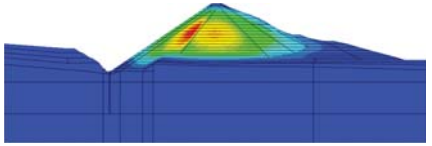
Transient State Analysis

Semi-Coupled Analysis

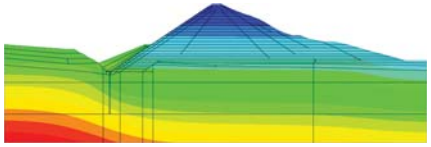
- Seepage force resulted from the groundwater flow generates displacements and stresses in the ground
- Calculate seepage forces using the pore water pressure obtained from seepage analysis
- Seepage force is centralized around the outflow boundaries where the total head decreases drastically
- Relatively low confined pressure near the outflow causes a decrease of shear and tensile strengths of the soil
- This effect can be considered in conjunction with stress analysis in construction stage analysis



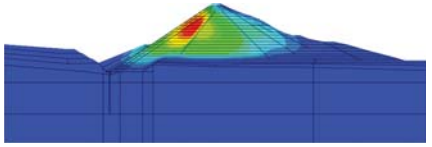
Initial condition



Embankment



Seepage analysis
(Consider Phreatic level Full water level)



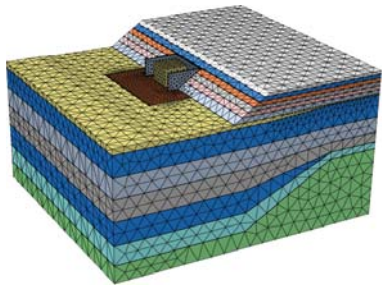
Stress analysis
(Full water level)

midas **GTS**

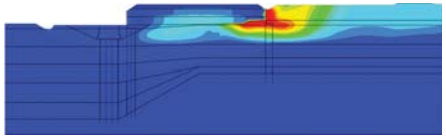
"Non-Linear Analysis optimized
in Geotechnical Engineering"

Consolidation Analysis

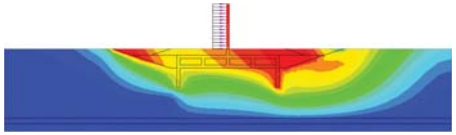
- Display dissipation of any excess pore water pressure behavior due to overburden load and display effective stresses of soils increase with dissipating the excess pore water pressure with time
- Assign non-consolidating/consolidating boundary conditions.
- Considering bi-directional drainage boundary conditions for 2D/3D models



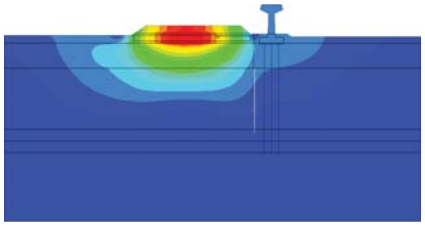
3D Consolidation Analysis



2D Consolidation Analysis



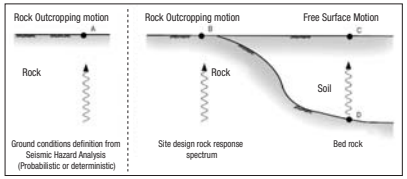
Harbor Structures



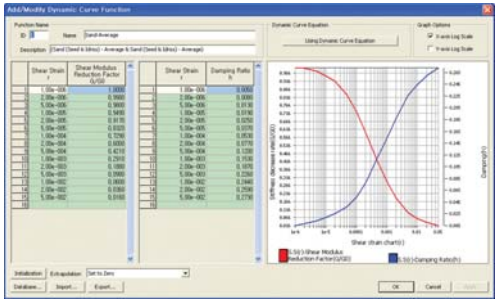
Pier Structure

1D Equivalent Linear Analysis

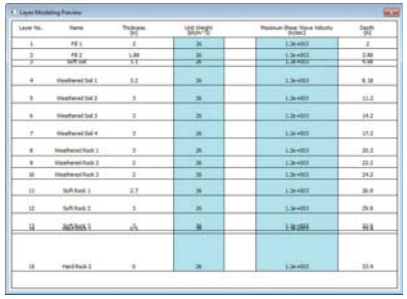
- Evaluate ground response against seismic waves prior to construction. Evaluating ground motion and damping effect based on seismic records for intact ground condition
- Determine critical seismic loads causing structural failure and liquefaction
- Predict ground vibration to obtain the design response spectra
- Analyze mechanism of quake-center, propagation of the seismic wave and the effect of geological strata based on ground behavior



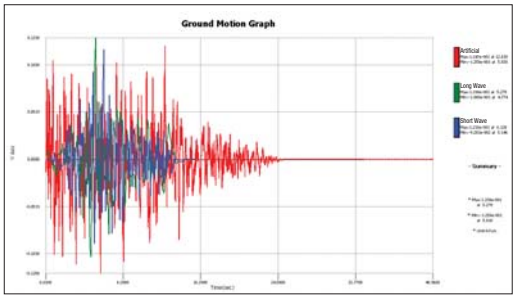
Schematic of Ground Response Analysis



Function of Dynamic Properties



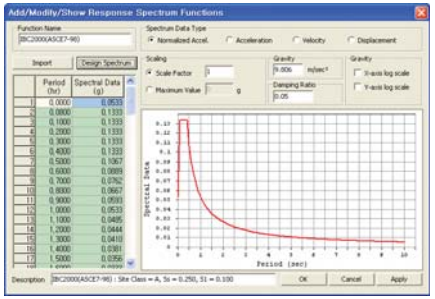
Geological Map



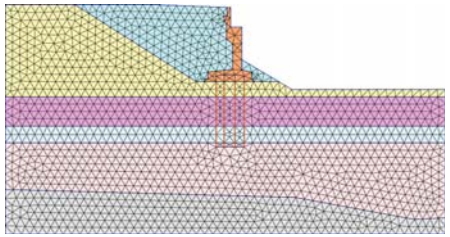
Ground Acceleration

Dynamic Analysis(Response Spectrum Analysis)

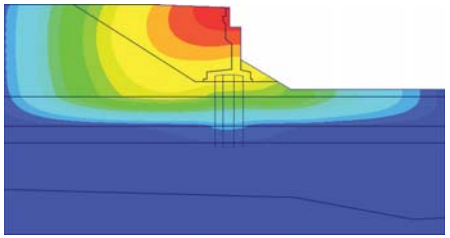
- Response of a multi-degree-of-freedom(MDOF) system is assumed to a combination of single-degree-of-freedom(SDOF) system
- Peak value of response such as displacements, velocities and accelerations, corresponding to the natural frequency is used for response spectrum analysis
- Spectral data can be generated from the seismic parameters such as dynamic coefficient, foundation factor, zoning factor, importance factor and seismic response factor



