UC-1 Geotechnical Analysis

GeoFEAS 3D / GeoFEAS 2D
Ver.up

Geotechnical Finite element Elastoplastic Analysis Software

UWLC
Ver.up

Dynamic effective stress analysis for ground

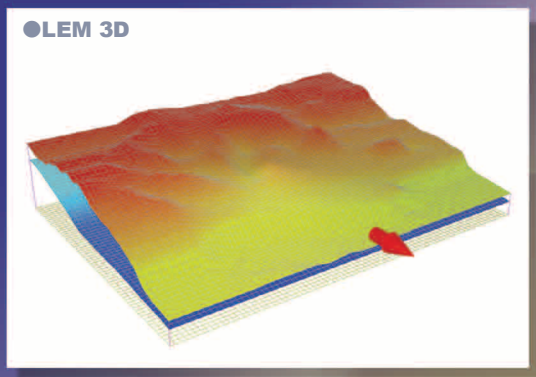
LEM 3D

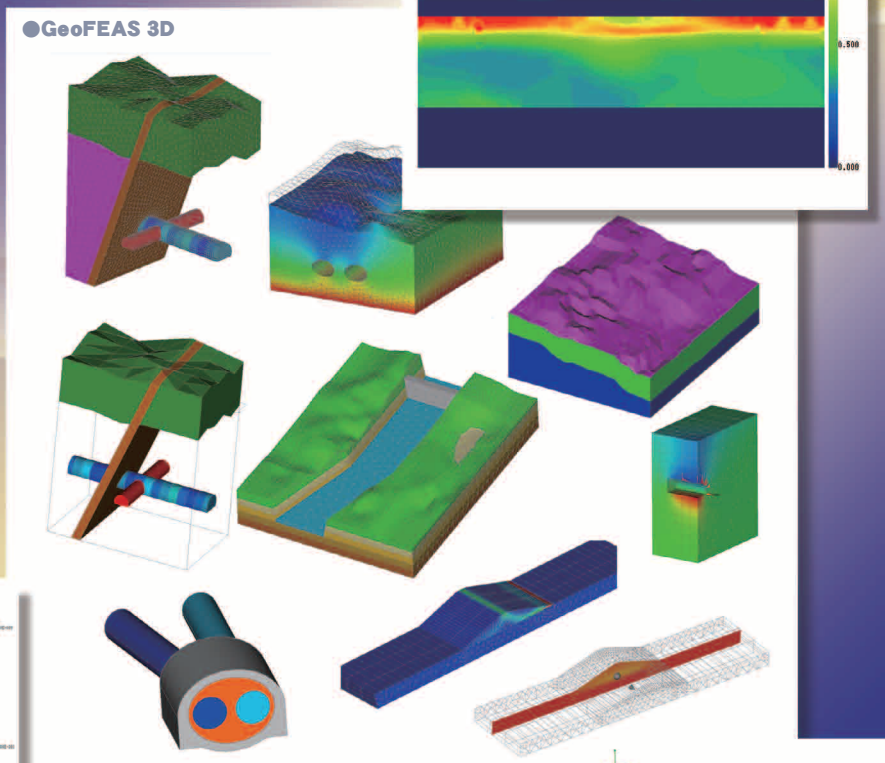
3-D slope stability analysis

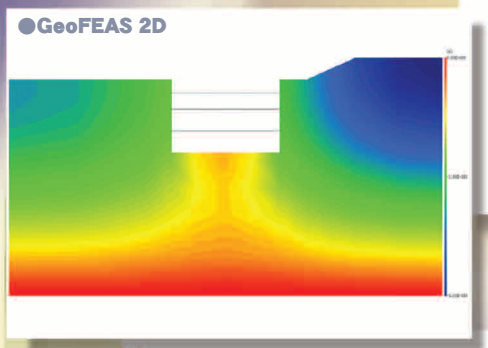
VGFlow / VGFlow2D
NEW

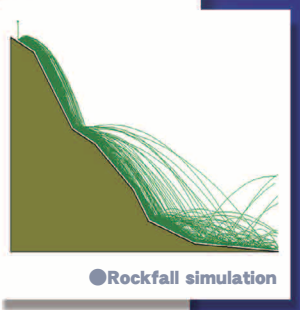
3-D seepage analysis / 2-D seepage analysis

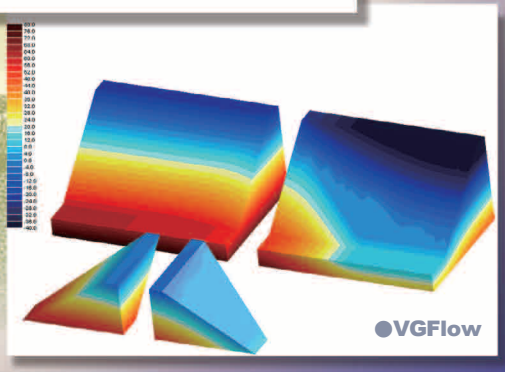
Geotechnical analysis support service

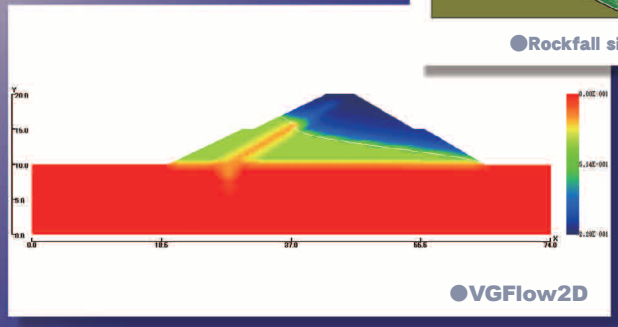












UC-win/UC-1
Design·Analysis/CAD&VR

FORUM 8

FORUM8 Co., Ltd.

GeoFEAS 3DVer.2 Ver.UP Geotechnical Finite element Elastoplastic Analysis Software

Software price US$ 9,800
Academic price US$ 4,500

Applicable to Windows NT/2000/XP/Vista/7

3D stress deformation analysis software using Finite Element Method (FEM)

INTRODUCTION

GeoFEAS3D stands for '3D Geotechnical Finite element Elasto-plastic Analysis Software' and it is a software for 3Dstress-deformation analysis of soil under static conditions. GeoFEAS2D is designed for 2D geotechnical analysis (including axial symmetric analysis). GeoFEAS3D is extended its performances to 3D on the same theories and soil models with GeoFEAS2D. Ver. 2 is enhansed with regard to modelling performance and analysis capability.

Functions and features

■Model creation function

・Intersect creation function

The intersection surface between objects such as solid-solid, solid-surface, surface-surface, surface-line, and line-line can be created in Ver.2. This function allows the creation of intersecting surfaces even if many civil structures are crossed in multiple layers in the ground.

・Grouping function

It is more difficult to create and edit the model in 3D, compared to 2D due to the increased number of objects in three-dimensional space. This function allows grouping of multiple objects which have same properites in one group so that you can select these objects at the same time, and assign the material constant to the group.

・Display/Nondisplay function and Selection function of an objects

Display/Nondisplay function allows to display only the object that you are working by hiding all other objects in complex 3D model. Selection function limits the selection of an object, such as member only, surface only, or solid only.

・Topographic data import function in Land XML format

3D coordinates and surface data in Land XML format can be imported.

This function allows automaticaly shaping complex surfaces without inputting a point coordinate one by one Structures can be easily modeled based on the imported information.

■Mesh dividing

This program allows the semi-automatic division of mesh. Firstly the number of divisions is specified as equal interval or specified ratio for the line segments of block. The surface is then divided into triangles or rectangles, and the solid is divided into tetrahedron, pentahedron, and hexahedron based on the number of dividing line segments. The mesh re-dividing of model can be easily performed if you change the dividing number.

■Elements library

Solid elements are used for modeling the ground in 3D analysis. This product supports tetrahedral, hexahedral and pentahedral element.

Plane element are generally regarded a plate elements or shell elements in 3D analysis, this program plate elements.

The interaction between ground and structures can be expressed by defining the structural elements (plate element, beam, truss, axial spring and shear spring element), and joint elements can be specified in contact faces.

■Load and boundary condition

GeoFEAS is based on the total stress representation (not considering the soil permeability in the current version). By considering the hydraulic pressure as nodal load, it can evaluate the effect of water pressure on soils.

