DIANA

FINITE ELEMENT ANALYSIS

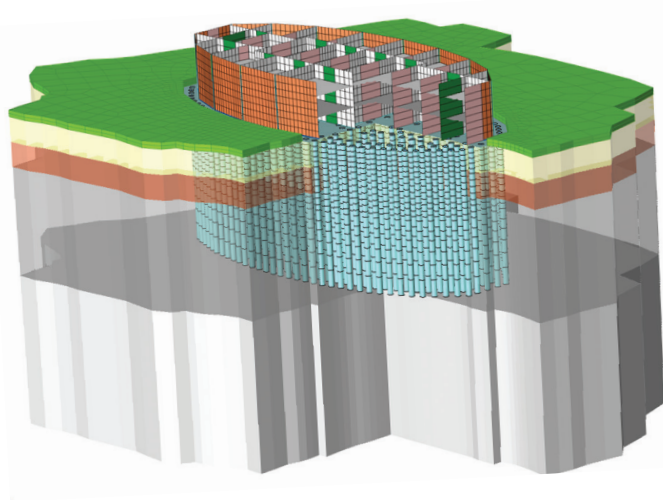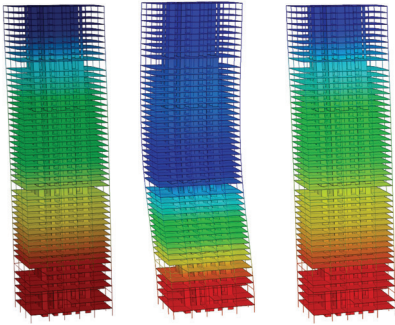**DIANA FEA**
a TNO Company

DIANA (DIsplacement ANAlyzer) is a multi-purpose finite element program, with a special strength in the field of civil, geotechnical, earthquake and oil & gas engineering.

DIANA development started in 1972 at the TNO Building and Construction Research Institute in the Netherlands.   In 2003, the organisation now known as DIANA FEA BV was established and continues to develop, market and support DIANA and undertakes customisation, consultancy and client training activities on behalf of customers worldwide.

Product Functionality

Fields of application

- Structural engineering
- Geotechnical engineering
- Earthquake engineering
- Dams & dykes engineering
- Oil & Gas engineering

Material models

- Linear, nonlinear and modified elasticity
- Hyperelasticity
- Isotropic and orthotropic plasticity
- Viscoplasticity
- Smeared crack models
- Total strain fixed and rotating crack models
- Young hardening concrete models
- Fiber reinforced material models
- Random field material models
- Creep and shrinkage
- Maekawa-Fukuura concrete model
- Soil specials
- Liquefaction models
- Concrete and steel materials according to international design codes
- Model Code models for concrete and steel
- Special models for interface elements
- Ambient and time dependent mechanical, heat transfer and groundwater flow properties
- Classic brick model for soil
- Modified two-surface model for cyclic behaviour of steel
- Menegotto-Pinto, Monti Nut, and Dodd Restreppo plasticity models for reinforcements
- User-supplied models

Analysis functionality

- Linear static
- Fatigue failure
- Linear transient
- Frequency response
- Spectral response
- Physical and geometrical nonlinear
- Transient nonlinear
- Eigenvalue
- Buckling and post buckling
- Steady state and transient heat flow
- Detailed and regional groundwater flow
- Steady state and transient groundwater flow
- Coupled flow-stress
- Phased structural and potential flow
- Hybrid frequency-time domain analysis
- Fluid-structure interaction
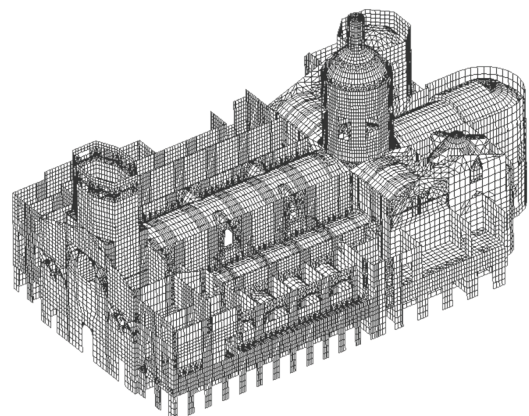- Strength reduction analysis

