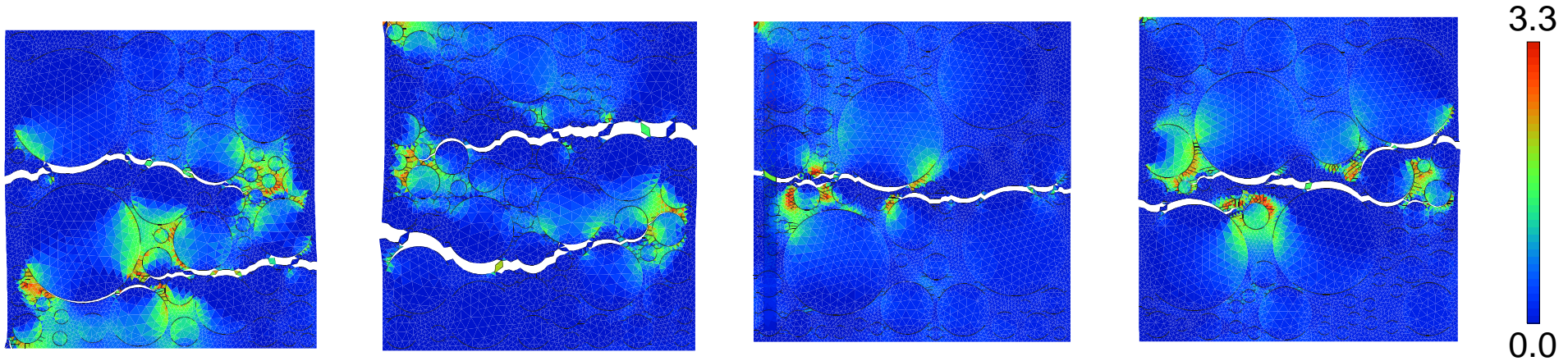


COMPUTATIONAL MECHANICS



Bert Sluys
Chair Computational Mechanics

Applied Mechanics section
Department Materials, Mechanics, Management & Design (3MD)
Faculty of Civil Engineering and Geosciences, TU Delft

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Mainly within Structural Mechanics specialization:

- Dynamics courses
- Structural element courses (beams, plates, shells)
- **Computational mechanics courses**

Preferred sequence for computational mechanics "package":

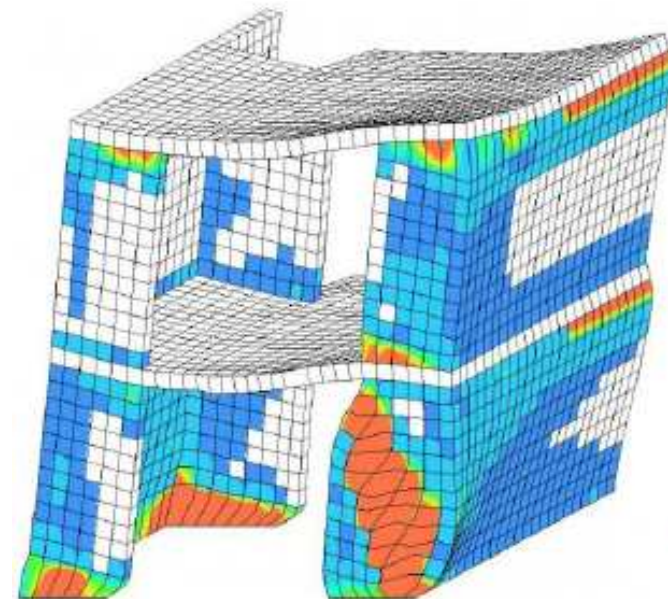
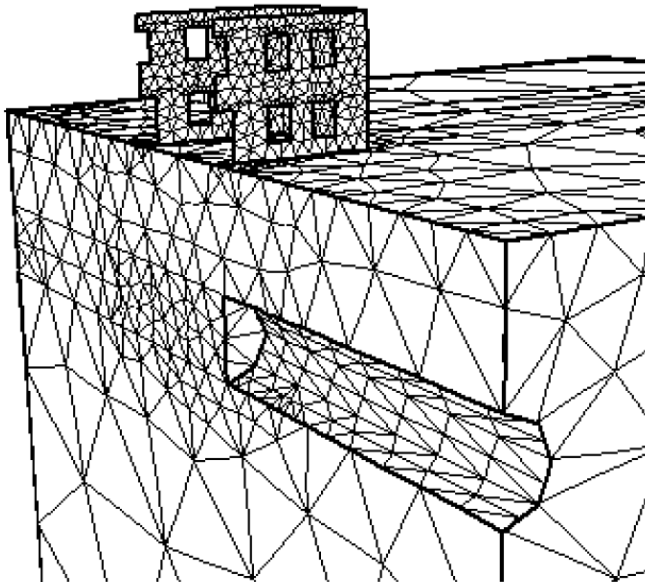
- Analysis of slender structures (CIE4190, Q1, 4 ECTS)
- Introduction to the Finite Element Method (CIE5123, Q3, 4 ECTS)
- Computational methods in nonlinear solid mechanics (CIE5142, Q4, 3 ECTS)
- Computational modelling of structures (CIE5148, Q1/Q5, 4 ECTS)

