DIANA

SOLUTIONS FOR OIL & GAS

DIANA FEA
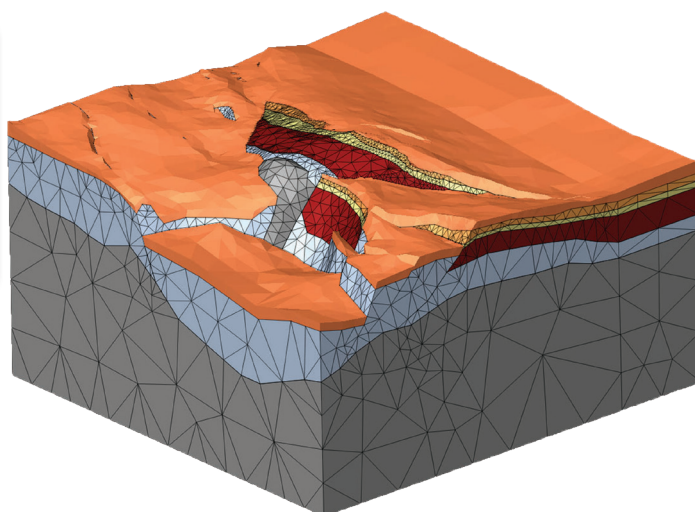a TNO Company

Production of Oil and Gas shifts from easily accessible reservoirs to those which are located at greater depths, or in formations with complex geological history. These come with larger risks and hazards.

Geo-mechanical analysis of Oil & Gas reservoirs or wellbores is one of the specialties of DIANA and is already used by many leading companies in the industry.

DIANA will help to quantify rock-compaction, stress changes, fault slipping in reservoirs, overburden and surface subsidence as result of, and related to production of oil and/or gas. DIANA can also be used on wellbore scale to quantify rock failure, casing deformations and cementing integrity during well completion, or operational conditions such as pressure, or temperature shocks, or fault sliding. Furthermore, the program is structured such that all several different analyses can be performed in one analysis command sequence.

Oil & Gas Specific Features

- Nonlinear material models for fracturing
- Shear-failure
- Creep and crushing of rock and frictional fault modelling
- Automatic meshing procedures for 3D formations starting from geological model data
- Distributed pressure fields and material properties
- Anisotropic material models for up-scaling
- Automatic and user defined solutions procedures for nonlinear problems
- Thermal and flow-stress effects
- Efficient direct and iterative parallel-processing solvers
- Powerful visualisation of models and results

Geo-mechanical Analysis of Reservoirs

Modelling features

- Modelling ground stratification based on borehole data
- Plane strain and 3D meshing procedures for elements with linear and higher order displacement interpolation
- Plane strain and 3D interface elements for modelling sliding faults with frictional properties
- Unstructured and structured mesh generation for 2D models.
- Automatic 3D meshing, inclusive interface element-definition for faults, from geological data represented by triangulate surfaces of horizons and faults
- Definition of materials and pore-pressure loadings as distributed properties

Material models

- Mohr-Coulomb and Drucker-Prager plasticity with and without plastic hardening for shear failure of rock
- Cam-clay and Modified Mohr-Coulomb model for combined shear and compression failure of soft rocks
- Creep
- Hoek-Brown and Jointed rock
- Orthotropic elastic and elasto-plastic
- Total strain and multi-directional crack
- Coulomb friction in interface elements, inclusive fault opening

Analysis features

- Stress initialisation with Ko procedures, inclusive calibration of plastic status of materials to initial stress condition
- Automatic and manual load and time stepping
- Heat-stress analysis
- Staggered and fully coupled flow-stress analysis
- Drained and undrained analysis
- Effective parallel direct and iterative equation solvers
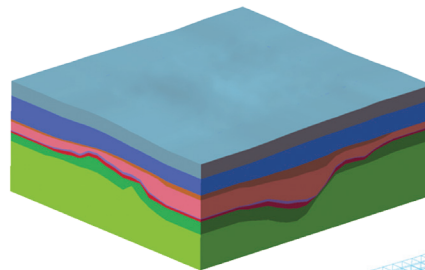
3D geomechanical depletion analysis modelling and results
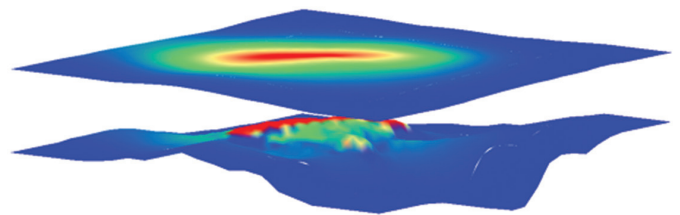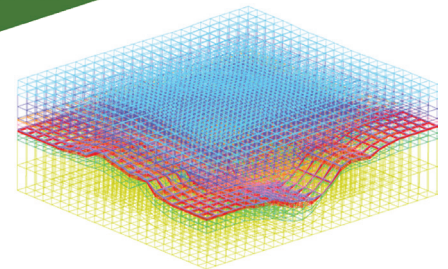
Geo-mechanical Analysis of Wellbores and Borehole Stability

Modelling features

- 2D and 3D meshing procedures
- Wide range of element types, inclusive generalised plane-strain elements

Material models

- Steel plasticity
- Rock material models such as described above for analysis on reservoir scale
- Concrete cracking and shrinkage
- Nonlinear interface models for bonding / debonding of casing and cement
- Viscoelasticity
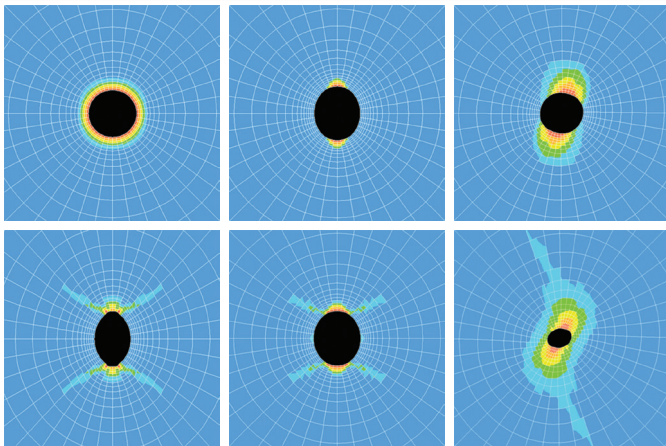
Wellbore stability analysis

Analysis features

- Nonlinear stress analysis predicting integrity and failure of wellbore
- Coupled and staggered heat-stress analysis
- Open hole analysis
- Transient analysis of creep and shrinkage effects

General Product Functionality

Element types

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

- Automatic solver selection
- Out-of-core direct equation solvers
- Nonlinear equation solvers
- Automatic substructuring
- Eigenvalue analysis
- 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 (auto load step option)
- Automatic incremental loading
- Direct, iterative and eigen solvers with parallel processing
- Updated and total Lagrange geometrical nonlinear formulation

Services

Support & training

Successful finite element modelling requires sound understanding of the background theory with good engineering judgment. 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 offers to carry out analysis consultancy projects on behalf of their clients which includes the analysis with DIANA and the interpretation of results

Software services

DIANA FEA BV Consultants and software development team can provide customised solutions for your engineering problems:

- Specialised software with dedicated GUI
- New modelling capabilities development and implementation
- Integration with customer software
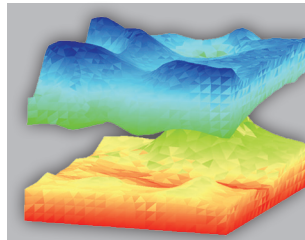
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