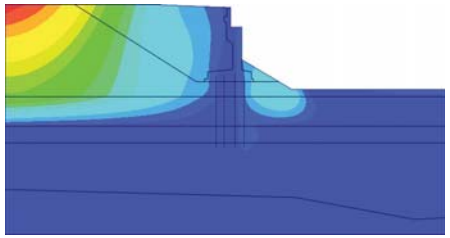
Design Spectrum



Abutment Structure



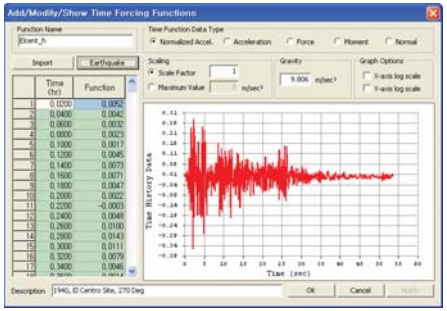
Horizontal Displacement



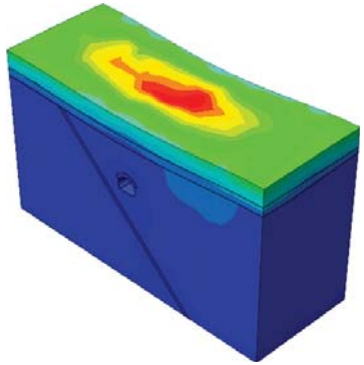
Vertical Displacement

Dynamic Analysis(Time History Analysis)

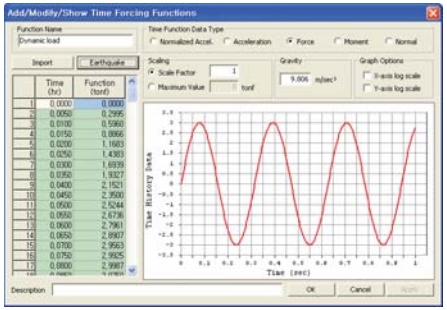
- Calculate structural responses such as displacements and member forces within a given period of time using the dynamic characteristics of the structure under the dynamic loads
- Modal Superposition Method
  - Estimate displacement of structures from a linear superposition of modal displacements, orthogonal to each other
  - Damping matrix is assumed as a linear combination of the mass and stiffness matrices
- Direct Integration Method
  - Integrating the dynamic equilibrium equation over given time steps without changing itself



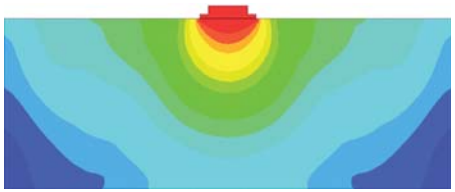
Seismic Loads



Seismic Analysis (Tunnel)



Vibration Loads



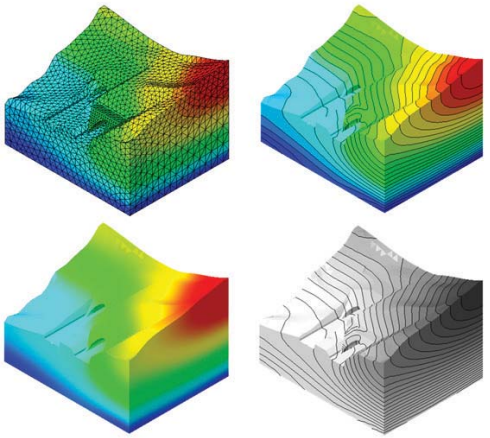
Dynamic Analysis (Foundation)

Post-processing

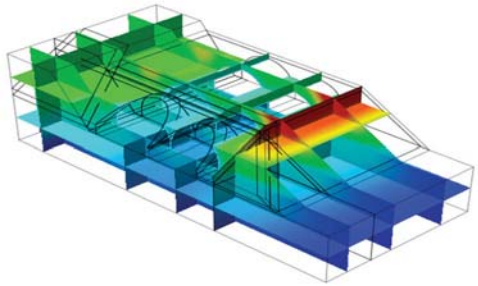
The post-processing engine is a powerful visualization tool capable of manipulating complex models into simple cross-sections, clipping planes, and contour line representations.

Benefits

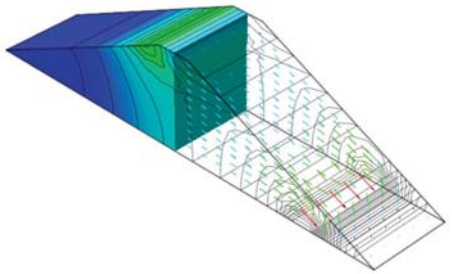
- Verify results using visual representations
- Adjust range of the results and contour colors



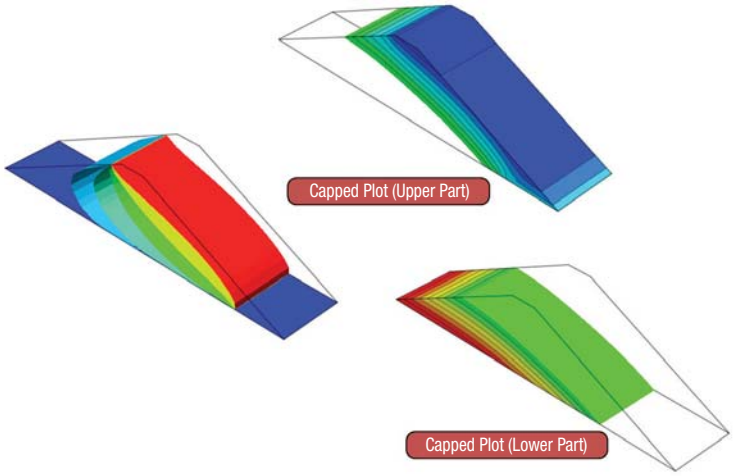
Various contour and edge type



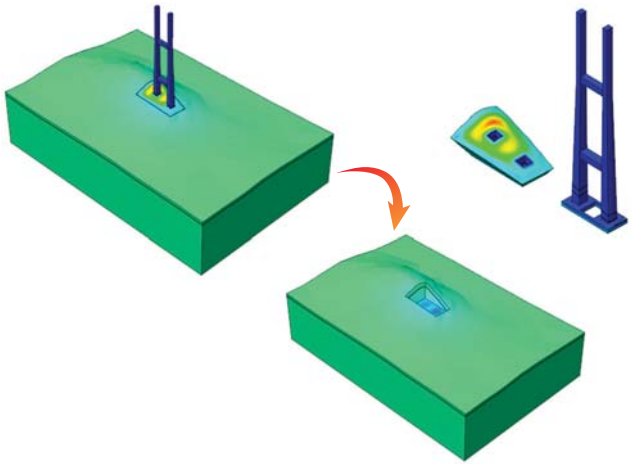
Contour on slice planes



Hybrid plot
(Combination of vector and contour plot on clipping plane)



Contour on Iso-surface



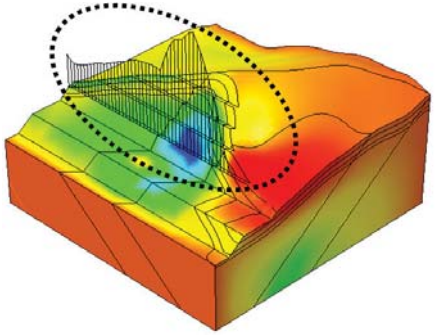
Virtual transformation of mesh sets
(Check the results of embedded mesh sets)

Post-processing

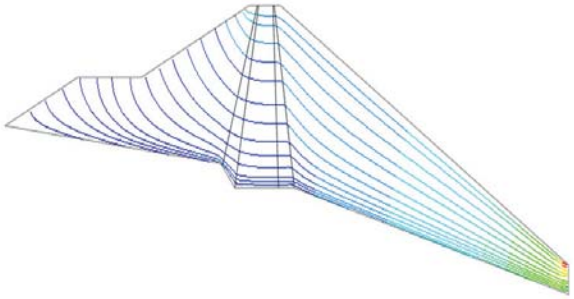
Reports can be created in a short time by extracting results into three formats:

