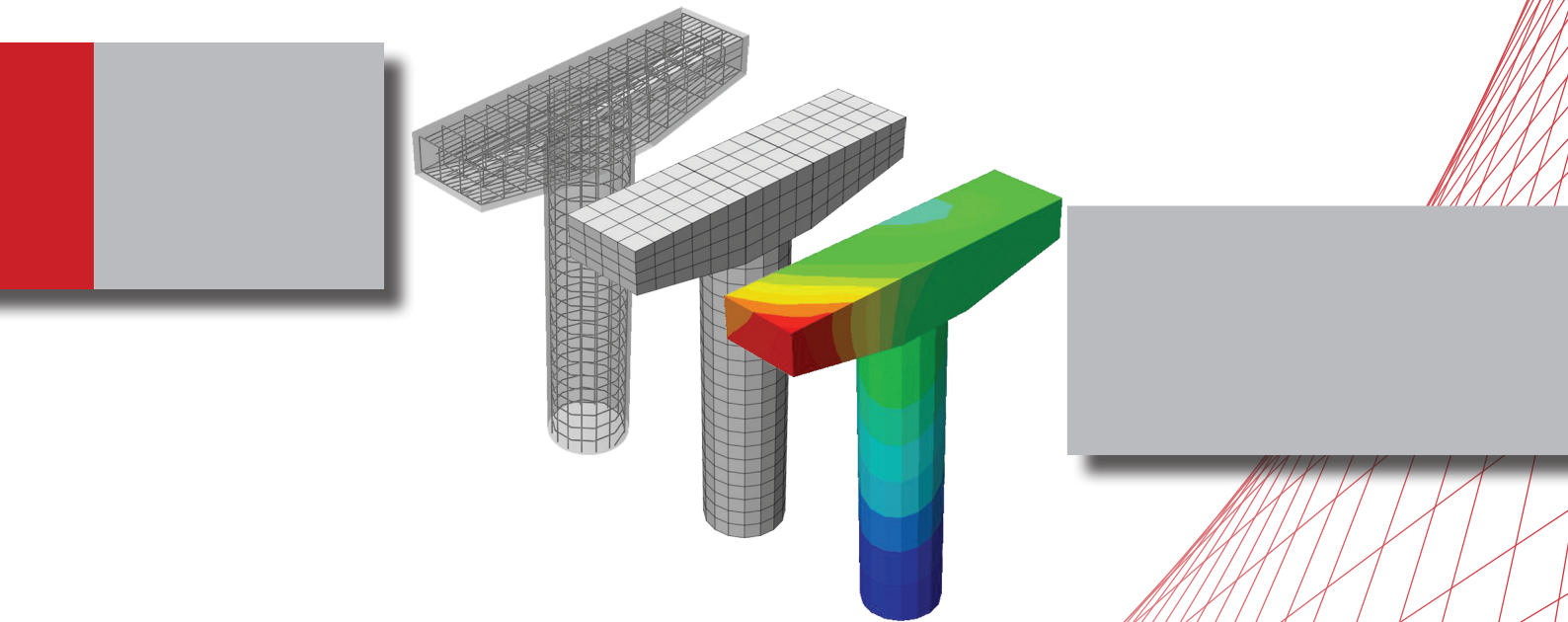


DIANA

SOLUTIONS FOR REINFORCED CONCRETE



DIANA has been used by research organisations worldwide since the 1980's as the numerical platform for implementation of material models which describe failure in reinforced concrete structures. Since then DIANA has gained its reputation as the leading software for crack analysis.

In the second half of the 90's, with the support of the Dutch Ministry of Public Works, further development was made towards a framework that can be used for analysing 3D reinforced concrete structures.

Nowadays, the team continues to work on user friendliness and performance, while DIANA is embraced by both researchers and practitioners alike.

Modelling the damage initiation and propagation until structural failure can be carried out accurately in DIANA by realistically modelling the geometry and the material behaviour of concrete, and individual reinforcement, individually and by defining their complete interconnection.

Furthermore, the wide range of analysis functionality allows modelling of the structure from construction, through service life to failure.

Recently, design check functionalities have also been added to the program as well as a simplified nonlinear approach that is known as "Stiffness Adaption Analysis".

