Special Column on *Shear Failure Test and Analysis of Concrete Structures*

Shear resistance capacity analysis is a traditional bottleneck problem for the analysis and design of reinforced concrete structures. Along with the use of high performance materials and the geometrical layout optimization of concrete, rebars and other additives, the performance of reinforced concrete components and structures are continuously improved. The testing, modelling and analyzing research works are continuously conducted for the accurate computation and conservative design of the improved concrete components and structures. This special column discusses: the new schemes and instruments for the shear or shear-dominated failure tests; new observations of the monotonic or cyclic shear or shear-dominated failure modes of concrete components with new formula or new shape; new explanation of shear or shear-dominated failure mechanisms and resistance analysis models; numerical analysis results based on new elemental or constitutive models; recent recommendations and formulas for the more economic and reliable design. The following five contributions accepted in this issue address the different aspects of this topic and show the diversity of the researches on shear capacity test and analysis of concrete components.

The first paper by Xu *et al.* puts its focus on the investigation of the influence of web horizontal reinforcement on the shear behaviour of RC beams. They conducted a series of test on eleven RC beams and observed the crack patterns and failure modes of those test specimens. Based on the obtained shear capacity curves and their analysis, they found that: web horizontal reinforcement carries the axial tension force induced by shear force across the cross section; combination of web horizontal reinforcements and stirrups will delay the occurrence of critical diagonal cracks and increase the shear capacity. Therefore, the authors recommend the influence of web horizontal reinforcement to be considered in design codes.

Marí *et al.* investigated the shear strength of slender RC elements subjected to point or distributed transverse loads. They presented a mechanical model and the related design-oriented expressions for the shear strength assessment. Some key points of the model are: the shear transferred by the concrete compression chord is linearly dependent on the relative flexural neutral axis depth; the concrete chord contribution of

beams with uniformly distributed loads can be considered equal to that obtained in the case of point loads. The researchers verified the expressions using the experimental results from the ACI-DAfStb databases. The presented application example is very detailed, which makes the paper a good reference for young researchers.

Schutte and Sigrist studied the force transfer from the webs of T-beams into the flanges based on the generalized stress field approach. The shear stress distribution expressions in the flange are derived, compared with Eurocode, and calibrated using some test results. Although no concluding findings are attained as the number of sufficiently documented tests is limited, some recommendations are offered at the end of the paper for the application of the proposed method.

Witarto *et al.* presents an experimental study on shear-critical RC columns under cyclic loads with various loading rates. Four typical short columns were tested and the horizontal force-displacement envelope curves are measured. The obtained curves show that the ultimate force and stiffness patterns are almost the same for those columns under different loading rates up to 5 Hz. Further numerical simulation study in OpenSees presents the similar global cyclic force-displacement curve as that obtained from the experimental tests. This justified the combined use of the Fiber Beam-Column elements for simulating the bending behaviour of the column and the Quadrilateral PlaneStress elements; furthermore, the shear resistance is found to be sufficiently accurate for the prediction of cyclic behaviour of short RC columns.

The final paper by Labib *et al.* presents a set of tests to study the ultimate shear strength of slender prestressed concrete (PC) I-girders and the shear concrete contributions along with the increase of concrete strength. Different ultimate shear strength prediction formulas were computed and compared with the experimental test data. The study shows that the ACI-318 (2011) code provisions are overly conservative and the AASHTO LRFD (2010) code is unsafe for the ultimate shear strength assessment of PC beams using high strength concrete. The UH-Method seems to be the most promising one for the prediction of ultimate shear strength of PC girders with high strength concrete.

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