- Table : Import to spreadsheet
- Diagram/Graph : Real time result update per stage
- Contour plot

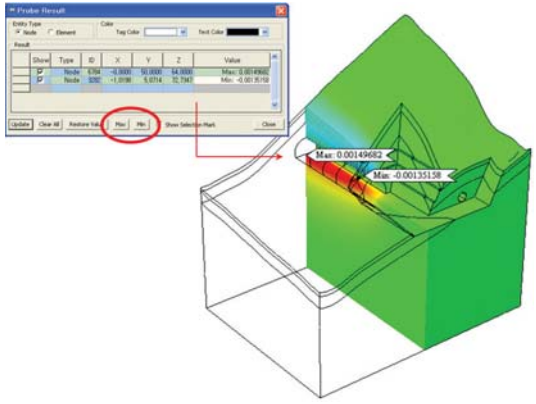
- Extract Result :
  user-selected data into a table or graph
- Probe Result :
  values at specific nodes/elements with probe tag or location of max/min value
- On-Curve Diagram :
  results along user-defined curve with diagram



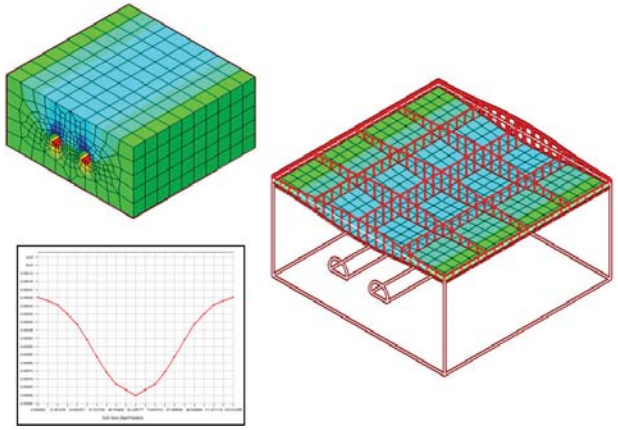
Contour on Clipping Plane



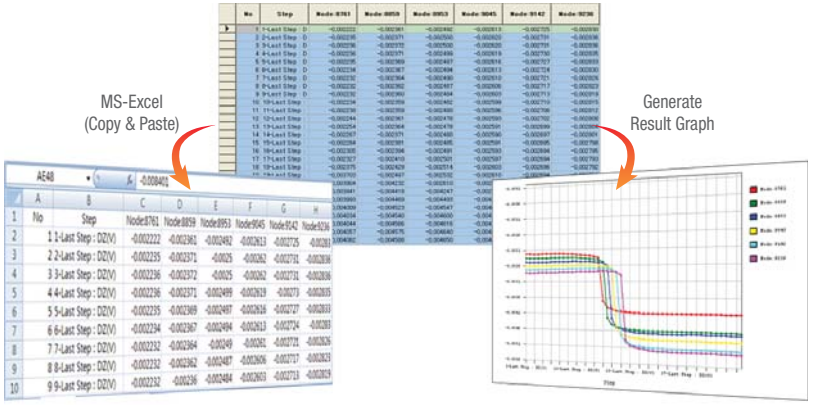
Flow Path



Probe Results for selected nodes



Settlement Diagram



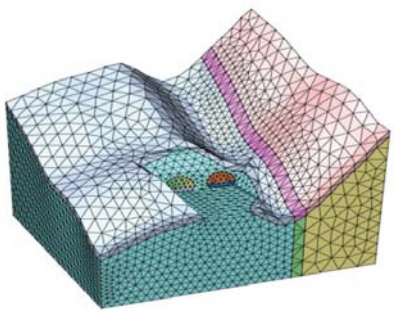
Output table and graph compatible with MS-Excel

Applications (Tunnel)

GTS is a proven numerical modeling software used by many international geotechnical firms. Selected applications which have been modeled in GTS are shown on the right.

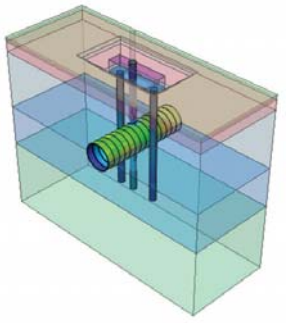
GTS includes two wizards for tunnels and anchors.
The Tunnel Wizard can model tunnels having regular pattern and define excavation method such as full face cut, bench cut and direction(one, both) as well. For each case, load relaxation can be considered by applying load distribution factor (LDF).

- Road Tunnel
  - Portal, Cross passage, Emergence area (Emergency zones) , Ventilation shaft, Electrical rooms, Fault fractured zone, Adjacent structures
  - Blasting load analysis
- Railway Tunnel
  - Fitting(T,Y-type), Shield TBM, Machine Room, TRcM/CAM, Station, etc..
  - Steel Pipe Roof (pipe umbrella reinforcement method), Forepoling, Steel Strut
- Full face/Bench cut, Ring cut, CD cut, Open cut, 2 Arch, 3 Arch

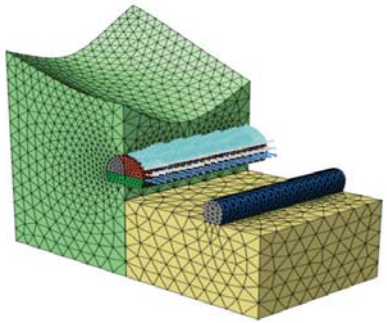


Portal with fault fractured Zone

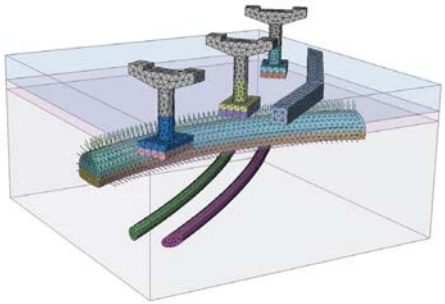
Ventilation Shaft (vertical/horizontal)



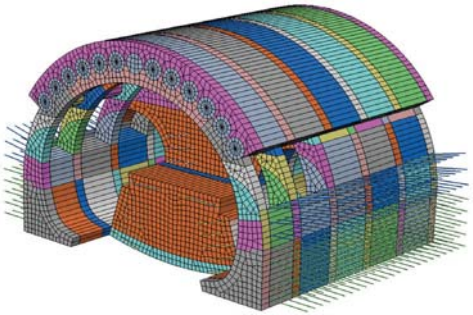
Shield TBM



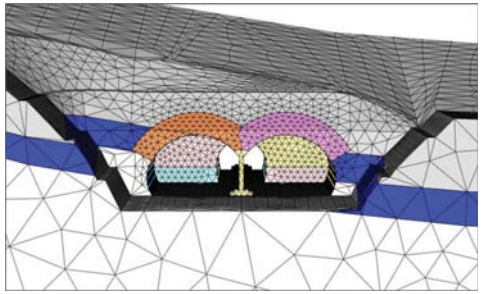
Steel Pipe Reinforced Step Grouting



Adjacent Structures



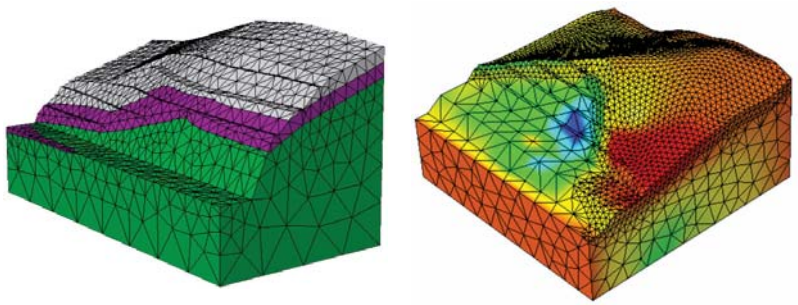
TRcM/CAM (Subway tunnel)



