Recent Diana-applications in Master- and PhD-studies at NTNU

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At NTNU, Diana is used by regular students who choose to spend their last year on in-depth concrete mechanics, which is quite popular. PhD-students, with a project related to analysis of concrete structures, have for more than 15 years been using Diana, for applications as well as for implementation of new algorithms. In essence, there are about 10-15 regular students, yearly, being involved with Diana-type project works and diplomaes and about 2-4 PhD students. The current presentation concerns three typical diploma-works, which were performed last year, and two ongoing PhD-studies.

Large openings in Concrete Beams – Design considerations (Diploma-Brikselli). In quite many cases, prestressed beams need to have openings due to technical installations like venting pipes, wiring etc. Such perforations require special reinforcement layout in order to ensure sufficient shear capacity in the web. The design calls for nonlinear analysis as a mean to study alternatives and find optimal solutions.

Static analysis of Nidarosdomen Cathedral (Diploma-Lo Kam Chuen)
Restoration works have revealed cracks, with considerable openings, in soapstone arches. The cracking could not be explained by either differential settlements or structural failure due to material strength. More likely, the reason could be volumetric expansion caused by chemical reactions in the stone. A phenomenon like this was simulated by means of nonlinear material modelling in combination with temperature expansion.

Nonlinear analysis of Risnes bridge (Diploma-Nateid)
One of the first concrete cantilever bridges built in Norway. The loadcarrying capacity relies completely on posttensioned cables, rock-anchored at the abuttments. Deterioration, particularly of the reinforcement cables, would therefore reqiure either strengthening or rebuilding the bridge. Nonlinear analyses, accounting especially for cable shape and geometry at local joints, have been carried out, in order to study stress distribution and stress level in reinforcement as well as in concrete sections.

Structural modelling of masonry - Coupling FEM-DEM (PhD-Hamed)
Structural failure mechanisms of masonry involve large deformations, translations and rotations of brick stones. The FEM was originally developed for material continuity, however the formulation has been extended to account also for discontinuities by means of contact- and interface elements. The Distinct Element Method (DEM), on the other hand, was developed for rock-mechanic purposes, and focus on the mechanical behaviour between linear elastic elements of different shapes, in motion. The study aims at coupling Diana and Udec: Diana for the global parts, not subjected to failure and Udec for the local simulation of masonry failure.

*Modeling of steel-lightweight concrete composite*s (PhD-Nedrelid)
This includes different approaches for modeling the interface between steel and concrete, in addition to find a proper material model for describing the triaxial behaviour of lightweight concrete with aggregate as the limiting constituent for the strength.