・Loads

Nodal load, uniform load, distributed load, volume load (self-weight load and static seismic load) are available,

・Boundary conditions

Simple nodal constrains (horizontal and vertical rollers, fixed, pin), multiple nodal constrains (MPC, hinge), and forced displacements are available Multiple stage analysis considering the construction steps is considerable, and the material constant number and boundary conditions can be changed at every stage (phase).

■Processor

・Analysis function

The elasto-plastic analysis is the most basic method for investigating the stress and deformation behavior of the ground. It is important to set up the appropriate analysis model, element definition, and applied structure model.

GeoFEAS supports 15 kinds of soil constitutive models; the elasto-plastic model can express the non-linear behavior of the ground (elastic model includes No-Tension analysis capability).

The deformation and stability analysis can be performed for wide variety of problems relating to the ground including excavated/banking area, slope stability and bearing capacity.

・Analysis speed

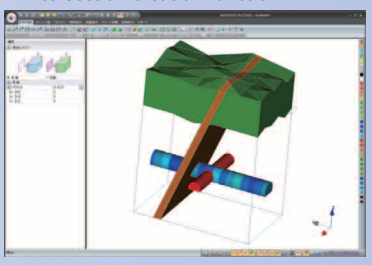
Ver.2 is improved with the speed of analysis and capacity of DOF (Degrees of freedom). It takes about 30 minute to analyze a model with 50,000 nodes per one stage with the spec of 3Gz Core2 CPU, 3G of memory, PC.

■Post-processor

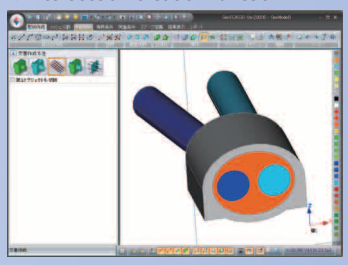
Post-processor provides the deformation diagram, contour diagram, vector diagram, and section force distributed chart (for member). The analysis result can be copied and pasted to other software, such as Excel, and can be exported as a HTML or PDF file.

Image samples

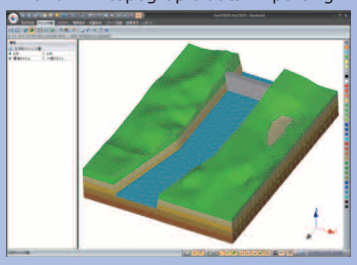
▼Intersection creation function 1



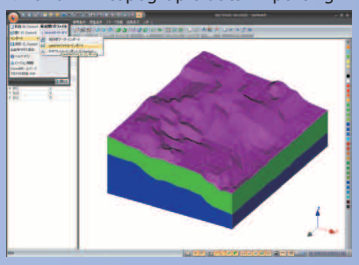
▼Intersection creation function 2



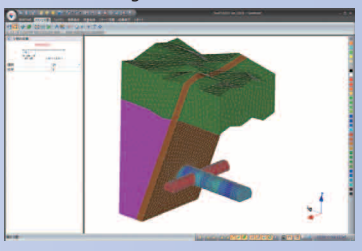
▼LandXML topograpic data importing 1



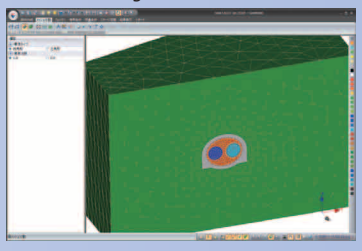
▼LandXML topograpic data importing 2



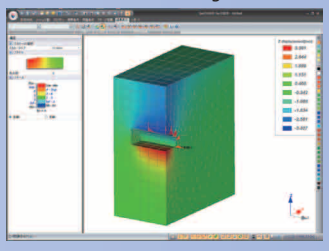
▼Mesh dividing 1



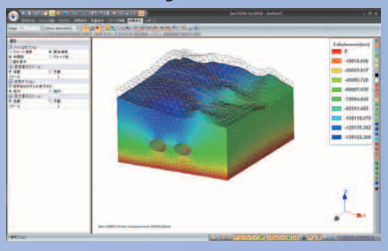
▼Mesh dividing 2



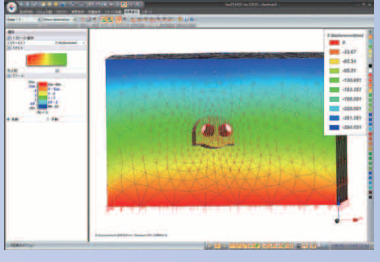
▼Sectionional force diagram



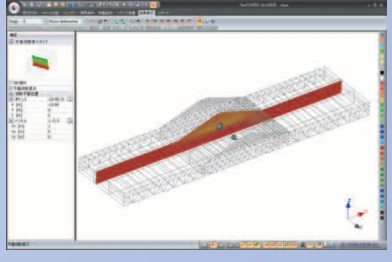
▼Deformation diagram



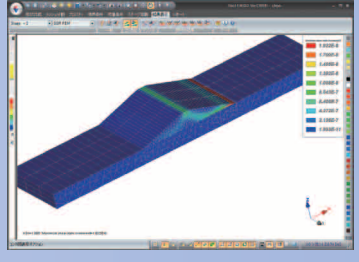
▼Stress vector diagram



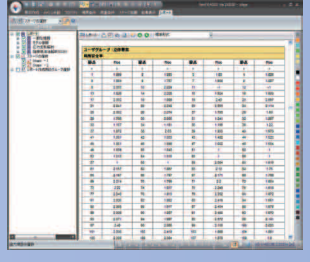
▼Contour diagram



▼Maximum strain increment distribution diagram



▼Result output



GeoFEAS 2D Ver.2 Ver.UP Geotechnical Finite element Elastoplastic Analysis Software

Software price US$ 6,000
Academic price US$ 2,000

Stress deformation analysis program of the ground with Finite Element Method (FEM)

Applicable to Windows NT/ 2000/XP/Vista/7

INTRODUCTION

GeoFEAS 2D is '2D Geotechnical Finite element Elastoplastic Analysis Software'. It is the software product for stress deformation analysis of soil under static conditions. This software conducts the powerful elasto-plastic finite element analysis in many engineering fields such as slope stability analysis, earth retaining works excavation analysis, tunnel design, etc. This product is designed for plane strain analysis, axisymmetric analysis in 2D Pre Post version. FEM model can be easily created through CAD method and SXF file import is also supported.

Functions and features

■Corresponding analysis models

(1) Analysis type: Static total-stress analysis
(2) Analysis Model : Plane strain analysis, Axisymmetric analysis
(3) Support for "The Seismic Capacity Evaluation Standard for River Structures 2007" in Ver. 2

■Main features

(1)Stage analysis:The stage analysis, or the phased construction analysis can be performed. It is possible to change material parameters, boundary conditions, and stress release factors at each stage.
(2)Shear strength reduction (SSR) analysis:The shear strength reduction (SSR) analysis can be performed using three kinds of elastic-perfectly plastic constitutive laws. It is possible to evaluate global safety factor and slip surface by SSR analysis at each stage.
(3)Local factor of safety:It is possible to calculate the local safety factors at each Gaussian point.
(4)Coordination with seepage analysis:It is possible to use nodal water pressure loads from seepage analysis (Note: This is for the analysis using load module).
(5)Combination of stage and SSR analyses:It is possible to perform both deformation and stability analyses at the same time by combining stage and SSR analyses, and to deal with a wide range of soil related problems such as filled/excavated area, slope stability, bearing capacity, etc.
(6)Mixed assignment of constitutive laws:It is possible to assign different constitutive laws for each material.
(7) The supported contents based on "The Seismic Capacity Evaluation Standard for River Structures 2007": FEM analysis is available for "Pre-liquefaction", "Post-liquefaction", "Settlement cased by the volume compression of liquefaction layer"

■Boundary conditions

It is possible to define the following four boundary conditions.
・ Supporting point (horizontal and vertical rollers, fixed, pin, enforced displacement)
・ Multi point constraint (MPC) ・ Spring supporting point ・ Pin connection

■Element libraries

Category	Element	2D	Axisym-metric	Note
Line	Beam / Bar	○	-	-
	Axial spring / Shear spring	○	-	Including spring supporting point
	Torsion spring/Distributed axial spring/ Distributed shear spring	×	-	-
Surface	Three-node triangle / Four-node quadrilateral	○	○	Primary element for 2D axisymmetric analysis
	Six-node triangle / Eight-node quadrilateral	○	○	Secondary element for 2D axisymmetric analysis
Joint	Four-node line joint / Six-node line joint	○	○	Applied between secondary surface elements for 2D

■Constitutive law models

(1)Constitutive law models for elements in plane strain and axisymmetric analyses:It is possible to use the following constitutive law models for elements in plane strain and axisymmetric analyses. Linear and laminated elasticity models can be used as no-tension materials.