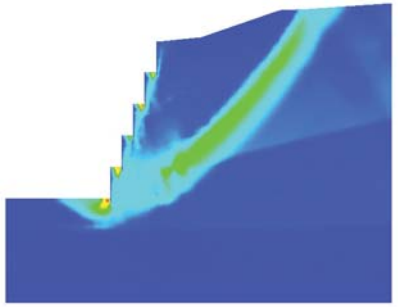
2-Arch Tunnel (NATM method)

Applications (Slope Stability)

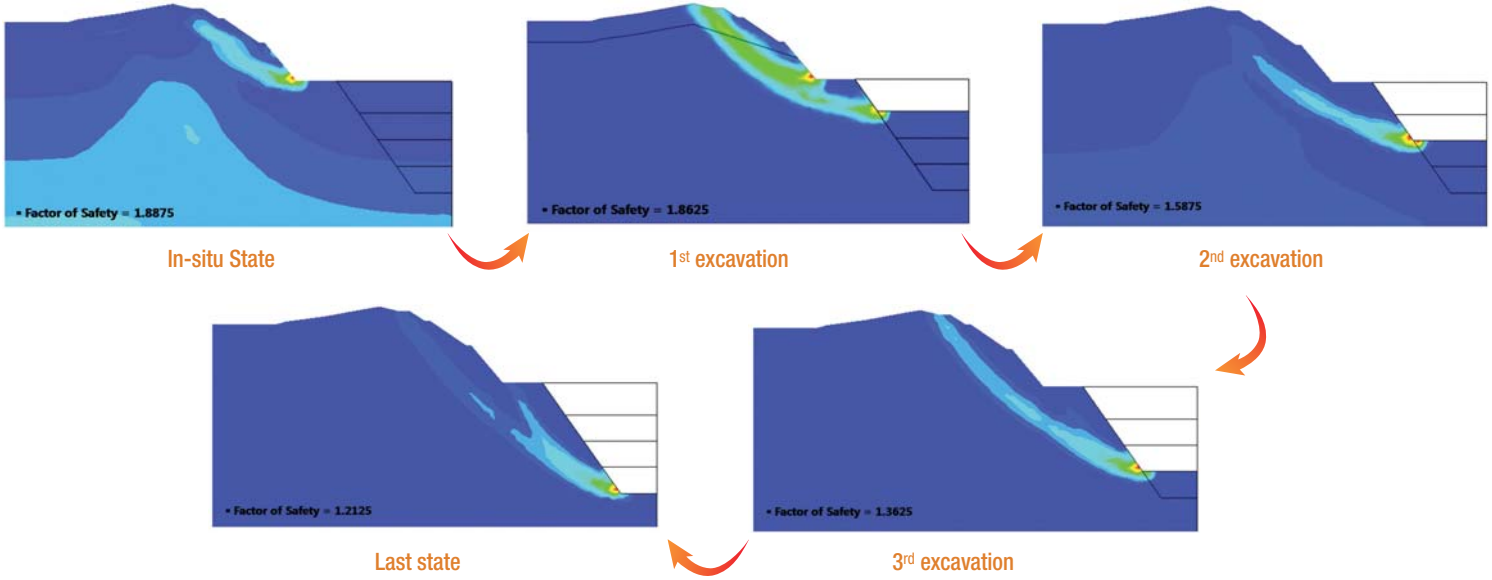
Slope Stability in GTS can be analyzed with Strength Reduction Method, which is based on reduction algorithm for soil parameters (c, Phi) simultaneously until failure occurs. Failure is governed using the force norm convergence criteria. The critical factor is the minimum factor of safety at which failure occurs.



3D Slope Stability Analysis



Slope stability considering earth retaining structures



In-situ State → 1st excavation → 2nd excavation → 3rd excavation → Last state

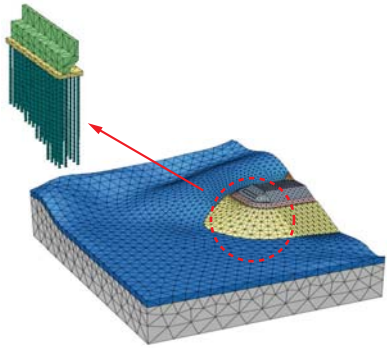
midas **GTS**

"Total Solution 2D/3D FEA Software
for Geotechnical Applications"

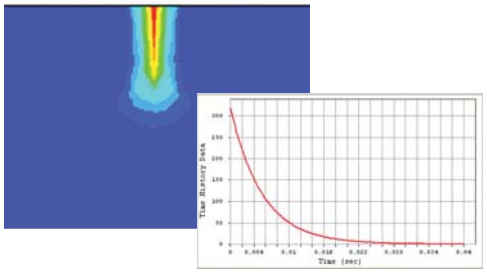
Applications (Foundation Systems)

Analyze driven or bored piles behavior either in isolation or grouped arrangements subjected to any combination of vertical , lateral load, and eccentric loads. Estimate the bearing capacity of various types of foundations and differential settlements due to active load sets.

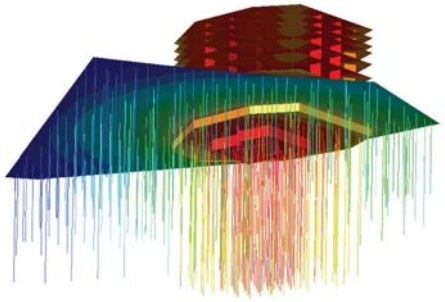
- Shallow foundation : Direct foundation, Foundation vibration
- Deep foundation(Pier/Abutment) : Pile(Steel Pipe, PHC, Drilled Shaft(RCD), Driven), Well foundation, Caisson, Raft foundation



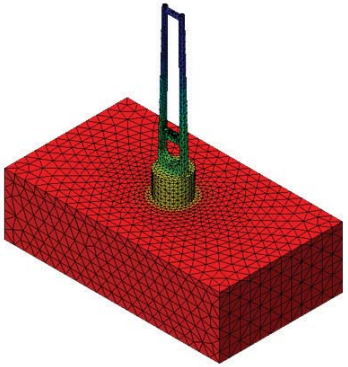
Foundation(Pier)



Driven Pile



Raft Foundation

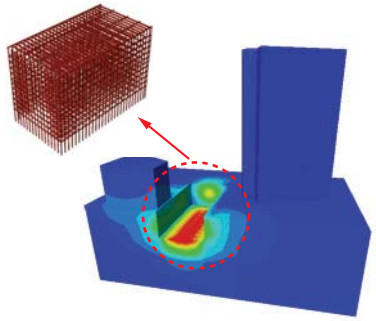


Well Foundation

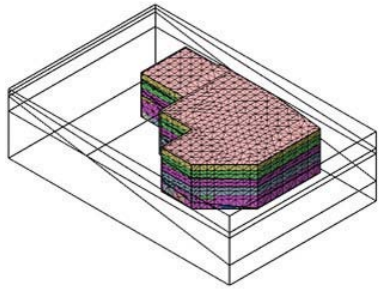
Applications (Excavation/Temporary Structures)

Simulate excavation sequences considering temporary structures to support deep excavation considering existing nearby facilities such as subway complex, buried conduit and box. Changes in earth pressure and ground water level are also can be taken into account.