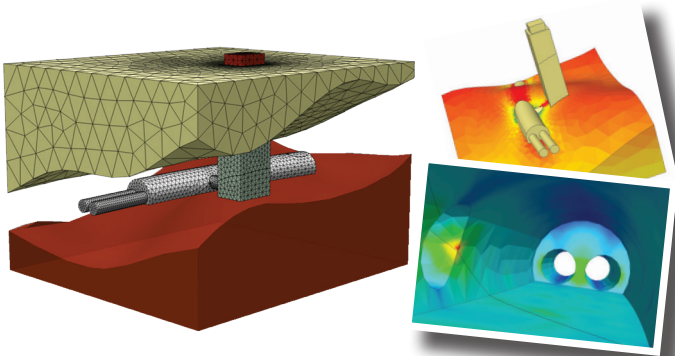- Stiffness adaptation analysis
- Parameter estimation
- Lattice

Element types

- Truss
- Solid
- Contact
- Flow
- Timoshenko, Bernoulli, and Mindlin beam
- Plane stress and plane strain
- Complete plane strain
- Axisymmetric
- Plate bending
- Flat, curved shell and layered shell
- Composed (line/surface)
- Interface
- Discrete spring/dashpot
- Base spring
- Bounding (spring/dashpot)
- Point mass/damping
- Embedded reinforcements
- Embedded pile elements
- Boundary surface elements
- Perfectly Matched Layers (PML)

Preprocessing

- CAD like geometry modelling functionality
- Parasolid built-in tools
- Import CAD/Revit file formats
- Python scripting
- Advanced selection methods
- Advanced geometry modelling
- Boolean operation for solid modelling
- Auto clash detection
- Geometry check and repair tools

- Practical mouse snapping
- Auto-, map- and protrude-mesh methods
- Hybrid mesher
- Mesh manipulation and check functionality
- Loads and boundary conditions applicable both on geometry or mesh
- Function based definition of loads and boundary conditions
- MS-Excel compatible tables

Postprocessing

- Contour and vector plots
- Iso-surface, slice, clipping and partition plot
- Diagram and vector plot
- Results extraction to MS-Excel compatible table
- Screen-shots in different picture formats
- Result animation
- Automatic report generation

Solution procedures

- Newton-Raphson, Quasi-Newton, Linear and Constant stiffness iterative procedures
- Load and displacement control incremental procedures
- Arc length control incremental procedure
- Adaptive load and time increments
- Automatic incremental loading
- Nonlinear equation solvers
- Direct, iterative and eigen solvers with parallel processing
- Automatic substructuring
- Eigenvalue analysis
- Automatic solution method
- Out-of-core direct equation solvers
- Updated and total Lagrange geometrical nonlinear formulation

Why DIANA?

Standard finite element packages can solve only a limited range of conventional engineering problems. Non-conventional engineering problems require advanced modelling and analysis functionality. Examples are: analysis of big structures such as dams; complex non linear material behaviour; stresses induced from extreme loading conditions such as fire, earthquake, explosions, etc; complex models where the structure interacts with soil/fluid. DIANA, with its extensive library of material models and analysis capabilities, offers a solution to those types of analyses in one package next to conventional engineering problems.

Services

Support & training

Successful finite element modelling requires a sound understanding of the background theory with good engineering judgement. We at DIANA FEA BV, together with our partners, are dedicated to provide the highest level of service for DIANA:

- Personalised hotline and email support by highly qualified staff
- Customised training solutions
- Regular training courses
- Extensive technical and theoretical manuals
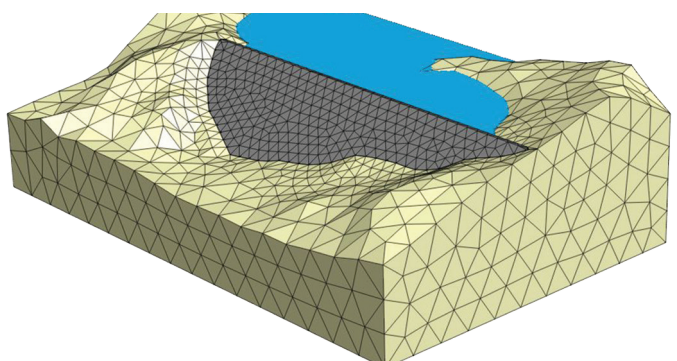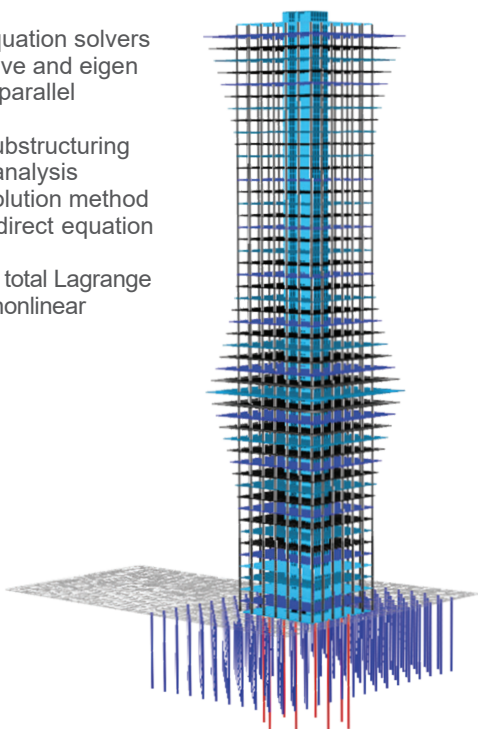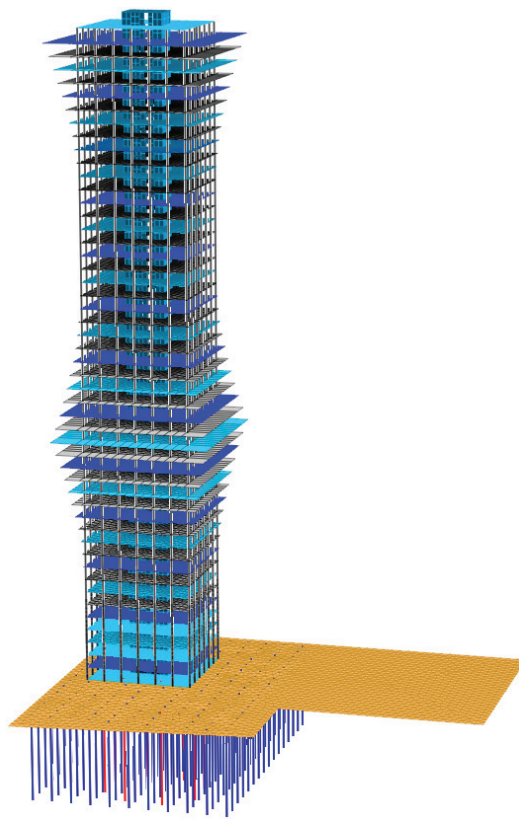- Online training sessions

Analysis consultancy

DIANA FEA BV carries out analysis consultancy projects on behalf of their clients, which includes analysis with DIANA and the interpretation of results

Software services

The DIANA FEA BV software development team and consultants can provide customised solutions for your engineering problems:
- Specialised software with dedicated GUI
- New modelling capabilities development and implementation
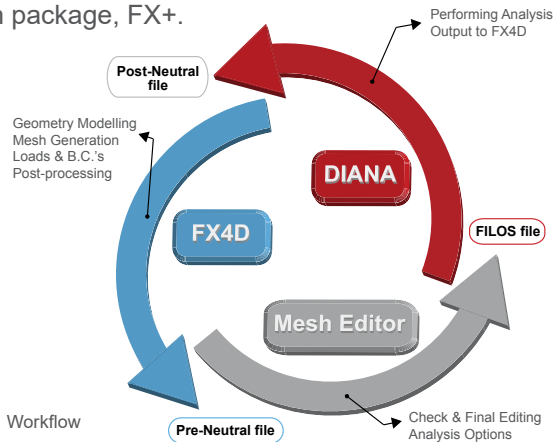- Integration with customer software

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FX+ for DIANA
Pre/Post Processor for DIANA

midas FX+ for DIANA (FX4D) was developed and customised to complement DIANA. The software is based on the general purpose pre/post processor CAE simluation package, FX+.

Performing Analysis
Output to FX4D

Post-Neutral file

Geometry Modelling
Mesh Generation
Loads & B.C.'s
Post-processing

DIANA

FX4D

FILOS file

Mesh Editor

Workflow

Pre-Neutral file

Check & Final Editing
Analysis Options

User Interface

Intuitive graphical user interface

- Windows based and CAD like user interface
- Easy to copy and paste into spreadsheets (MS-Excel)
- Easy access to desired task, command or model data
- Works tree displays geometry, mesh, analysis and result data in a tree structure similar to Windows Explorer
- Property Window provides various information of selected item and allows change of basic properites such as name, colour, material/property parameters, etc.
- MS-Excel compatible tables for nodes, elements, loads, constraints and results.

Various display options

- Shading, transparency, wireframe, bounding box, etc (combination allowed)
- Virtual mesh transformation
- Flying view for walk-through navigation

Advanced selection methods

- Pack/window, circle, polyline, polygon, quick pick, ID, etc.
- Dedicated selection filters for geometry and mesh entities

Geometry Modelling

Advanced features for curve, surface and solid modelling

- Practical curve types: polyline, rectangle, B-spline, tunnel section, etc.
- Non-manifold surface modelling functions: sew, fuse, trim, divide, imprint, etc.
- Various solid primitives: box, cylinder, cone, torus, sphere, etc.
- CAD data exchange: AutoCAD, DWG/DXF, ACIS, parasolid, etc.