Category	Constitutive law
Elastic	Linear elasticity(Isotropic) / inated elasticity(Anisotropic) Shear rigidity reduction material1※, Shear rigidity reduction material2※
nonlinear elastic	Duncan 1(Use constant Poisson ration) / Duncan 2(Define volume coefficient) / D-min(Technique by CRIEPI)
Nonlinear	HD (Hardin-Drnevich) / RO (Ramberg-Osgood) / UW-Clay (Ugai-Wakai)
Elastic-perfectly plastic	MC (Mohr-Coulomb) / DP (Drucker-Prager) / MC-DP (Mohr-Coulomb / Drucker-Prager)
Elasto-plastic	PZ-Sand (Pastor-Zienkiewicz) / PZ-Clay (Pastor-Zienkiewicz)
No-Tension	Linear elasticity / Laminated elasticity
Bilinear elastic	Liquefaction material

※ is for "The Seismic Capacity Evaluation Standard for River Structures 2007"

(2)Constitutive law models for beam, bar, spring, and joint elements:It is possible to use the following constitutive law models for beam, bar, spring, and joint elements.

■Loads

・Nodal force load (2D, axisymmetric)
・Uniform pressure load (2D, axisymmetric)
・Defined-per-node pressure load (2D, axisymmetric)
・Self weight load (2D, axisymmetric) ・Seismic inertia load (2D)
・Nodal water pressure load (2D, axisymmetric)

GeoFEAS2D can take into account water pressure, but not soil permeability.

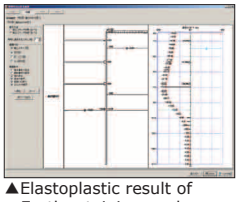
■Postprocessor (After-treatment)

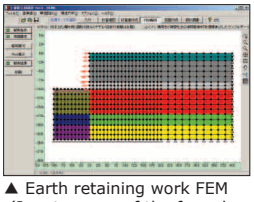
Output analysis of processor (Analysis section) is processed.Output / confirmation of result figures and numerical values are carried out.In this program, the following can be output mainly.

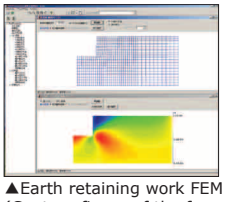
Model figure / Deformation figure / Vector diagram / Contour figure
Distribution map / Numeric output

■Combination with the UC-1 Earth retaining work design (Option)

In Earth retaining work design, it allows examining the effect to surrounding ground by "enforcement displacement method" which works vertical overburden pressure on the bottom of excavation if needed, giving the FEM analysis model that modeled only ground to the displacement of earth retaining wall from elastoplastic analysis as enforced displacement.


▲Elastoplastic result of Earth retaining work


▲ Earth retaining work FEM (Input screen of the forced displacement method)


▲Earth retaining work FEM (Contour figure of the forced displacement method)

■Applicable scope

This product is mainly applicable to the following problems.
・Stress-deformation analysis of soil ・Slope stability analysis
・Earth retaining works excavation analysis
・Analysis of surrounding soil effect by shield tunnel construction
・NATM tunnel construction analysis
・Study of water pressure variation effect on soil
・Study of soil-structure interaction ・Ground response acceleration method

■References

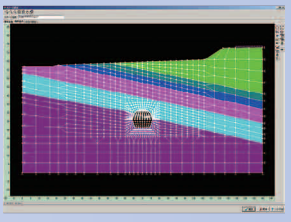
・Potts, D., Axelsson, K., Grande, L., Schweiger, H. and Long M.: Guidelines for the use of advanced numerical analysis, Thomas Telford, 2002.
・Civil Engineering Design Division of Kajima Corporation : Main Points of Civil design (5), Tunnel Kajima Institute Publishing, 2003
・T. Tanaka, K. Ugai, M. Kawamura, S. Sakajo and H. Ohtsu : Three-dimentional elasto-plastic finite element analysis of soils, Maruzen, 1996
・Zienkiewicz, O.C., Chan, A.H.C., Pastor, M., Schrefler, B.A. and Shiomi, S.: Computational Geomechanics with Special Reference to Earthquake Engineering, JOHN WILEY & SONS, 1999.
・M. Goto : Engineering Finite Element Method - For Analysis of Large Elastic-Plastic Deformation, Corona publishing, 1995
・O.C. Zienkiewicz, Robert L. Taylor, translated by G. Yagawa : Matrix and finite element method (Newly-revised version), Kagaku gijutsu Shuppan

<Ver.2.01.00 Revised information(April 10, 2009 Released)>

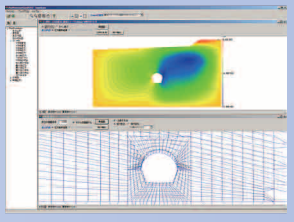
1. Improvement of the list, display, and selection function in Pre part, Modification of Post part
2. Import/export of "Terrain data file for geotechnical analysis" common in geotechnical analysis series of UC-1.

Image samples

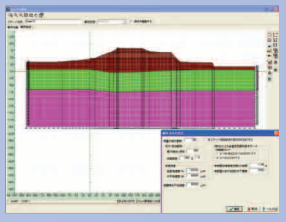
▼ Tunnel excavation analysis (Preprocessor)



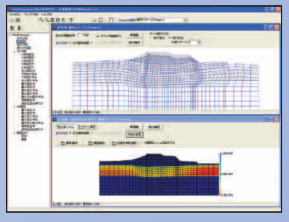
▼ Tunnel excavation analysis result (Deformation figure)



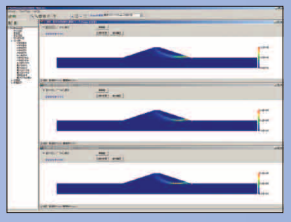
▼ Riverbank seismic self-weight deformation analysis (Model diagram)



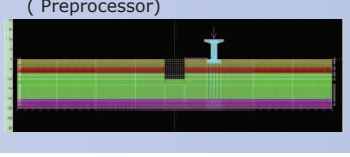
▼ Riverbank seismic self-weight deformation analysis (Deformation diagram, FL diagram)



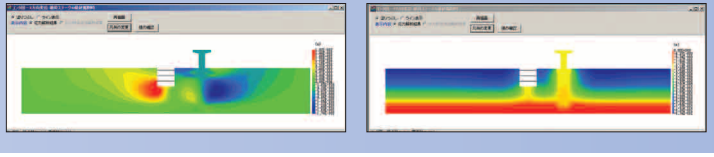
▼ Slope stability analysis (Maximum strain increment)



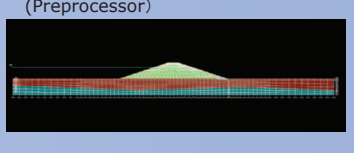
▼ Earth retaining excavating analysis (Preprocessor)



▼ Earth retaining excavating analysis result(Contour figure of an X direction)



▼ Slope stability analysis (Preprocessor)



UWLC Ver.2 Ver.UP — Dynamic effective stress analysis for ground

Software price US$ 5,800
Academic price US$ 2,000

Applicable to Windows NT/2000/XP/Vista/7

Analysis of elementary stress/dynamic analysis of the total stress / dynamic analysis of effective stress (liquefaction analysis) program

INTRODUCTION

This program is to analyze dynamic land transformation using finite element method (FEM). Taking into consideration the method of elastic theory based on effective stress, excessive pore water pressure which occurs during earthquakes and the declining of stiffness, it is possible to calculate land transformation by the hour. This program can be applied to investigating the stability of earth structures (banks or raised mounds), the lift of underground structures, and the dynamic interrelation between an earthquake and structures. Another program with function to decide parameters in liquefaction is attached. It allows you to input in a CAD style making easy creation possible. It also accepts reading from SXF files.