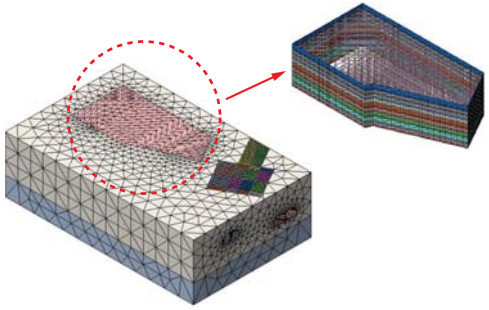
- Retaining wall : H-Pile + slurry wall, Sheet Pile, CIP, SCW, D-Wall
- Strut : Steel Strut, Earth Anchor, Rock Bolt, Soil Nail, Tie Rod, Raker
- Stability analysis for adjacent structures



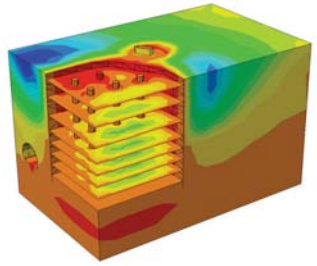
Subway station
(H-Pile+slurry wall)



Diaphragm Wall



Temporary structure for foundation
of high-rise building

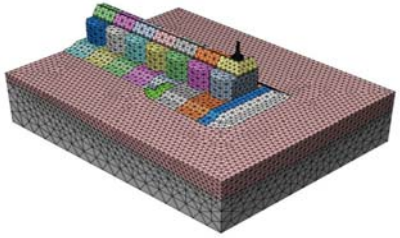


Stress distribution of subway line
and ventilation shaft by excavation

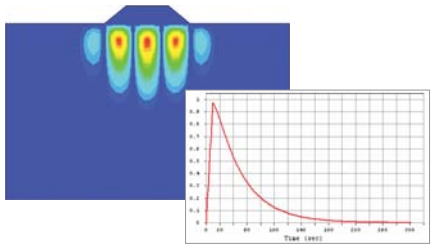
Applications (Soft Soil/Embankment)

Calculate the dissipation of generated excessive pore water pressure in the model due to surcharge loading process. Extract results to graph time-settlement behavior of various types of surface profiles. Acceleration of soil consolidation using vertical drains in 2D/3D (spacing & geometrical configurations considered)

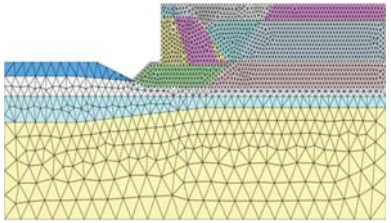
- Soft soil : SCP-reinforced, Dewatering method(PBD, PSD, SD)
- Embankment : Revetment, quay wall, dock, breakwater



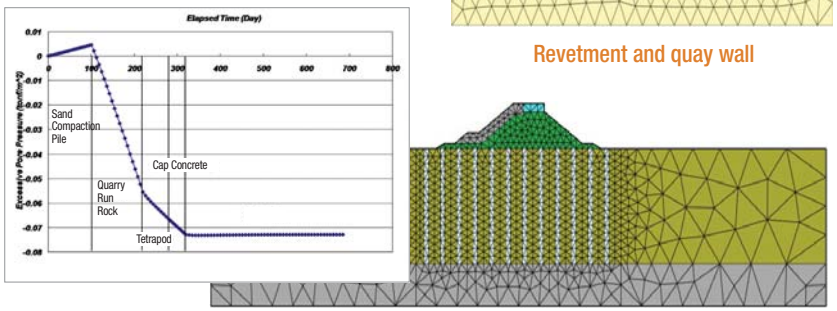
Breakwater



Vertical Drainage(PBD)



Revetment and quay wall



Consolidation analysis for
SCP drainage system in soft clay

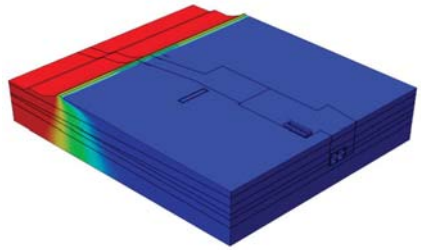
Applications (Hydraulic & Underground Structures)

Two types of seepage analyses for both steady state and transient flow based on Darcy's law.

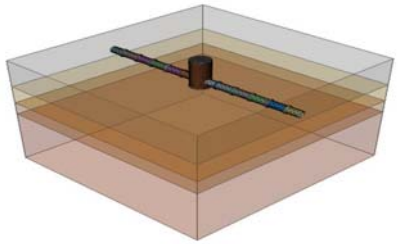
- Steady state and transient seepage for tunnels, dams, slopes...
- Stress-seepage semi-coupled analysis for the analysis of water-front systems, dewatering...

- Hydraulic structures : Earth Dam, CFRD, levee, water way tunnel(pipe & culvert)
- Underground Structures : Box, underground driveway

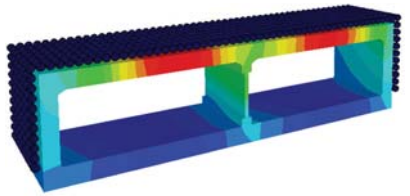
CFRD stability analysis



Seepage analysis for embankment



Fitting of water way tunnel

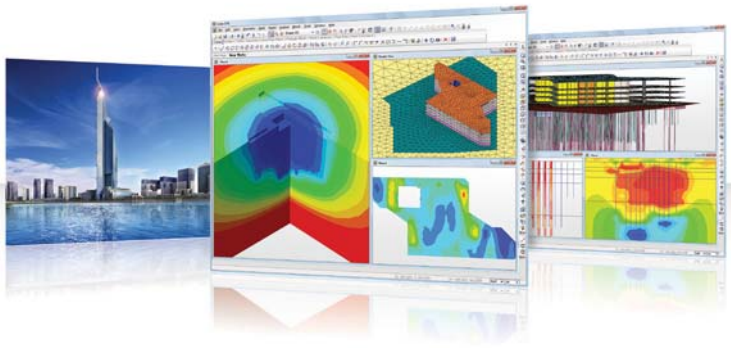


Underground driveway(Front Jacking)