CAD-like modelling functions

- Extrude, revolve, loft, sweep, local prism, fillet, chamfer, shell, etc.

Powerful Boolean operation for solid modelling

- Fuse, cut, common, trim and embed

Efficient and robust geometry checking and repairing tools

- Healing: split revolved surface, simplify surface, fix topology, etc.
- Repairing: merge/match/break sub-edges, merge surfaces, etc.

Practical mouse snapping

- Coordinate input by mouse snapping (global and work plane)
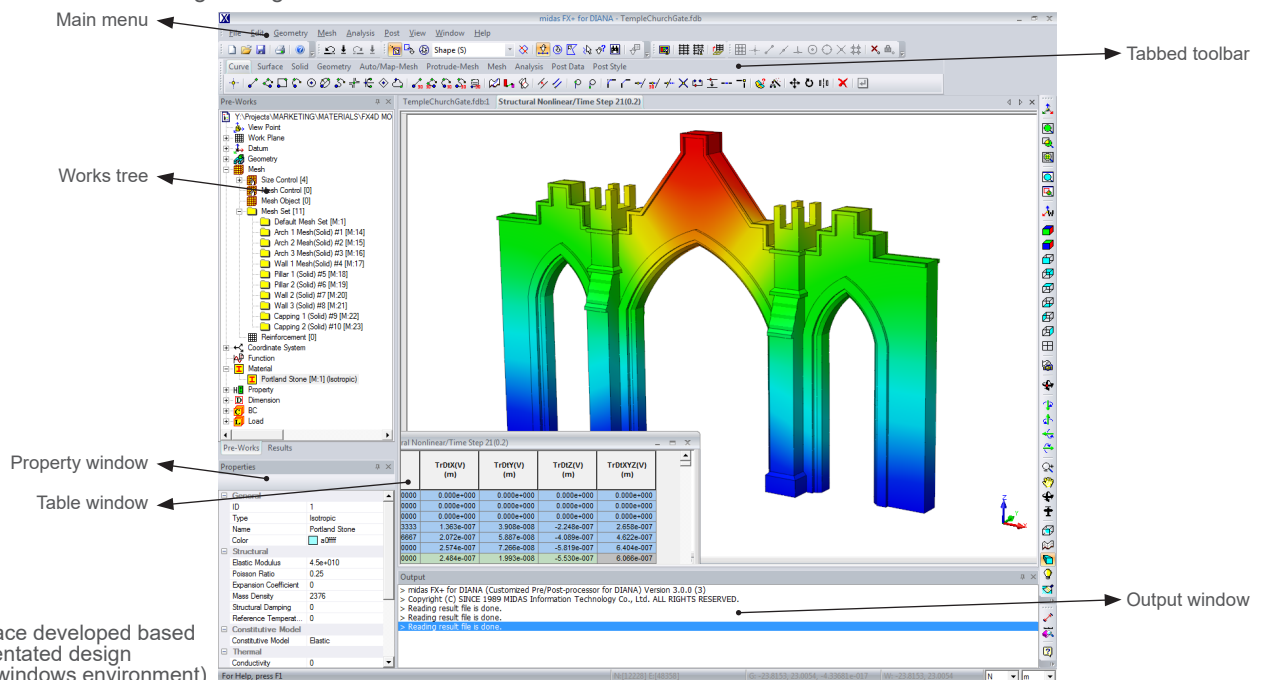- Grid, vertex, end, middle, intersection, centre, quadrant, node, etc.

Main menu

Works tree

Property window

Table window

Tabbed toolbar

Output window

User Interface developed based on task orientated design paradigm (windows environment)