Functions and features

■Analytic features

(1)It is possible to set parameters in liquefaction by carrying out simulation for element test.
(2)Dynamic analysis program with optimized method allows the determination of input parameter based on the experimental data.
(3)The input parameter of the sand constitutive model (PZ-sand) can be estimated by the N value of standard penetration test results.
(4)It conducts one-dimensional and two-dimensional analyses.
(5)It is possible to carry out the dynamic analysis of total stress method and of effective analysis (analysis in liquefaction).
(6)Applied elements for total stress method (ignoring water pressure) and applied elements for effective stress method (considering water pressure) can be used in mixed situations.
(7)Dynamic analysis of earth and water successively formed on the assumption of water penetration.
(8)Plenty of structure models of land (eight categories) are available and these can be used freely.
(9)It adopts BFGS, which is a line search for calculating convergence.
(10)Stable analysis by making automatic adjustment in time steps of dynamic analysis.
(11) Vertical and horizontal simultaneous vibration

■Scope of application

(1)Investigation of the dynamic interrelation between land and building structures by using the total stress method.
(2)Investigation of stability at an earthquake including earth structures(river banks, for example).
(3)Investigation of the lift of structures in the liquid land.
(4)Effect assessment for liquefaction countermeasure work (ex. Construction method based on structure, consolidation process, sand compaction pile method)
(5)Excess pore pressure dissipation method (gravel drain method)
(6)Experiment simulation including centrifugal shaking, large shaking table
(7)Judgment of minute liquefaction by means of one-dimensional response analysis during earthquakes.

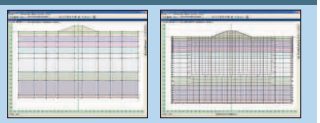
Liquefaction countermeasure work examples

(1)structure method (2)solidarity method (3)sand compaction pile method (4) gravel drain method)

Analysis feature

Procedure of analysis model creation

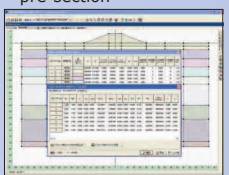
◆Creation of 2D FEM model with CAD operation
◆CAD data importing function
◆Mesh dividing (Block dividing method)
◆Easy creation function for primary analysis model
◆Output function for mesh data
◆Input of material parameter table



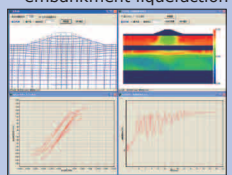
Reference
"High-Standard Bank Embankment Design and Enforcement Manual"
March 2000 Foundation for River front Improvement and Restoration

Image samples

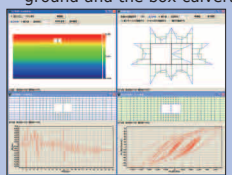
▼Input image of the pre-section



▼Examination of the embankment liquefaction



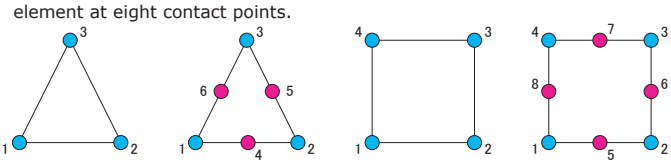
▼Examination both of the ground and the box culvert



■Theory of analysis

1.Element

(1)Distortion element on a plain surface : It is possible to define four elements:triangular element at three contact points,trangular element at six contact points,quadrangular element at four contact points and quadrangular element at eight contact points.



(2)Beam element : It is possible to define primary beam element.
(3)Axial spring element : Definition is given at two contact points
(4)Shearing spring element : Definition is given at two contact points.
(5)Mass element centered on one contact point. : Definition is given at one contact point.
(6)Damper element : It indicates declining in the axial and shearing directions.

2. Constituent models

(1)Distortion element model on a plain surface
Linear elastic model / Laminated elastic model
Elastic and complete plastic model
Modified Ramberg-Osgood model (RO model)
Modified Hardin-Drnevich model (HD model)
Ugai-Wakai model (UW-Clay model)
Pastor-Zienkiewicz model for sand (PZ-Sand model)
Pastor-Zienkiewicz model for clay (PZ-Clay model)
(2)Beam element model : Linear elastic model or bilinear model can be used as stability feature in the axial direction and shearing spring element. It is also possible to define the concentrated mass at contact points at both the ends of spring.
(3)Spring element model : As the stability characteristic of the direction of an axis, and the shear spring element which is not carried out, an alignment elastic model or a bilinear model is applicable.Moreover, node concentration mass can be defined with the direction of an axis and the shear spring element which is not carried out of this product as the both-ends node of a spring.

3.Mass matrix and damping matrix

(1)Concentrated matrix and consistent matrix
In this program it is possible to choose either concentrated matrix or consistent matrix to be applied to mass matrix and damping matrix.
Mass matrix:Concentrated mass matrix or consistent mass matrix
Damping matrix:Concentrated damping matrix or consistent damping matrix
However, you have to use consistent damping matrix if you regard Rayleigh damping as viscous damping.
(2)Rayleigh damping : Energy damping covers viscous and fugitive dampings as well as aftereffect damping.In this program Rayleigh damping can be considered to be viscous damping.

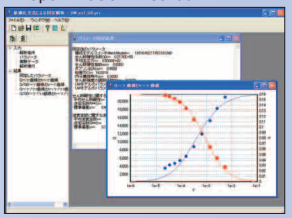
4.Dynamic equation and simultaneous equation

(1)Degitizing and integral calculus in dynamic equation
Explicit method:forward calculus of finite differences.
Implicit method:Newmark-β method/HHT-α method/WBZ-α method/Generalized-α method.
(2)Solution of simultaneous equation
This program stores into memory total rigid matrix by means of skyline method.As solution of simultaneous equation it adopts LDLT resolving method which is changed from Gaussian elimination.

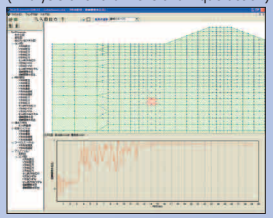
■Representational function of the analyzed results

It supports displaying model diagram, distortion diagram, time history diagram, drawing of characteristic force of restitution, responsive spectrum diagram, Fourier spectrum diagram, contour diagram, diagram of cross-section force, main stress/main distortion. It also supports representation in animation.

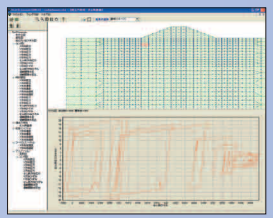
▼verification analysis with optimization method



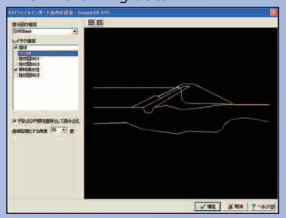
▼Excessive pore water pressure rate (Analysis of two-dimensional liquefaction)



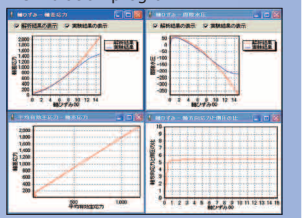
▼Features of force of restitution



▼Import function of the SXF drawing data



▼Element test simulation program



LEM 3D 3-D slope stability analysis(LEM)

Software price US$ 3,000
Academic price US$ 1,000

Three-dimensional analysis of slope stability /program for planning countermeasure work

Applicable to Windows NT/ 2000/XP/Vista/7

INTRODUCTION

Currently it is common to analyze slope stability with two-dimensional plain surface in mind, but this program will enable you to condut stability analysis reproducing real land shapes and sliding surface in three dimensions. Three-dimensional land shapes are designed to be displayed relatively with ease by entering plenty of cross-sectional drawings in a two-dimensional method. In the process of countermeasure work it is possible to draw up a plan of piling using three-dimensional deterrent force, with consideration that putting in piles can be easily put into image in a two-dimensional way. Moreover, considering that current standards about a piling plan are intended for two-dimensional deterrent force, this program is designed to facilitate making a plan of piling by means of two-dimensional deterrent force as well.

Functions and features

■Analysis methods

(1)Analysis methods: Following 3 methods are available, 2-dimensional limit equilibrium method expanded to 3-dimensional.
- Hovland (Hovland) method
- Hovland (Hovland(water weight)) method
- Simple Janbu (The Janbu method)

(2)Calculation types: Following is available at both all time and earthquake.
Stability factor calculation / Back calculation method (c is fixed) / Back calculation method (ϕ is fixed) / c-tanϕ-related figure

(3)Additional capabilities

1.Arbitrary water pressure can be considered to the landslide side (not the hydrostatic pressure from ground water, but hydraulic pressure examined separately).

