Červenka Consulting s.r.o.
Na Hrebenkach 55, 150 00 Prague 5
Czech Republic, phone: +420 220 610 018
e-mail: cervenka@cervenka.cz, web: www.cervenka.cz

ATENA 2023 – Technical Specifications

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Material Models

- 3D fracture-plastic concrete model based on Menetrey-Willam law: smeared cracks, fracture-energy based softening, Compression Field Theory, aggregate interlock in shear, non-associated plasticity, unloading direction, user defined functions, variable parameters, fiber-reinforced concrete FRC, UHPFRC, SHCC, ECC
- 2D SBETA concrete model, also for high strength and SFRC: smeared cracks, crack-band, fracture-energy-based softening, Kupfer's compressive failure, variable shear retention, strength reduction of cracked concrete.
- Reinforcement bi-linear and multi-linear. Reinforcement with bond. Cyclic reinforcement (Menegotto-Pinto / Bauschinger effect) and bond.
- Von Mises plasticity for metals.
- Drucker-Prager plasticity with associated / non-associated flow rule for rock and soil.
- Bazant M7 Microplane concrete.
- Interface with Mohr-Coulomb material law.
- Isotropic elastic.
- Non-linear springs.
- Temperature dependent material properties (Fire loading).
- Creep and shrinkage (Bazant B4, Eurocode, ACI, fib model code 2010).
- Heat and moisture transport, hydration heat model CERHYD.
- Fatigue of concrete in tension.
- User-defined material model (user-compiled DLL in C/C++ or FORTRAN).

Loading

- Load cases: body forces, loading forces, supports, prescribed deformations, temperature, shrinkage, prestressing.
- Load steps: combination of load cases, solution methods.
- Arbitrary load history in steps, non-proportional, cyclic, dynamic.
- Construction process.
- Simulation of 3D concrete printing.
- Chloride/Carbonation boundary conditions for reinforcement corrosion modelling.
- Alkali aggregate silica reaction loading for durability modelling

Finite Elements

- 2D isoparametric elements, quadrilateral, triangular, axisymmetrical elements.
- 3D solid elements: tetrahedron, brick, wedge; low- and high-order. Shells (layered) and beams (fiber).
- 1D fiber beam elements and 2D layered shell/plate elements.
- Truss elements for reinforcement, external cable elements.
- Spring supports – point, line, surface.
- Interface elements, 2D and 3D.

Solution Methods

- Direct band (skyline), PARDISO and sparse iterative equation system solvers; eigenvalues.
- Newton-Raphson, modified Newton-Raphson, arc-length; line-search.
- Tangential and elastic stiffness predictors.
- Newmark and Hughes Alpha for dynamics.
- 64 bit solution core.

Graphical User Environment

- 2D/3D ATENA Eng. Pre. Graphical user environment for model definition for ATENA Engineering: pre-processing, geometrical modeling, reinforcement (bars, smeared), automatic meshing, material properties, loading and supports, solution methods, monitoring.
- ATENA Studio. Graphical user interface for both ATENA Engineering and Science for run-time control and post-processing of both 2D and 3D models, post-processing (iso-lines, iso-areas, rendering, vectors, tensors, cracks, response diagrams, cuts/sections, user-defined numerical output).
- GiD interface (GiD - general FE pre- and post-processor from CIMNE, Spain) with interface to ATENA is a necessary product for ATENA Science.

System Requirements

Minimum: PC with MS Windows 10, 2 GB RAM memory and 500GB HDD/SSD, graphics card with OpenGL 1.1 and 1024x768 resolution. GiD 9 or later (for ATENA Sci/Full).

Recommended: PC with MS Windows 11, 32 GB RAM memory, 4 TB hard disk, discrete graphics card with resolution of 1920x1080 and OpenGL 1.4 with 3D hw-acceleration, designed for CAD (e.g., nVidia FX, ATI FireGL/FirePro). GiD 64bit 16 or later (for ATENA Sci/Full).