In addition, new features have been added at material level to consider the heterogeneity of concrete as well as introducing fiber materials in order to simulate fiber reinforced material models.

Thus, design and assessment of Service and Ultimate Limit States up to integral failure analysis can be carried out in DIANA using the same program.

Design & Assessment of Service & Ultimate Limit States

Modelling and analysis features

- Full 3D modelling capabilities with beam, shell, plate and solid elements
- Composed elements for automatic integration of stresses in reference lines or planes.
- Automatic connectivity of different element types
- Material definition according to international design codes
- Mobile loads and influence field analysis
- Full range of loads type and history
- Easy definition and handling of load combinations, and scanning over results from different load cases
- Young hardening concrete with associated cooling
- Design checks of reinforcements
- Stiffness adaptation analysis

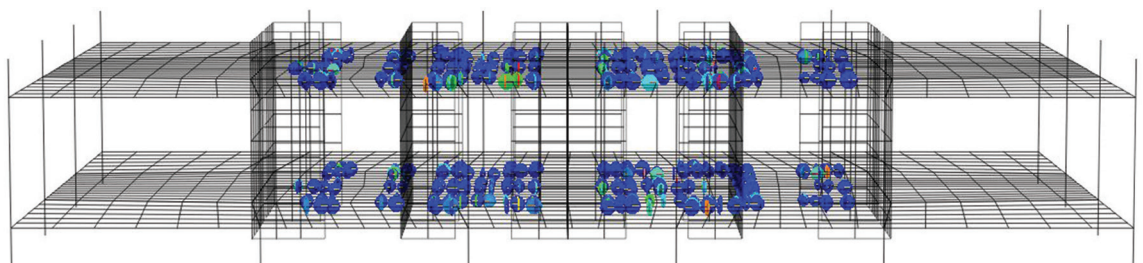
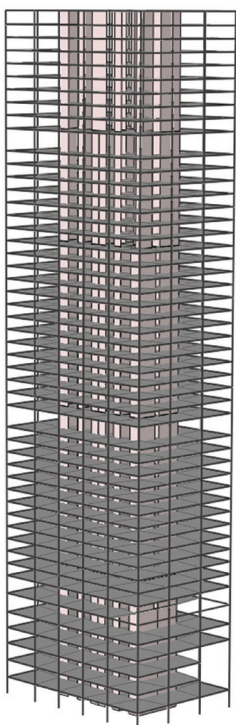
Material models

- Linear elastic anisotropic and orthotropic models
- Nonlinear joints
- Full range of nonlinear material models
- Fiber reinforced material models
- Random field material models

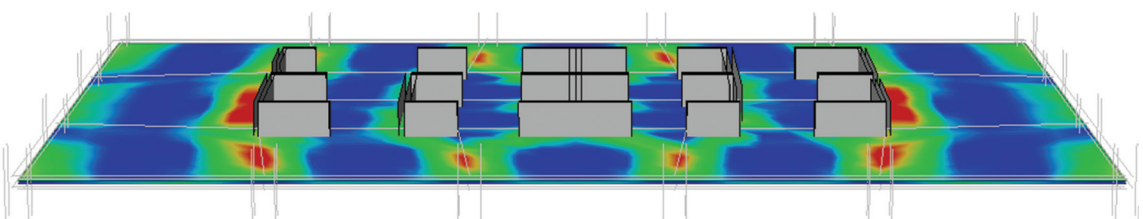
Integral Failure Analysis

Modelling and analysis features

- Embedded reinforcements bars and grids, which can be defined in all element types and independently on the underlying mesh.
- Pre and post tensioning tendons
- Bond-slip between reinforcement and concrete
- Phased analysis for accurate description of load history
- Coupled heat-stress analysis for thermal effects
- Ambient influence on material behaviour
- Dynamic analysis
- Dedicated post-processing of crack patterns



Crack pattern and stress distribution in the reinforcement of a section of a high rise building under earthquake load