2.It supports the up and down collective movement of groundwater. (examination of increase in pore water pressure by rainfall and the effect of drainage measure).

3.The deterrent of the countermeasure construction is calculated to satisfy the designed safety factor.The safety factor is not particularly described for the 3-dimensional limit equilibrium method, but the 2 dimensions limit equilibrium method in most design manuals.Usually when the 3-dimensional designed safety factor (Fsp(3D)) equivalent to the 2-dimensional designed safety factor (Fsp(2D)) is used, it is necessary to estimate the designed safety factor to be slightly bigger. Therefore, it is suggested that the 3-dimensional designed safety factor should be calculated from 2-dimensional designed safety factor, so the additional function to set the 3-dimensional designed safety factor is equipped with this product.

■Main analysis, a list of calculation functions

Article	Detail
Analytical methods	Simple Janbu / Hovland / Hovland(Water weight)
The safety factor calculation	The c ϕ is input to calculated the safety factor → requirement deterrent is calculated
Terrain	The number of layers (10 layers)
The Back calculation method	The c value is fixed to calculate ϕ. / The ϕ value is fixed to calculate the Co. / The ϕ value is fixed to calculate Ck experience value (augmentation factor). / Making of the c -tanϕ-related figure
Design of the countermeasure construction	The 3-dimensional designed safety factor is calculated from the 2-dimensional designed safety factor / The 3-dimensional designed safety factor is calculated from the 2-dimensional designed safety factor
Additional capabilities	The 3-dimensional designed safety factor is calculated from the 2-dimensional designed safety factor / Examination at earthquake / The up and down collective movement of groundwater / The consideration of the arbitrary hydraulic pressure on the landslide side / Direct input and edit of DEM data
Tools	SXF data import tool Seepage analysis result cooperation tool (SATL3D):Tetrahedral primary element Terrain model conversion tool (GMTL3D) BoringCD/3D-Pro(GeoMap3D)□¨Section data for Lem, DEM data for LEM

■Applicability

Top items	Middle items	Sub items	Limit
land features	number of landslide layers	Multilayered ground correspondence	10
	number of cross sections (lateral lines)	–	99
	SXF data read in	Possible to import CAD data	○
	Components	Grade / Ground water table / A landslide side / A bed boundary-surface	199
	Submergence terrain	Analysis is carried out to lower the groundwater level forcibly	–
analysis	Column partition numbers	Partition numbers to x and y direction	200

■About the countermeasure construction design

(1)The design calculation of the pile work by the 3-dimensional analysis (the 3-dimensional deterrent) is available.

(2)The design calculation of the pile work by the 2-dimensional analysis (the 2-dimensional deterrent) is available at the same time.

(3)3 types of piles, "a wedge pile", "a shear pile" and "a prevention pile" are available in the pile work design calculation.

(4)Examination of the most suitable pile location by the Ru-Ly curve is available.

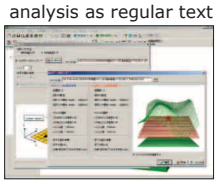
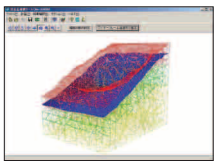
(5)As pile arrangement, examination of a single row and a staggered arrangement is available.

■Tools (support)

(1)**[SXF data import]** Reading of SXF file, which CAD data support as 2-dimensional sectional input tool.

(2)**[Terrain model conversion tool]** the 2-dimensional cross section data or the DEM data that terrain data of BoringCD/3D-Pro (GeoMap3D) was converted into can be imported to this product.

(3)**[Seepage analysis result combination tool]** Slope stability analysis can be carried out, generating groundwater necessary to analyze landslide with our product "3-dimensional Seepage FEM analysis (VG Flow)" or by using of result analysis as regular text format even if it is another companys product.


■Drawing, output capabilities

(1)Both "course of traverse type" (Tin type) 3D" and "DEM type 3D" can be displayed by 3D drawing function.It allows 3D models to be exported in 3DS format and imported in UC-win/Road.

(2)"Thrust vector diagram" and "Maximum shear resistance force figure" are available to be output as the 3-dimensional slope stability analysis result.

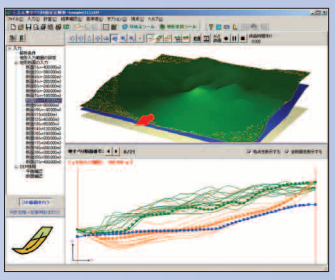
■Reference

(1)Roadwork "Guideline for safety work on a slope" published March, 1999 by Corp. Japan Road Association

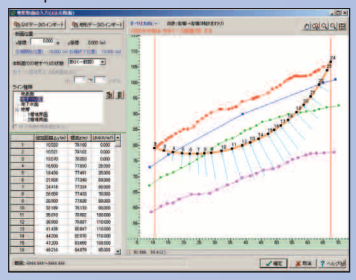
(2)"Guideline for planning steel pipe pile against landslide" published June, 2003 by Corp. Japan Landslide Society

Image samples

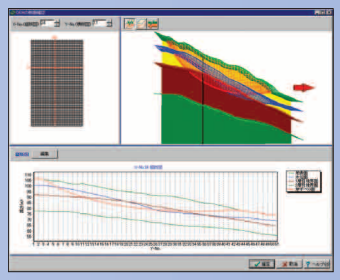
▼Main window



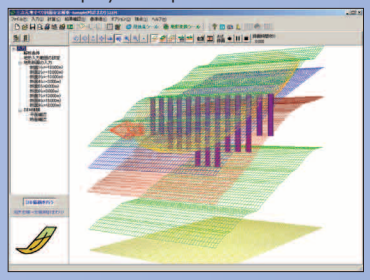
▼Input of terrain cross section



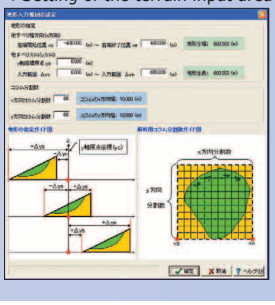
▼Confirmation of DEM cross section



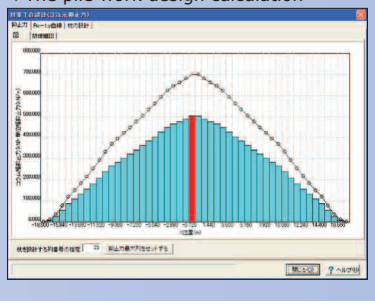
▼3D display example



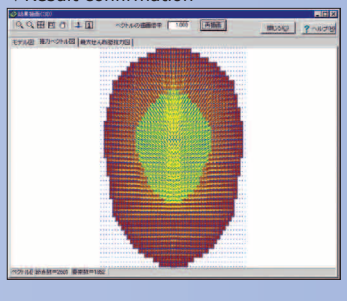
▼Setting of the terrain input area



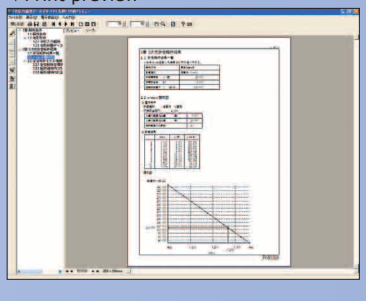
▼The pile work design calculation



▼Result confirmation



▼Print preview



VGFlow / VGFlow2D NEW 3-D seepage analysis 2-D seepage analysis

Software price
US$ 7,300(VGFlow)、US$ 2,500(VGFlow2D)
Academic price
US$ 3,600(VGFlow)、US$ 1,000(VGFlow2D)

2D/3D Saturated/Unsaturated Seepage, Steady/Unsteady FEM Analysis Program

Applicable to Windows NT/2000/XP(VGFlow)
Windows NT/2000/XP/Vista/7(VGFlow2D)

INTRODUCTION

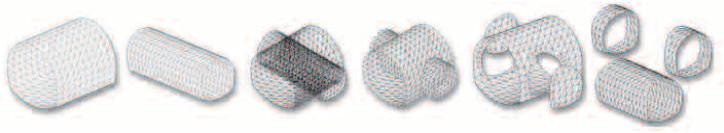
VGFlow is saturated/unsaturated seepage analysis program using Finite Element Method (FEM). There are two types of product VGFlow2D (2D analysis) and VGFlow3D (3D analysis) based on pre-post. Richard's equation is used for the proper saturated/unsaturated seepage analysis. This product can be used for all purposes without the limitation of applicable scope as all topics are covered without simplifying the dominant equations for seepage phonomena. The seepage analysis is expected to be used more often due to the increase in frequency on disaster-affected cases as a result of the recent torrential rainfall. This program allows the simulation with FEM analysis for the increase of gap ground water pressure which occurs in torrential rainfall.

