Structural Characteristics of HPDSP Concrete on Beam Column Joints

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Abstract : Inadequate transverse reinforcement is considered as the main reason for the beam column joint shear failure observed during recent earthquakes. DSP matrix consists of cement and high content of micro-silica with low water to cement ratio while the aggregates are graded quartz sand. The use of reinforcing fibres leads not only to the increase of tensile/bending strength and specific fracture energy, but also to reduction of brittleness and, consequently, to production of non-explosive ruptures. Besides, fibre-reinforced materials are more homogeneous and less sensitive to small defects and flaws. Recent works on the freeze-thaw durability (also in the presence of de-icing salts) of fibre-reinforced DSP confirm the excellent behaviour in the expected long term service life.DSP materials, including fibre-reinforced DSP and CRC (Compact Reinforced Composites) are obtained by using high quantities of super plasticizers and high volumes of micro-silica. Steel fibres with high tensile yield strength of smaller diameter and short length in different fibre volume percentage and aspect ratio tilized to improve the performance by reducing the brittleness of matrix material. In the case of High Performance Densified Small Particle Concrete (HPDSPC), concrete is dense at the micro-structure level, tensile strain would be much higher than that of the conventional SFRC, SIFCON & SIMCON. Beam-column sub-assemblages used as moment resisting constructed using HPDSPC in the joint region with varying quantities of steel fibres, fibre aspect ratio and fibre orientation in the critical section. These HPDSPC in the joint region sub-assemblages tested under cyclic/earthquake loading. Besides loading measurements, frame displacements, diagonal joint strain and rebar strain adjacent to the joint will also be measured to investigate stress-strain behaviour, load deformation characteristics, joint shear strength, failure mechanism, ductility associated parameters, stiffness and energy dissipated parameters of the beam column sub-assemblages also evaluated. Finally a design procedure for the optimum design of HPDSPC corresponding to moment, shear forces and axial forces for the reinforced concrete beam-column joint sub-assemblage proposed. The fact that the implementation of material brittleness measure in the design of RC structures can improve structural reliability by providing uniform safety margins over a wide range of structural sizes and material compositions well recognized in the structural design and research. This lead to the development of high performance concrete for the optimized combination of various structural ratios in concrete for the optimized combination of various structural properties. The structural applications of HPDSPC, because of extremely high strength, will reduce dead load significantly as compared to normal weight concrete thereby offering substantial cost saving and by providing improved seismic response, longer spans, and thinner sections, less reinforcing steel and lower foundation cost. These cost effective parameters will make this material more versatile for use in various structural applications like beam-column joints in industries, airports, parking areas, docks, harbours, and also containers for hazardous material, safety boxes and mould & tools for polymer composites and metals.

Keywords : high performance densified small particle concrete (HPDSPC), steel fibre reinforced concrete (SFRC), slurry infiltrated concrete (SIFCON), Slurry infiltrated mat concrete (SIMCON)
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