DUCTILITY OF CONFINED CONCRETE

Are structural engineers designing concrete structures with greater capacity and safety than they realize? By exploring effects of confinement in order to incorporate them in usual design procedures of engineering consulting companies, concrete structures will possibly in the future be both stronger, thinner and have a greater ability to deform prior to failure – three properties that are highly desirable to exploit in practical designs.

One of the main tasks of a structural engineer is to estimate the variation of loads on structures over time, and subsequently to design structures with sufficient capacity to carry the load, based on knowledge of the material strengths.

As a result of the favourable compressive strength, concrete is often chosen as a central material in bearing constructions. However, concrete never stands alone - looking within concrete structures, one will always find reinforcement. This is steel rods, which mainly are added to strengthen the concrete structure in tension.

Unutilized additional effects of reinforcement in concrete

The reinforcement is, however, not only strengthening the concrete in tension – it is also known to increase the compressive strength of concrete and to significantly improve the ability of the structure to deform prior to failure. These improving effects of the reinforcement to the concrete structures are referred to as passive confinement effect – and are presently not considered in design procedures.

One can picture the passive confinement effect as active confinement, where an external compressive stress actively supports a concrete column on the outside. In this case, it seems logical to imagine that the concrete

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column is stronger than the case without lateral support.

Mathematical models of active confinement already exist. The main issue is thus to translate the actual reinforcement design into an equivalent external stress, thus enabling the use of existing active confinement models.

Theoretical and experimental study

The aim of the project is, thus, to relate the passive and active confinement to fully understand the confining effects the reinforcing arrangement has on the concrete member. Thereby we will be able to establish the improving effects of passive confinement on real structures.

The first step will be to study the physical behaviour of the confining effect through a theoretical understanding on a micromechanical level. The knowledge of the behaviour on a micromechanical level will be compared to the already existing models, which describe the effect of external confining pressure.

The principal approach to the project will be based on analytical modelling. However, experimental studies will as well be essential in verifying any theoretical model and to conduct parametric studies on the topic.

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