Required area of reinforcement per unit length in the horizontal direction

Material models

- Discrete cracking with interface elements
- Smeared crack models with fixed and rotating cracks
- Material aging
- Creep and shrinkage models according to different international design codes
- Elasto-plastic models such as Mohr-Coulomb, Drucker-Prager, Rankine
- Modified Maekawa-Fukuura model for cyclic loading
- Von-Mises plasticity with hardening and hysteretic models for steel reinforcement
- User-supplied materials
- Modified two-surface model for cyclic behaviour of steel
- Menegotto-Pinto, Monti Nuti, and Dodd Restrepo plasticity models for reinforcements

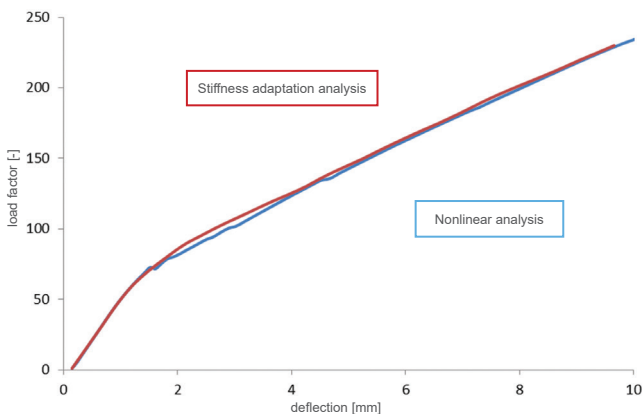
General Product Functionality

Element types

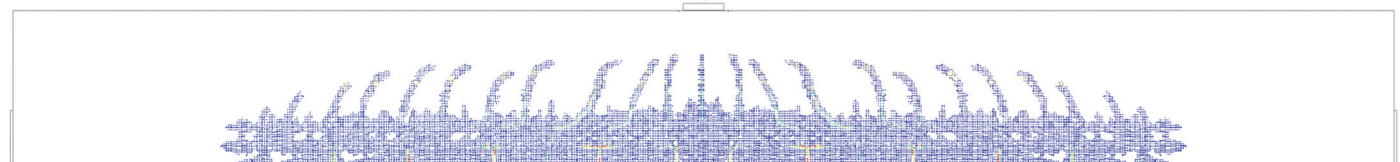
- Truss
- Timoshenko, Bernoulli, and Mindlin beam
- Plane stress, plane strain and axisymmetric
- Complete/general plane strain
- Plate bending, flat, curved and layered shells
- Solid, composed (line/surface), interface and contact
- Discrete spring/dashpot
- Base spring and bounding
- Point mass/damping
- Embedded reinforcements
- Flow
- Embedded pile
- Boundary surface
- Perfectly Matched Layers (PML)

Preprocessing

- CAD like geometry modelling functionality
- Parasolid built-in tools
- Python scripting
- Advanced selection methods
- Advanced geometry modelling
- Boolean operation for solid modelling



Load-deflection curves for a beam under a point load



Crack strain in stiffness adaptation analysis at load factor 240

- 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 boundaries applicable both on geometry or mesh
- Function based definition of loads and boundary conditions
- MS-Excel compatible tables

Postprocessing

- Contour and vector plots, plus diagram and vector plot
- Iso-surface, slice, clipping and partition 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 solver selection
- Out-of-core direct equation solvers
- Updated and total Lagrange geometrical nonlinear formulation

Services

Support & training

Successful finite element modelling requires a 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 / email support by highly qualified staff
- Customised training solutions
- Regular training courses
- Extensive technical and theoretical manuals
- Online training sessions

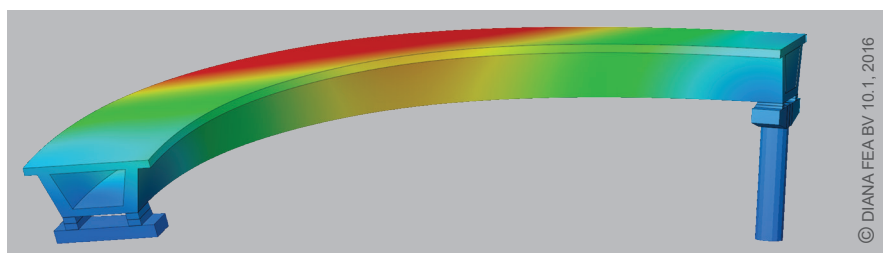
Analysis consultancy

DIANA FEA BV can execute analysis consultancy projects on behalf of their clients which includes 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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