Summary and conclusions of the discussions in Task Group E (Seismic Design, Shear and Torsion)

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The beneficial effects of using HPFRCC materials in structural members that experience high shear forces have been experimentally verified in numerous investigations. These effects are particularly advantageous in seismic resistant structures, which undergo relatively large shear reversals under seismic excitation. It has been demonstrated that the substitution of concrete with HPFRCC at locations of the structure with high deformation demands leads to a significant qualitative improvement of their structural behavior. The improvements are characterized by a reduction in required steel reinforcement to resist shear forces, a confinement effect of the HPFRCC at large deformation levels, as well as high damage tolerance.

The discussions in Task Group E on the topic of Seismic Design, Shear and Torsion identified shear as the governing mechanism for these types of loading. While the ultimate goal of the activities in Task Group E is to develop a seismic design methodology for structural members using HPFRCC including shear design, the subsequent discussion focused on the response of HPFRCC to shear.

The establishment of a relationship between HPFRCC material characteristics and the design for a specified performance of a structural application requires definition of the expected performance level and the acceptable damage of the structure. It was agreed upon that a distinction could be made in the level of complexity to determine the shear loading capacity compared to the shear load-deformation response of an HPFRCC structural member. Both objectives, however, require the incorporation of HPFRCC material properties such as the tensile stress-strain behavior and the shear stress-strain behavior as a function of the imposed tensile strain. Furthermore, a reduction in compressive strength at increasing transverse tensile strains must to be considered in the analysis and design of shear critical structural members.

The determination of the appropriate material response mechanism for shear was identified as the most immediate challenge. The potential mechanisms include the tensile stress-strain response and the shear sliding of tensile cracks in HPFRCC under combined tensile and shear deformations.

In summary, future research tasks were identified as the shear resistance mechanism of structural members with HPFRCC, the influence of HPFRCC properties on the shear force-deformation response of structural members, and the shear sliding resistance as s function of tensile strain and tensile crack opening. On the materials level, experimental investigations of the shear sliding mechanism will be conducted to aid the development of analytical and numerical models of HPFRCC under shear loading. These models are critical in the design and prediction of shear critical structural members constructed with HPFRCC materials.