Excavation & Foundation

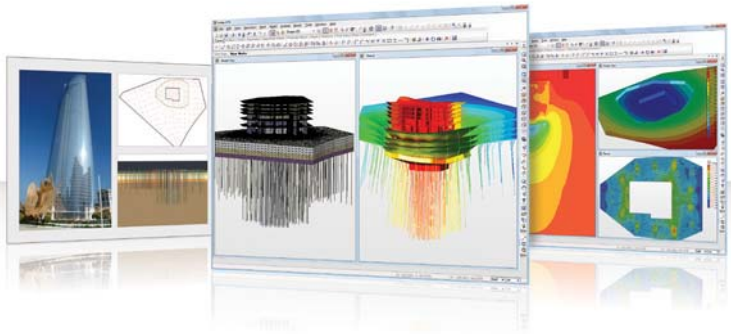
Dubai Tower

Piled-raft Foundation Design



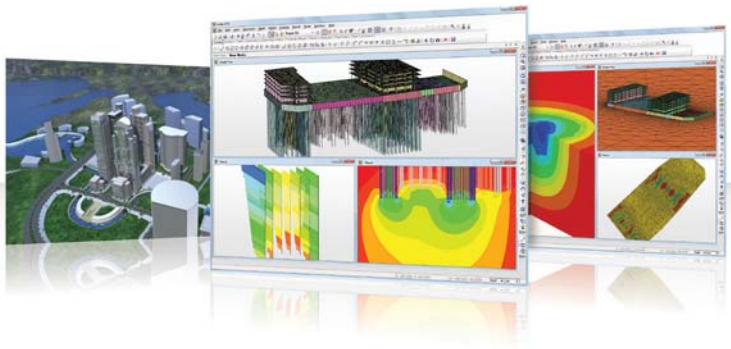
Palazzo Versace and D1 Tower

80-storey Building, Foundation Behavior Analysis using 3D FEM



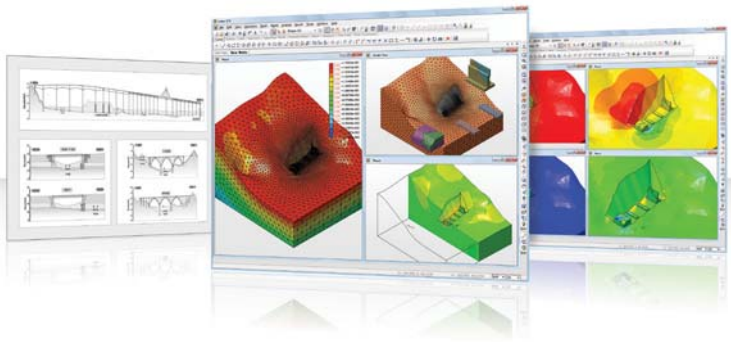
Abu Dhabi Tower

Foundation Behavior Analysis using 3D FEM



Yongduk Bridge

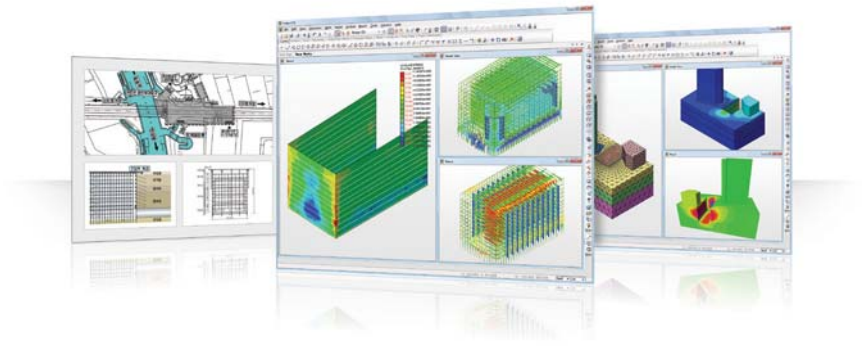
Abutment's Foundation Analysis



Excavation & Foundation

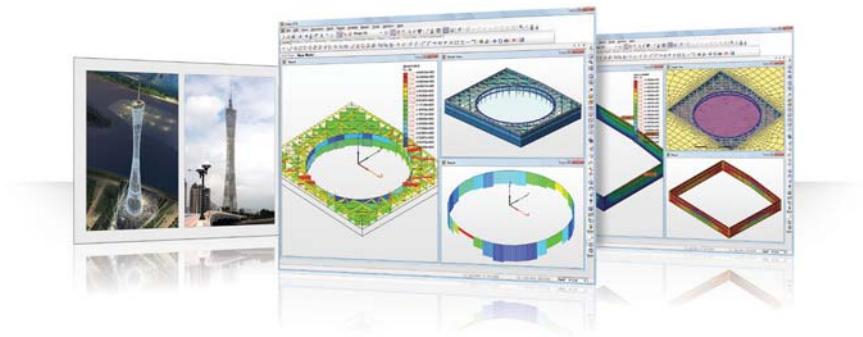
Urban Express Railway

Excavation and Temporary Structure Analysis



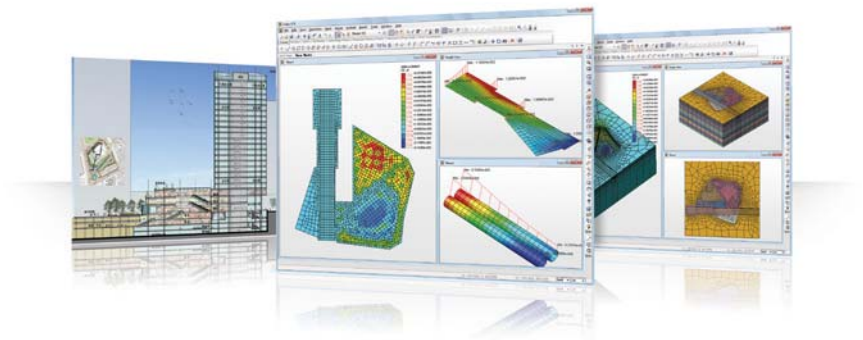
Guangzhou TV Tower

Second tallest metal tower, Foundation Behavior Analysis



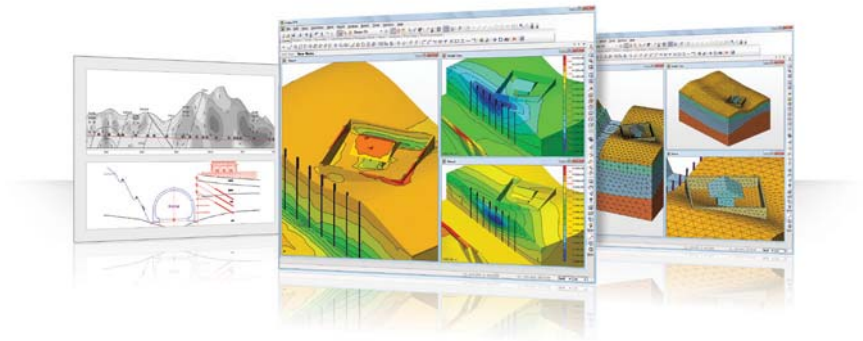
Sichuan Subway Station

Behavior Analysis of Underground Structure using 3D FEM



Hujeong Tunnel

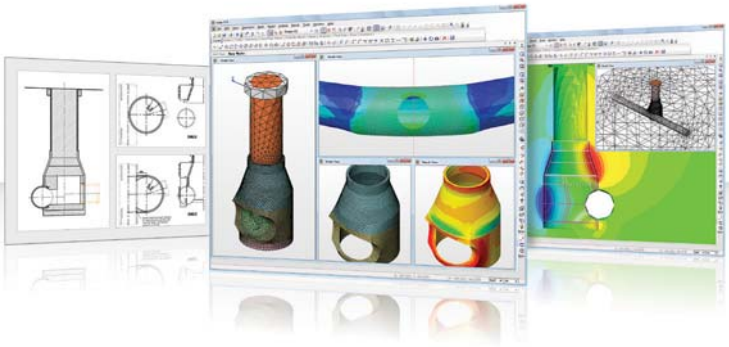
Evaluation of Excavation Stability



Tunnel

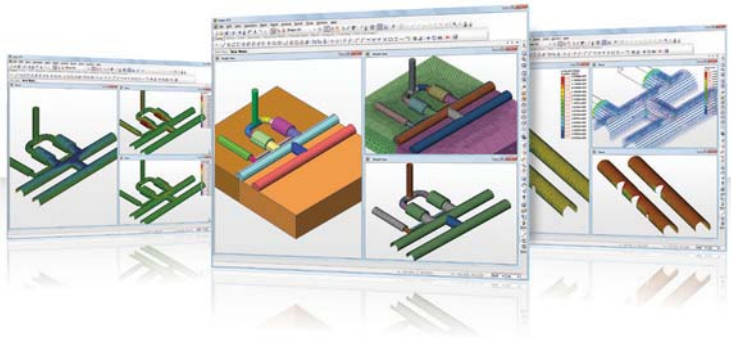
Segmental & Sprayed Concrete Shaft Construction