Functions and features

■Analysis Type:Steady flow analysis / Transient flow analysis
■Analysis Model:Two-dimensional horizontal plane flow model / Two-dimensional vertical plane flow model / Axisymmetric flow model / Three-dimensional flow model
■Node configurations:First-order Element : Three-node triangle element / Four-node quadrilateral element / Four-node tetrahedron element / Six-node prism element / Eight-node hexahedron element Second-order Element : Six-node triangle element / Eight-node quadrilateral element / Ten-node tetrahedron element / Fifteen-node prism element / Twenty-node hexahedron element
■Boundary Conditions:This product can define the following six types of boundary conditions and set fluctuating water level and rainfall boundaries at the same time.
・(:Steady:Unsteady) Known hydraulic head / Potential seepage face / Rainfall /Flux /Point source/(Unsteady)Fluctuating water level /Outflow forbidden
■Saturated seepage characteristics:Anisotropy of water penetration factor, layer gradient.
■Unsaturated seepage characteristics:
van-Genuchten model / Direct inputs of Volumetric water contents - Suction and Volumetric water contents - Relative hydraulic conductivity
■Applicable scope
1.Check of rainfall effect on road banking based on the revised civil engineering work standard
2. Influences of rainfall and spring in large basin
3. Measures of seepage surface and water pressure distribution in river levee, dam and reservoir
4. Design calculation of fill dam body and investigation of seepage on the ground around reservoir
5. Investigation of permeability in the basic process including curtain grouting
6. Background calculation of reservoir body and pre-low ground around reservoir for disaster prevention
7. Investigations of piping and boiling during excavation
8. Influences of confined groundwater
9. Analysis of water pressure distribution variations by infiltration well in landslide region
10. Investigation of seepage variation in the coffer dam construction
■Applicable standard
"Japanese Road Construction Guideline"- Japan Road Association
"Design Standard for Railway Structures" -Railway Technical Research Institute
"Construction Ministry, Technical Criteria for River Sand Control Works : Practical guide for Design[I] (Draft plan)" -Sankaido Publishing Co., Ltd
"River Bank Structure Guideline", -Japan Institute of Construction Engineering
"Guideline of embankment checking and provision in the small-and-medium-sized rivers (Draft plan)" --Japan Institute of Construction Engineering
"High-Standard Bank Embankment Design and Enforcement Manual" - Foundation for River front Improvement and Restoration
"Land reform project design standard" - Ministry of Agriculture, Forestry and Fisheries of Japan
"All-purpose Dam Construction" - Japan Dam Engineering Center
"Survey and provision of the landslide around the water reservoir" -Japan Institute of Construction Engineering
"Disaster Prevention Control Reservoir Technical Standard (Draft plan)" -Japan River Association

Pre-post-section Overview

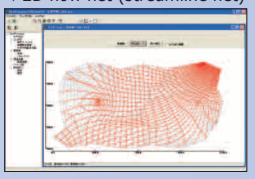
■2D pre-post characteristics
-Creation of layer shape model from various electronic medium and drawing (AutoCAD2007or SXF format, drawing (paper information) scanning)
-Common interface with FEM products of our geotechnical analysis series
-Representative parameter including based on "River Bank Structure Guideline"
-Unsteady analysis result with animation, easy to understand time-history
-Flow net (streamline net) output with animation
-Saving function of the unsteady analysis result in AVI format
■2D post output capabilities
Model diagram, Contour figure(equivalent potential, equal interval water pressure, horizontal hydraulic gradient, vertical hydraulic gradient, saturation degree, water content by volume), Contour map(streamline, flow net), Vector diagram, Time-history diagram, Numerical value(node, element), Specified section flow amount
■3D pre-post characteristics
-Creation of 3D mesh of the complicated shape as the general-purpose mesh generator
-Creation of the surface mesh of the terrain and layer surface based on DEM data with the projection function of base surface mesh
-Editing of the surface and solid mesh after creating mesh with surface mesh crossing part divided Boolean operator and solid mesh dividing function



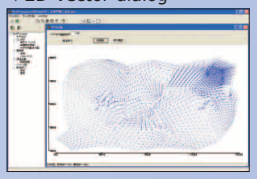
■3D post output capabilities
Contour figure (equivalent potential, equal interval water pressure, water content by volume), Iso surface figure (Equivalence curved surface figure),Curve plot (Graph display of contour value), Surface figure (Display of contour distribution as curved surface),Vector diagram, Groundwater graph, Section flow

Image samples

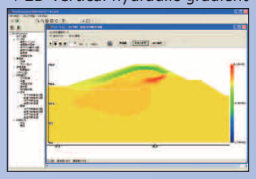
▼2D flow net (streamline net)



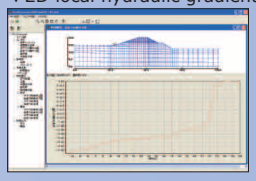
▼2D Vector dialog



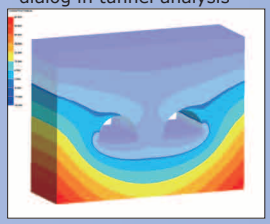
▼2D vertical hydraulic gradient



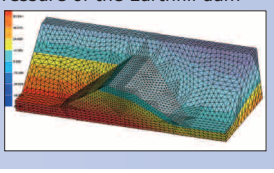
▼2D local hydraulic gradient time history



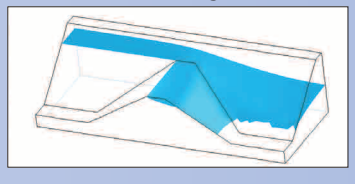
▼3D water pressure contour dialog in tunnel analysis



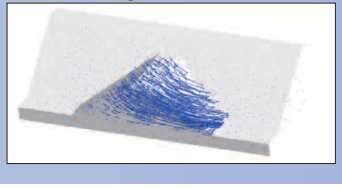
▼ The contour figure of the hydraulic pressure of the Earthfill dam



▼Phreatic surface dialog



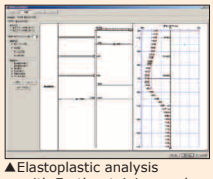
▼Vector dialog



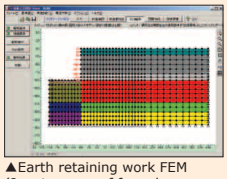
Earth retaining FEM Package
(Temporary sheathing work design /GeoFEAS2D)

Set Price:US$8,100
Academic:US$5,300

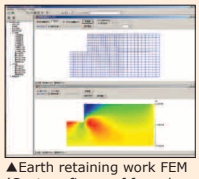
In the Earth retaining work design, it allows putting the displacement of earth retaining wall obtained from elastoplastic analysis on the FEM analysis model that modeled only ground as enforced displacement. It also allows examining the effect to surrounding ground by "enforcement displacement method" which works vertical overburden pressure on the bottom of excavation if needed. (Input data creation function for "GeoFEAS2D", Geotechnical Finite element Elastoplastic Analysis Software is equipped).