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Introduction to the Finite Element Method (CIE5123)

We will teach you:

- background mathematics/mechanics
- FEM solution procedures
- simple FEM programming, insight in structure FEM code
- modelling with FEM
- how to interpret FEM results

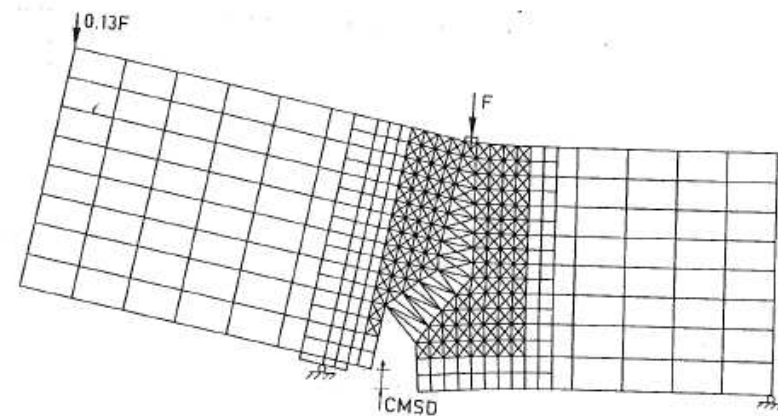
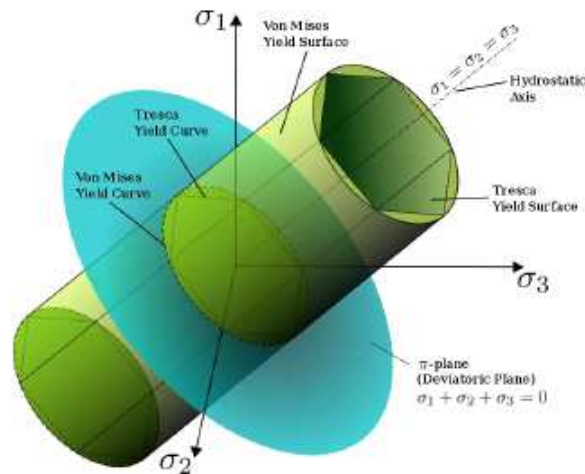


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Computational methods in nonlinear solid mechanics (CIE5142)

We will teach you:

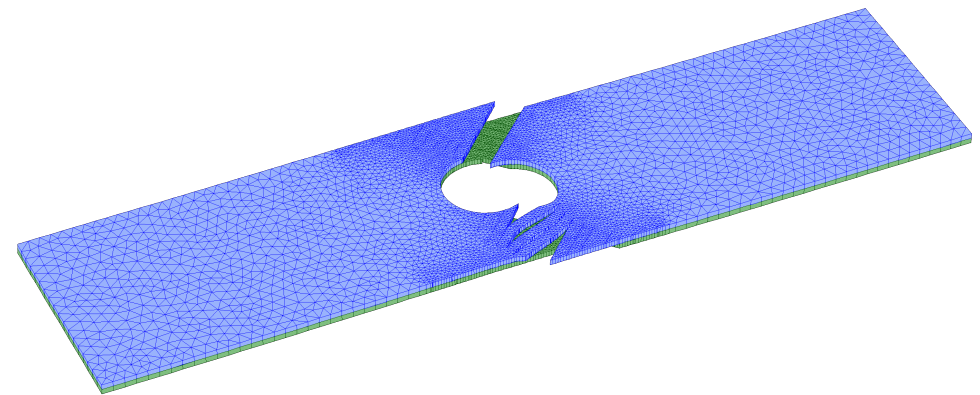
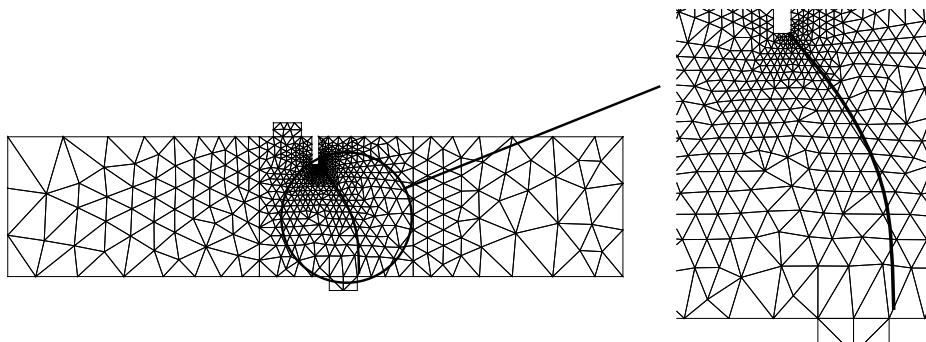
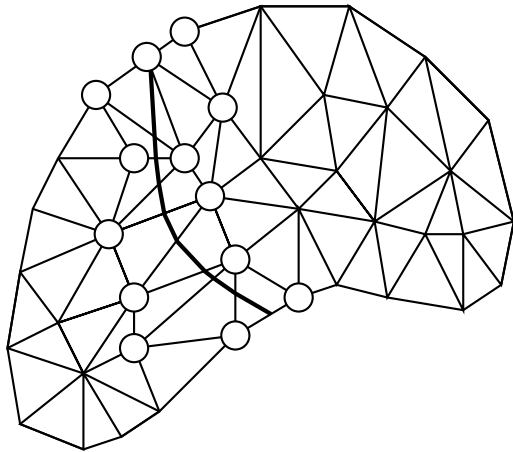
- difference in material and geometrical nonlinearities
- nonlinear solution techniques (Newton-Raphson procedures)
- nonlinear constitutive modelling (plasticity, damage, fracture)
- simple nonlinear FEM programming, structure of nonlinear FEM code
- issues as bifurcation, stability, convergence, mesh sensitivity etc.



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Computational methods in nonlinear solid mechanics (CIE5142)

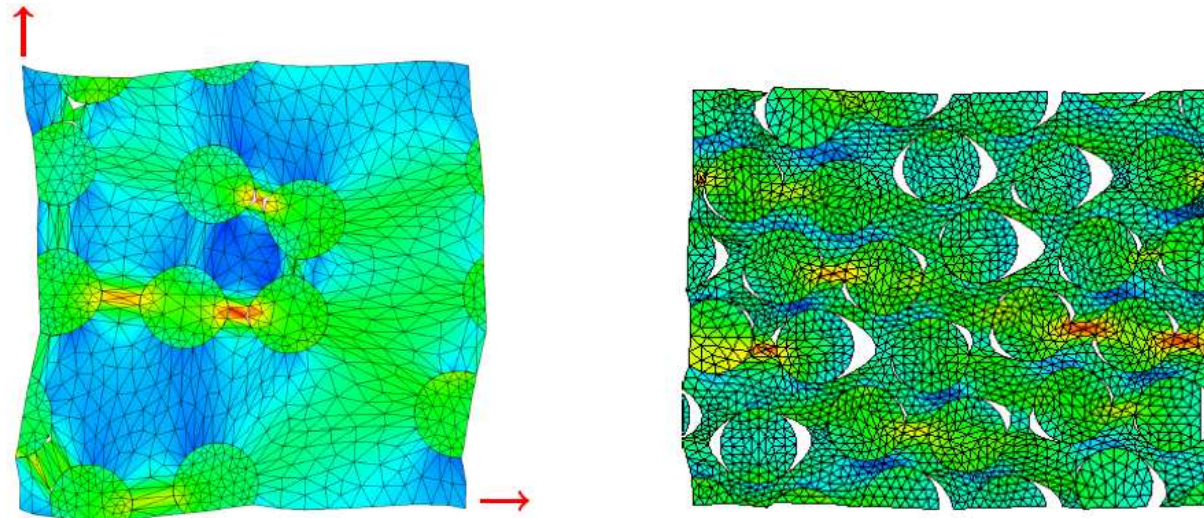
- Novel/robust FE-techniques (XFEM) for **arbitrary** crack propagation (left) and **multiple/competing** fracture mechanisms in composites (right)