Construction Analysis for Stability of Concrete Lining



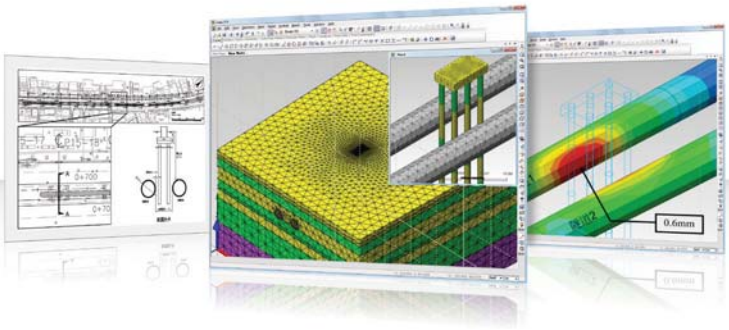
Inje Tunnel

Tunnel Junction Analysis



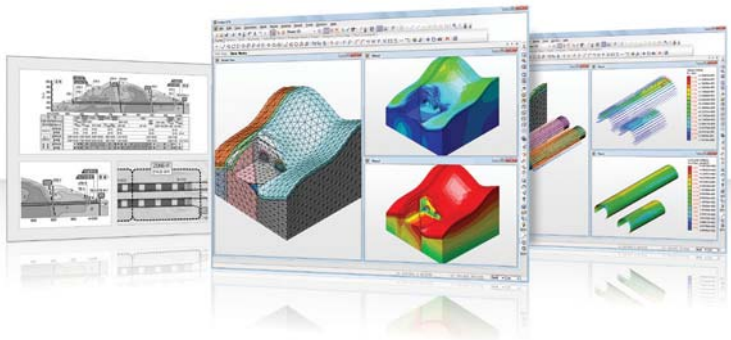
Soil-pile-tunnel Interaction

Pile Construction and Loading Effects on Existing Shield Tunnels



Nahu Tunnel

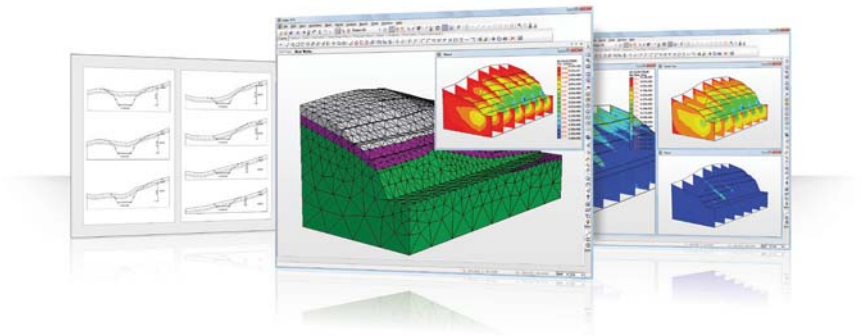
Tunnel Exit Analysis



Stress-seepage semi-coupled analysis

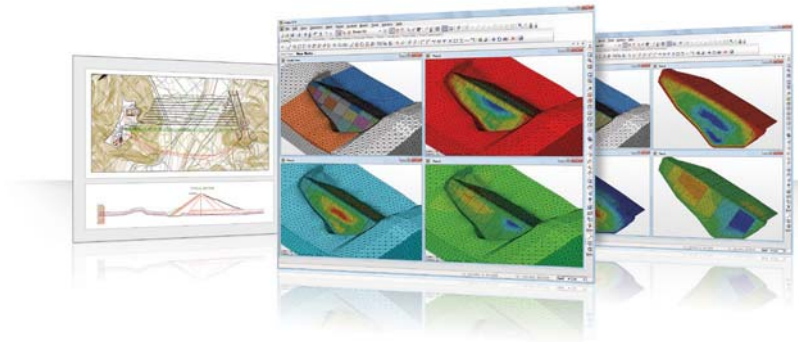
Yeosu Highway Construction

Slope Stability Analysis at Cutting Surface



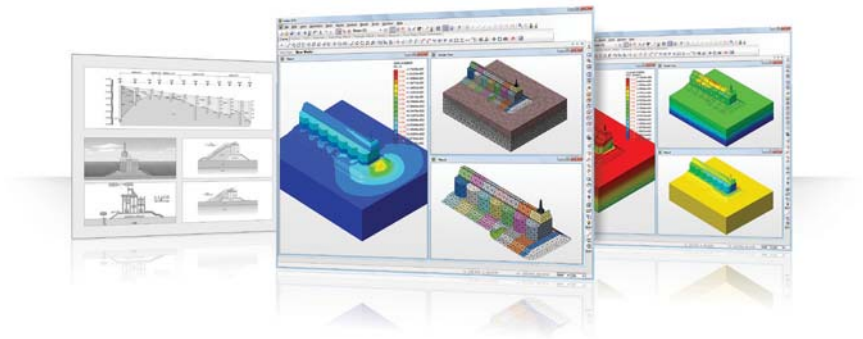
Buhang Dam

Impervious Zone Stress Analysis for Gravity Dam



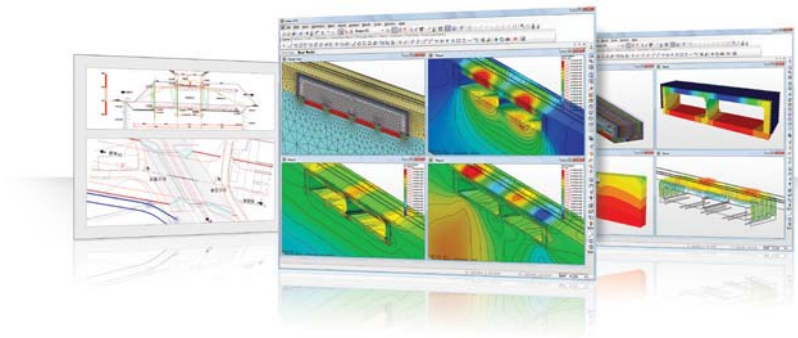
Navy Station's Breakwater

Stability Check due to Wave and Earthquake



East Circulation Road

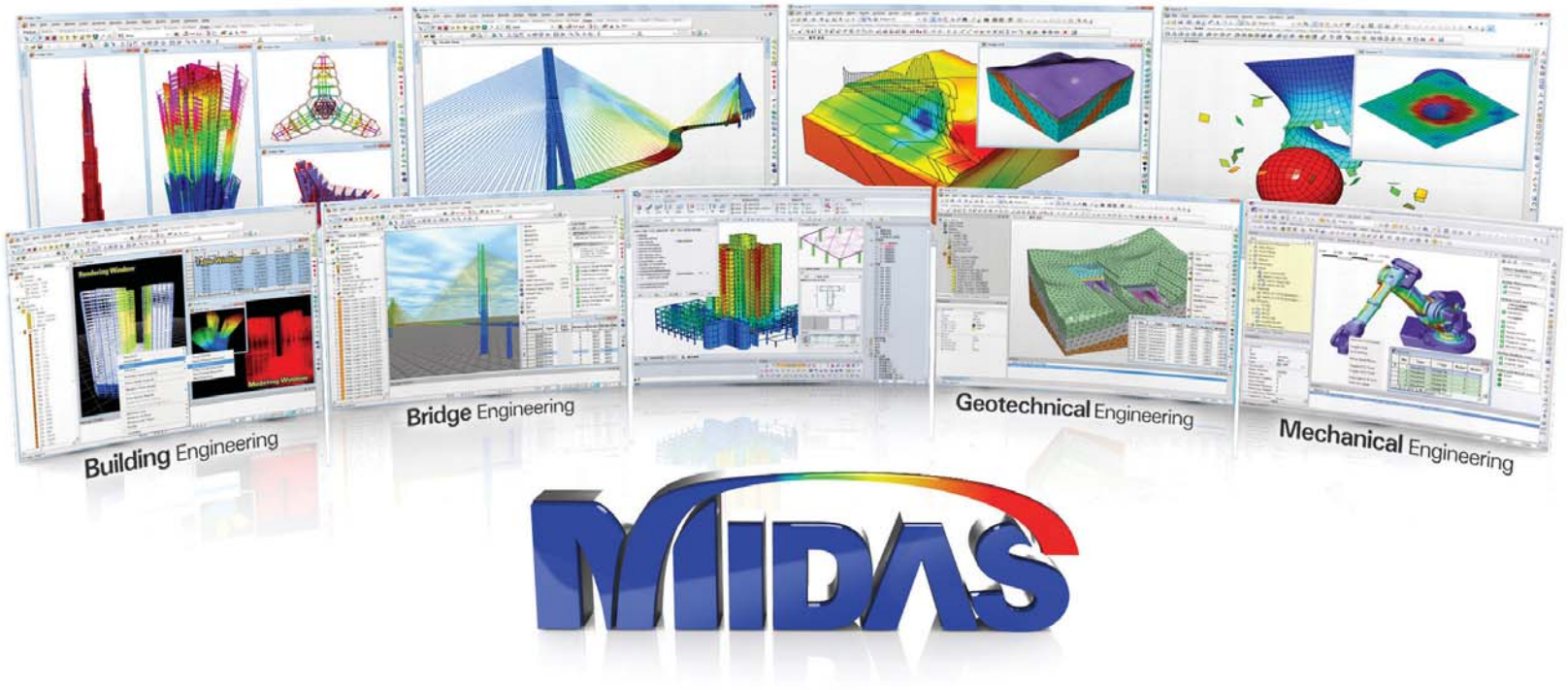
Culvert Analysis using 3D FEM



“The world’s leading engineering solutions and services provider setting the platform in engineering advancement and development through MIDAS technology”

About MIDAS IT

“**MIDAS IT** is taking flight with endless passion and devotion to provide technological solutions worldwide”



MIDAS Information Technology Co., Ltd. develops and supplies mechanical/civil/structural engineering software and provides professional engineering consulting and e-Biz total solutions. The company was officially incorporated in year 2000, and currently employs 350 global developers and engineers with extensive experience. MIDAS IT also has corporate offices in US, China, Japan, and India. There are also global network partners in over 24 countries supplying our engineering technology. MIDAS IT has grown into a world class company.

MIDAS IT is dedicated in becoming the world’s best engineering solutions and services provider on grounds based on vision, trust, and respect between our employees and our clients. We believe that true happiness can be achieved between our employees and our clients through our world-class solutions, and we will put our endless efforts to make this into reality. MIDAS IT is taking flight with endless passion and devotion to provide the technological solutions worldwide for the purpose of bringing true happiness all over the world.