Mesh Generation

- Advanced features for mesh generation
  - Extrude, revolve, fill, sweep, etc.
- Various easy & strong meshing algorithms for 1st and 2nd order elements
  - Surface meshing: looping, Delaunay, grid-based approach and mapping
  - Solid meshing: tetra, full-mapping, combined mapping
  - Both mesh and geometry based mesh generation
- Efficient size control methods
  - Element length, division and biased seeding (length/ratio)
- Easy mesh manipulation
  - Change property, order, normal, local csys., transformation, etc.
- Embedded reinforcement generation
- Automatic DIANA element type selection
- Dedicated element property manager for DIANA elements
 - Categorised property management, copy, import, etc.
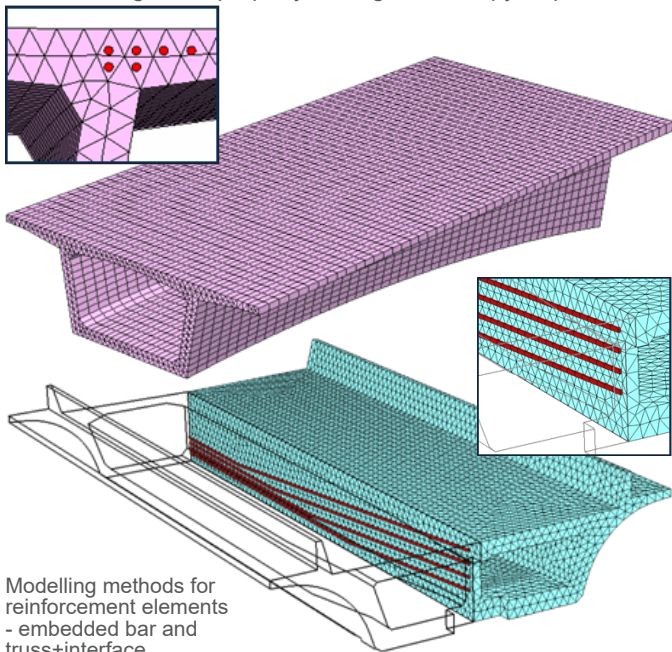
Modelling methods for reinforcement elements - embedded bar and truss+interface

Post Processing

Complete solution to result interpretation

- Flexible user-control on legends, colours, fonts, magnification, etc.
- Multiple plots, graphs and tables in multiple windows
- Deformed shape combined with undeformed shape (including mode shape)
- Local plots defined by geometrical topology or user-selection
- Contour plots and animations (AVI, snap shots)
- Iso-value lines (2D) and surfaces (3D)
- Clipping planes and slice lines/planes
- Partitioned plots
- History plots in various graphs and animations (AVI)
- Results values in MS-Excel compatible tables
- Results probe and extraction

- Result extraction for construction stage analysis and time history analysis
- Screen-shots in WMF, BMP and PNG picture formats
- Works tree, toolbar and property window based operation and manipulation
- File I/O for configuration
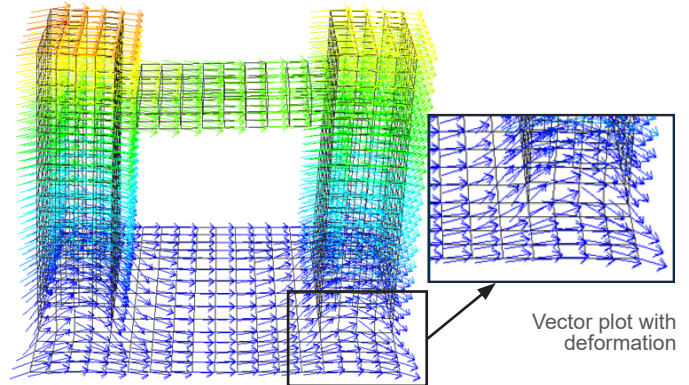
Vector plot with deformation
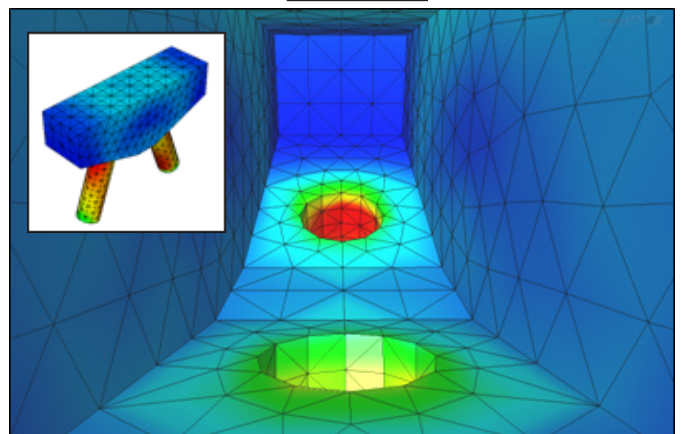
Flying view within gradient contour with mesh

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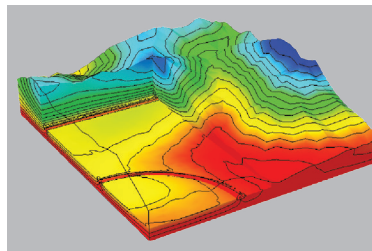- Online training sessions

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