Dynamic structural capacity of reinforced concrete slabs due to rockfall (AGB2006/017)

Dynamische Tragfähigkeit von Stahlbetonplatten bei Steinschlag (AGB2006/017)

Funding: National (Switzerland)
Duration: Aug 2007 - Dec 2015
Status: Complete

Background & policy context:

Falling weight tests at the Lochezen stone pit in Walenstadt with boulders from 825 to 4125 kg on reinforced concrete slabs measuring 3.5 x 4.5 m and heights of fall up to 15 m will give results on the influence of the cushion material, the slab stiffness and the impact dynamic. Providing different slab depths and reinforcement schemes shall provoke not only failures in bending but also in punching.

Modelling based on the test results will be based on mass-spring models (multiple-degree of freedom systems) and finite elements. Damping of the impact by the cushion layer, load extension in the cushion, propagation of the compression wave in the slab, cracking of concrete, yielding and subsequent tension stiffening of the reinforcement, concrete crushing and reinforcement breaking, and the strain-rate dependency of material strength will be simulated.

A better knowledge on the ongoing processes will allow for developing simplified design procedures for the hazard scenario “rockfall”. In the ideal case equivalent static forces can be determined, otherwise mass spring models will be used. In any case the scientific background for the revision of the actual guidelines for protection galleries of the Swiss Federal Railways and the Swiss Federal Road Office will be provided.

Objectives:

The scientific goal is to model as accurate as possible the dynamic behaviour of reinforced concrete slabs subject to rockfall. Not only the damping properties of the cushion layers, but also those of the structure shall be taken into account more precisely.

Together with failure loads also failure modes are relevant, because the consequences of a failure differ depending on the kind of failure.

Based on a deeper knowledge of the influence of the different parameters, simplified design rules that are suitable for practical application shall be developed. Like this in assessments the structural capacity of existing rockfall protection galleries (rock-sheds) can better be evaluated and in design of new galleries restricted financial measures can be allocated optimally.

Methodology:

Following steps will be done during the project:

- Mass-spring models,
- Numerical solution of coupled motion differential equations
- Finite Element programs,
- ABAQUS / Explicit or other

Parent Programmes:
ARAMIS - ARAMIS information system

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