▲Elastoplastic analysis with Earth retaining work



▲Earth retaining work FEM (Input screen of forced displacement method)

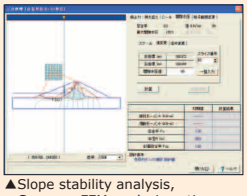


▲Earth retaining work FEM (Contour figure of forced displacement method)

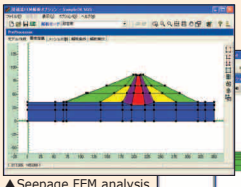
Slope FEM Package
(Slope stability analysis /VGFlow)

Set Price:US$8,400
Academic:US$6,100

Slope stability analysis, Seepage FEM analysis option:It allows producing animation of vertical 2-dimensional Saturated/ Unsaturated Seepage FEM analysis and also analyzing slip failure depending on seepage by importing the analysis into Slope stability analysis software. (Correspond to unsaturated Seepage Properties described in "Guidebook for examination of river embankment construction")

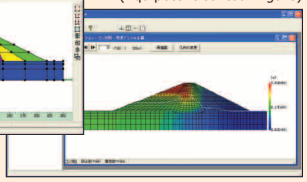


▲Slope stability analysis, Seepage FEM analysis option



▲Seepage FEM analysis (Element definition)

▼Seepage FEM analysis (Equipotent contour figure)



Geotechnical analysis support service

Engineering service to support making initial models for geotechnical analysis and FEM

INTRODUCTION

We support tedious tasks to make initial models for geotechnical analysis and especially for FEM. We provide engineering service to evaluate the influence of liquefaction induced by an earthquake (uplift of underground structures, residual displacements due to liquefaction), and to study and design countermeasures; to predict the upward movement of water table and to evaluate its influence to the ground stability, settlement and so on; to evaluate slope stability and to quantitatively evaluate improvement after reinforcement. In this engineering service, our technical support group and development staff back up. Three dimensional FEM analysis can be conducted in a handy way with smooth flow from data generation to post processing and visualization of analysis results.

Examples of engineering services

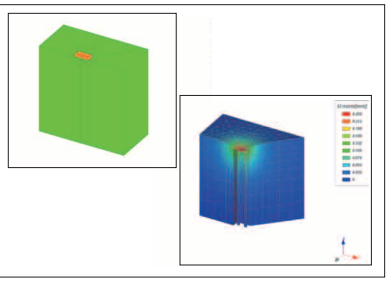
■ Geotechnical Finite element Elastoplastic Analysis Software (GeoFEAS)3D NEW

Pile foundation analysis

Number of nodes=2180
Number of stages=2

- Beam elements are unused
- 3D ordinary model
- solid model only
- 2D ordinary model
- Effective stress analysis

About us US$ 5,200

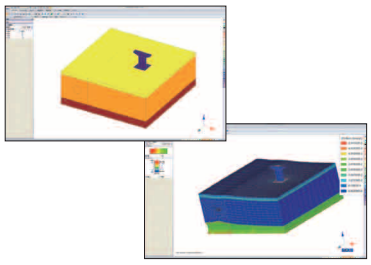


Bridge pier and tunnel analysis

Number of nodes=10347
Number of stages=2

- Beam elements are unused
- 3D ordinary model
- Solid model, beam model
- 2D ordinary model
- Effective stress analysis

About us US$ 9,120



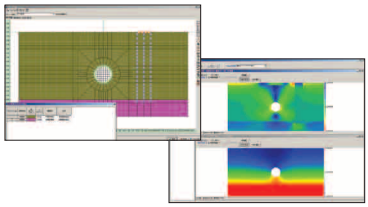
■ Geotechnical Finite element Elastoplastic Analysis Software (GeoFEAS)2D

Tunnel excavation analysis

Number of nodes=1260
Number of stages=6

- Beam elements are used.
- 2D ordinary model

About us US$ 4,330

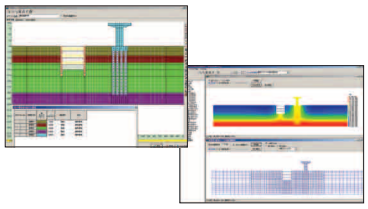


Analysis of earth retaining works in adjacent construction

Number of nodes=1260
Number of stages=6

- Live load exists.
- Beam elements are used.
- 2D ordinary model

About us US$ 4,780



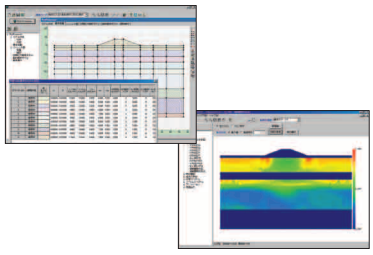
■ Dynamic effective stress analysis for ground (UWLC)

Embankment

Number of nodes=2440
Number of stages=1

- Ground surface inclines
- No surcharge load
- Only solid model
- 2D ordinary model
- Effective stress analysi

About us US$ 7,970

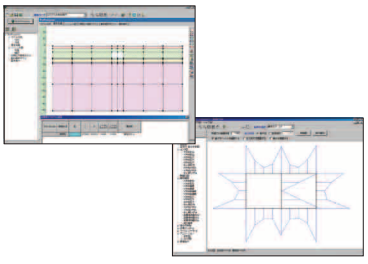


Box culvert

Number of nodes=1103
Number of stages=1

- No ground surface inclination
- No surcharge load
- Solid model, beam model
- 2D ordinary model
- Effective stress analysis

About us US$ 7,300

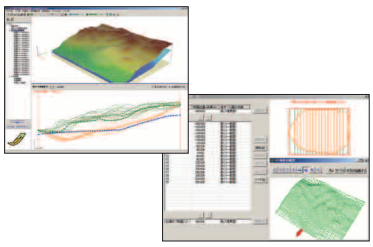


■ 3-D slope stability analysis (LEM)

Number of nodes=3500
Number of stages=1

- Water table exists

About us US$ 2,560



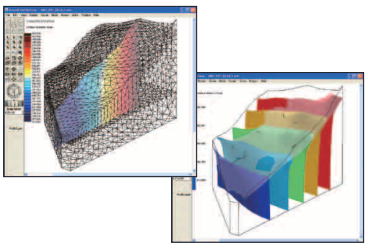
■ 3D seepage analysis (VGFlow)

3D excavation

Number of nodes=18766
Number of stages=1

- No ground surface inclination
- No surcharge load
- 3D ordinary model
- Solid model only
- Steady analysis

About us US$ 11,840



Easy!! Estimates on web

https://www2.forum8.co.jp/jiban_estimate/html/main.htm

FORUM 8 Training Seminar

FEM Analysis

Simultaneously held in Tokyo, Osaka, Nagoya, Fukuoka with TV conference system

●GoeFEAS Seminar CPD certification of Japan Geotechnical Society

Introductory seminar for geotechnical engineers about dynamic FEM analysis.Elasto-plastic theory based on effective stress, excessive pore pressure occurrence, soil deformation by time-domain analysis.

Schedule : 9:30-16:30 Charge : US$ 157.5

●UWLC Seminar CPD certification of Japan Geotechnical Society

Foundations of FEM analysis, data generation using Geotechnical elasto-platic analysis GeoFEAS, methods to evaluate analysis results.

Schedule : 9:30-16:30 Charge : US$ 157.5

●VG Flow 2D/3D Experience Seminar NEW

The seepage analysis program (VG Flow2D/3D) with pre-post function was developed as 2D FEM Software, comparably priced products as GeoFEAS2D and UWLC in geotechnical analysis series.

Schedule : 13:30-16:30 Charge : Free

◆Related Seminar

- Flexible structure sluiceway design seminar
- Slope stability analysis seminar
- BOX culvert design seminar

Schedule : 9:30-16:30 Charge : US$ 157.5

FORUM 8 Design Conference report on the special lecture

We report the two special lectures on geotechnical topics presented in the first to third FORUM8 design conference in Tokyo Conference Center Shinagawa, from 2007 to 2009.

Special Lecture on Geotechnical Analysis Software Series

■Lecturer's profile

Keizou Ugai (Doctor of Engineering)　　Major: Geotechnical Engineering

Personal history: Master of Science and Engineering from Tokyo Institute of Technology. Research Assistant of Civil Engineering Division, Department of Engineering at Niigata University. Assistant Professor of Construction Engineering Division, Department of Engineering at Gunma University. At present, Professor of Geotechnical Engineering Research Laboratory, Department of Civil and Environmental Engineering, Chief of Kantou Branch of Japan Landslide Society

Awards: Contribution prize of the Japan Geotechnical Society in 1999

Excellent paper prize of the Japan Landslide Society in 2003

■"Actual condition and issue of Geotechnical Analysis"-1st Design conference

Professor Ugai is an expert of landslides with special concentration in research on landslides during earthquakes at present. He is also engaged with FORUM8 as an advisor to review our programs in our Geotechnical Analysis Software Series.

