## ABSTRACT

Studies on the bond behaviour of deformed steel rebars in conventional concrete have been widely covered. However, the studies on the bond behaviour between deformed steel rebars and high-strength self-compacting concrete (HSSCC), particularly with the addition of steel fibres, are still very limited. Hence, in this research, an in-depth study was conducted to investigate the effects of steel fibres on the bond behaviour of deformed steel rebars embedded in steel fibre high-strength self-compacting concrete (SFHSSCC). Experimental works were carried out in two phases. Phase 1 involved the design of concrete mixes and the testing of fresh and mechanical properties of the normal vibrated concrete (NVC), HSSCC and SFHSSCC. The steel fibres used in SFHSSCC were the hooked-end type with 35 mm length and an aspect ratio of 63.6. The research works in Phase 2 involved the direct pullout testing conducted according to the RILEM RC6 Part 2 standard. A total of 72 pullout specimens with a dimension of 200 mm x 200 mm x 200 mm were prepared and tested at 30 ± 2 days. A few of SFHSSCC specimens were tested at the 6 months of concrete age. The pullout specimens comprised high yield deformed steel rebars of 12, 16, and 20 mm diameters. The pullout specimens were subjected to increasing axial pullout load. The test results in Phase 1 showed the proposed design mix of self-compacting concrete managed to achieve high compressive strength of 60-80 N/mm$^2$. As compared to HSSCC, the concrete compressive strength of SFHSSCC had increased slightly, but the splitting tensile strength had increased tremendously. The results showed that SFHSSCC with 1.0% of steel fibre volume fraction was the best mix that satisfy the self-compacting and harden concrete requirements and therefore was selected for further study in Phase 2. The test results of Phase 2 showed that the effect of steel fibres in increasing bond strength between rebar and the high-strength self-compacting concrete is seen to be insignificant as the results of bond strength of rebars in HSSCC and SFHSSCC concrete showed small differences only. However, the addition of steel fibres in SFHSSCC had improved the concrete ductility very significantly. At the age of 6 months, the confinement energy of the SFHSSCC improved substantially by about 80% as compared to the confinement energy at 30 ± 2 days. Based on the stress-strain behaviour in concrete, it was observed that the SFHSSCC was able to expand significantly under large stresses with controllable strains which justifies that the presence of steel fibres had contributed to improved confinement effects to the extent that the SFHSSSCC had the ability to provide high confinement energy and good ductility. Subsequently, based on the pullout test results, two new bond strength equations are proposed to predict the bond strengths of deformed steel rebars embedded in HSSCC and SFHSSCC. Finally, it can be concluded that the presence of steel fibres in SFHSSCC could overcome the brittle failure in high strength self-compacting concrete and significantly improves the concrete ductility, which delay the loss of bond between rebars and concrete.