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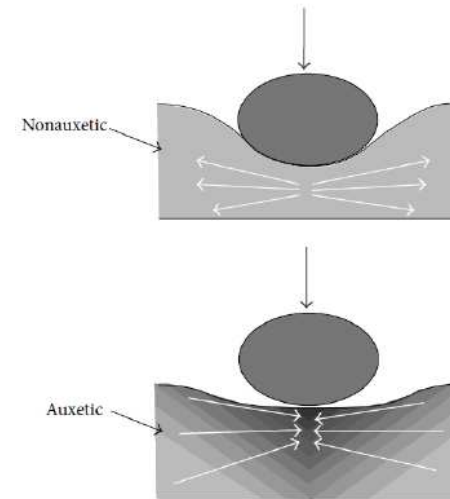
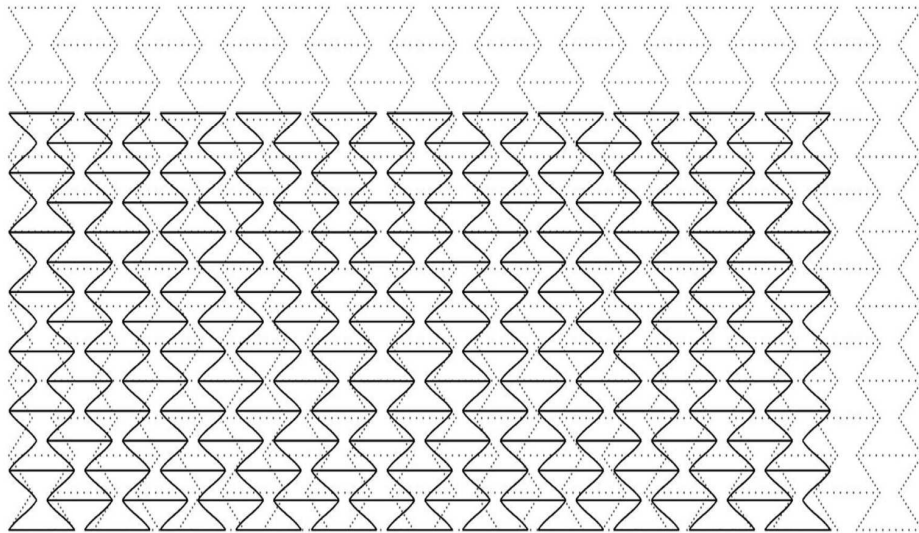
Recent MSc-projects in Computational Mechanics group:

- Numerical modelling of cone cracking in ceramics via indentation
- The Virtual Element Method - Applications to linear and gradient elasticity
- FE analysis to assess the protective capabilities of helmets against blast loads
- FE and BE modelling of geothermal structures
- FE modelling of fiber reinforced composites
- Numerical framework for ageing and fatigue in laminated composites



COMPUTATIONAL MECHANICS

Ongoing challenging MSc-project(s) on metamaterials



- So-called auxetic material with a negative Poisson's ratio
- Materials demonstrate increased indentation resistance and shear stiffness
- Beautiful!! But, what about strength and durability properties....

COMPUTATIONAL MECHANICS

Ongoing challenging MSc-project(s) on geothermal energy/energy piles



- Provide geothermal heating to buildings
- FEM/BEM modelling of mechanical behaviour and heat flow in shallow geothermal systems
- Optimize geothermal systems w.r.t. efficiency (reduce energy loss)