He mentioned the necessity of 3D analysis with the comparison of the 2D and 3D FEM analysis to the theoretical solution and showed examples of earth retaining excavation and bridge abutment issue(figure1) considering the piping phenomenon occurred in the sand ground excavation.

In the presentation of "Damages by liquefaction and measures", he introduced some examples of damages by liquefaction occurred in the 1964 Niigata earthquake and the 2004 Niigata-ken Chuuetsu earthquake. He mentioned the necessity to simulate liquefaction phenomena using FEM analysis (fig.2) As recent topics, he presented "Analysis example of rock slope failed during the 2004 Niigata-ken Chuuetu earthquake", "Deformations and damages in residential land by liquefaction occurred in the 2007 Chuuetsu-oki earthquake". He talked about the necessity to use UWLC as dynamic analysis software for quantitatively evaluating the safety improvement of residential land by soil improvement and reinforcement.

■"Disasters in intermediate and mountainous areas caused by recent earthquakes in the inland region"- 2nd Design conference

He presented the latest information including the disaster-affected condition, survey condition, and mechanism with the example of Chuuetsu earthquake in Niigata prefecture, Inland earthquake in Iwate-Miyagi prefecture, Wenchuan Earthquake in Sichuan, China.

He made special mention and pointed out that the mechanism of the large sized landslide is quite different in between Japan and China. Despite majority of the sliding soil mass consisting of earth, sand, and weathered soft rock, the slope gradient is comparatively smooth in Japan. It consists of the weathered soft rock developed from the rift and the joint, and the slope is steep in China.

In addition, he mentioned that the occurrence of slope failure resulted from the seismic inertial force. The effected force after the beginning of the slope failure is the gravity and not the inertial force. Earth, sand and the rock mass has been moved in the long distance with this effect, and would result in large sized sediment disaster. He emphasized the importance of the numeric simulation such as FEM (Fig.2) to solve the mechanism of the long-distance movement.

■"Ground analysis : Present situation and future development"- 3rd Design conference

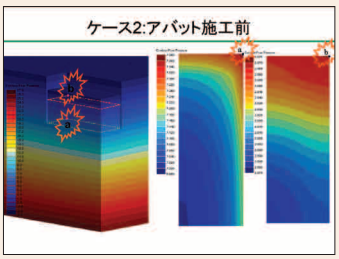
His themes were the safety factor assessment for the slope using elasto-plastic FEM, the method to define the provision with the prediction of the ground liquefaction using FEM(figure3), the resolution of the large sized landslip structure resulted by huge earthquake using elasto-plastic FEM. He introduced the current condition that FEM analysis software (GeoFEAS, UWLC) is allowing the accurate resolution of mechanism from the high precision analysis result and the selection of conclusive countermeasure work.Finally, he advised that it was very important for FORUM8 to take in consideration of the needs and convenience of users while developing FEM software.

References

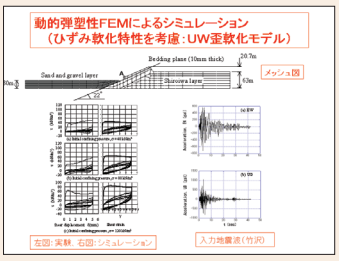
・3D elasto-plastic finite element analysis of soil, Maruzen, 1996

・Guide to understand elasto-plastic finite element anlysis, The Japana Geotechnical Society, 2003

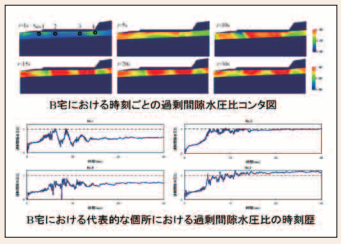
▲Keizou Ugai (Doctor of Engineering)



▲fig.1 Case 2 abutment before construction



▲fig.2Soil description of analysis model (upper)



▲Figure 3 : Analysis result of liquefaction

Special Lecture on civil engineering and temporal structure works

■Lecturer's profile

Cai Fei (Doctor of Engineering)　　Major: Geotechnical Engineering

Personal history: Master of Engineering from Tsinghua University. Researcher in the water resource in water resources laboratory, the Ministry of water, traffic, and electric power industry. Research Assistant of Civil Engineering Division, Department of Engineering at Gunma University. At present, Assistant Professor of Construction Engineering Division, Department of Engineering at Gunma University

Awards: Prize of the best paper in the third international conference on landslides and safety of social infra-structure (Singapore) in 2002, Prize of the best presentation in the international symposium on subsurface water problems in ground environments, IS-OKAYAMA, Prize of research encouragement in 2004, the Japan Landslide Society

■"Example of slope stability calculation and future issue""- 1st Design conference

Assistant Professor Cai is engaged with the researches, such as landslide measures, liquefaction, seepage analysis, etc. through numerical analysis of soil.

He developed the most of solvers as engines for UWLC, GeoFEAS, VGFlow, LEM3D which consist of Geotechnical Engineering Software Series. In this time, as examples of important slope stability analysis and problems in future, he gave us a lecture on "Definition of factor of safety", "New back analysis", "Evaluation of total stability of residential land embankment" and "Problems in future".

As the definition of factor of safety, he mentioned factor of safety based on two kinds of definition; "Ratio of sliding force on a failure surface and shear resistance" and "Reduction factor of shear resistant constants to create the equilibrium state in a slope along a failure surface" and the method for calculating necessary resistant forces. He also explained the differences in the two kinds of definition (fig.1).

As for the evaluation of total stability of residential land embankment, he noted that a more dangerous failure surface than an arc failure surface would be possibly created, using key words, stability of embankment slope, total stability of embankment, filling valley type, and lateral filling type (fig.2) from the commentary on the guideline of deformation prediction survey in large residential land embankment. To troubleshoot problems in future, he suggested (1) method of automatic searching a critical failure surface, (2) method to calculate factor of safety by the limit equilibrium state method in accordance with the standard or design guideline with regards to the failure critical surface, which is found as a critical failure surface by the shear resistance reduction FEM (SSR-FEM) (fig.3).

(3) new method to divide a slope into slices, uniform central angle method, to avoid some errors due to the number of division in the uniform width method used generally, and (4) needs to use 3D slope stability analysis. We recognized some dwelling problems in arc slope stability analysis which was assumed to have no argument about the basic idea as an evaluation method, and resolved to work for a new design method.

■"Utilization of temporary sheathing work design and FEM Analysis"- 2nd Design conference

He lectured on FEM analysis case example for earth retaining work design including "Boiling", "Heaving", and "Stress and deformation calculation".

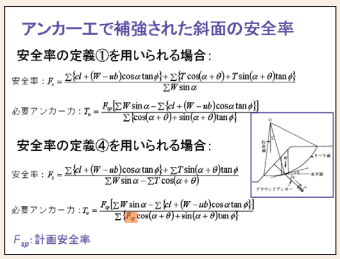
He pointed out that the analysis results using 3D seepage FEM analysis and the temporary guideline calculations which set up the corrective coefficient for earth retaining shape were comparatively similar. As for the stress and deformation calculation, he pointed out that it can be matched with measured value depending on the method of giving the ground physicality value using for FM analysis, but the judgment of the designer is very important as the ground physicality value depends on the warp level. We would develop more products with FEM analysis function for the design calculation with FEM.

References

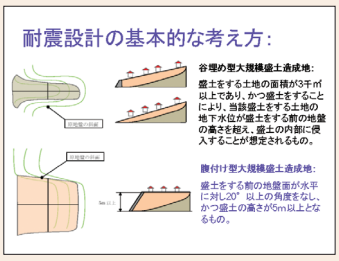
・3D elasto-plastic finite element analysis of soil, Maruzen, 1996

・Highway Earthwork Standard - Standard for Design of Temporary Structures, Japan Road Association, 1999

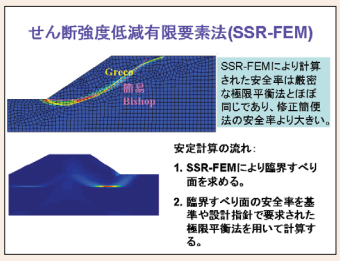
▲Cai Fei (Doctor of Engineering)



▲fig.1 Factor of safety of slope reinforced with anchors



▲fig.2 Basic concept for earthquake resistance design



▲fig.3 Shear resistance reduction FEM (SSR-FEM)

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