"MIDAS Family Programs are advanced CAE (Computer Aided Engineering) solutions that were developed using the latest technology"

MIDAS Family Programs

All MIDAS IT programs are being used by engineers worldwide in the related fields of mechanical/building/civil/ geotechnical engineering.

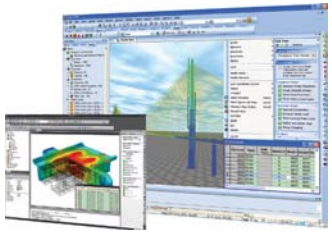
In the near future, to further grow as a leading global engineering solutions developer and provider, MIDAS IT plans to expand its CAE software solutions and technology to other engineering and business fields such as ship building, aerospace, electronics, environment, and medical industry.

Mechanical

Nastran FX
Total Solution for
True Analysis-Driven Design

midas **FX+**
General Pre & Post Processor
for Finite Element Analysis

Bridge



midas **Civil**
Integrated Solution System for
Bridge and Civil Structures

midas **FEA**
Advanced Nonlinear and
Detail Analysis System

midas **Abutment**
Abutment Automatic
Design System

midas **Pier**
Pier Automatic Design System

midas **Deck**
Pier Automatic Design System

Building

midas **Gen**
Integrated Design System for
Building and General Structures

midas **Building**
A revolutionary building specific
design system with auto-drafting
modules

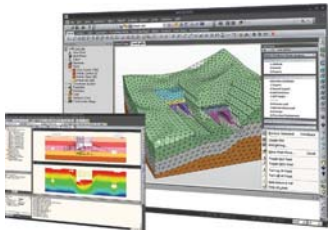
midas **ADS**
Shear wall type Building
Design System

midas **SDS**
Slab & basemat Design
System

midas **Set**
Structural engineer's tools

Geotechnical

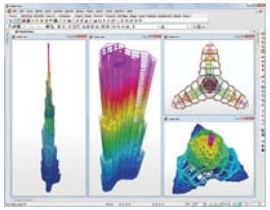
midas **GTS**
Geotechnical and
Tunnel analysis System



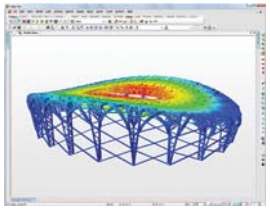
midas **GeoX**
Temporary shoring & Settlement
analysis System for Excavation

Soil+
(CTC in Japan)

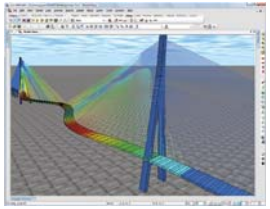
MIDAS Program Applications



Burj Khalifa (UAE)
- World's tallest building to date
- Height: 800 m, 160 floors



Beijing Olympic Stadium (CHINA)
- Area: 78,000 sq. m.
- Allowed Capacity: 91,000 people



Sutong Bridge (CHINA)
- World's longest cable stayed bridge to date
- Total span: 8,206 m

midas GTS

Next Generation Solution for Geotechnical and Tunnel Engineering

www.MidasUser.com