Fibre-reinforced polymer (FRP) strengthened and unstrengthened reinforced concrete (RC) structures are susceptible to intense deterioration when exposed to elevated temperatures, particularly in the incident of fire. FRP has the tendency to lose bond with the substrate due to the low glass transition temperature ($T_g$) of epoxy; the key component of FRP matrix.

Previously, various types of high performance cementitious composites (HPCC) were explored for the protection of RC structural members against elevated temperature. However, there is an inadequate information on the influence of elevated temperature on the ultra high performance fibre- reinforced cementitious composites (UHPFRCC) containing ground granulated blast furnace slag (GGBS) and/or fly ash (FA) as a replacement of high alumina cement (HAC) in conjunction with hybrid fibres (basalt and polypropylene (PP) fibres). This could be a prospective fire resisting material for the structural components. The influence of elevated temperatures on the compressive, flexural and tensile strength of UHPFRCC, made of HAC-GGBS and hybrid fibres, was examined in this study along with complete microstructural, chemical and thermal analysis. Total fourteen (14) mixes were developed. Besides control sample (without fibres), three other samples, containing 0.5%, 1% and 1.5% of basalt fibres by total weight of mix and 1 kg/m$^3$ of PP fibres, were prepared and tested. Another mix was also prepared with only 1 kg/m$^3$ of PP fibres. Nine (9) more mixes were developed with the replacement of GGBS with FA. Each of the samples were retained at ambient temperature as well as exposed to 400°C, 700°C and 1000°C followed by residual mechanical (compressive, tensile and flexural), thermal (TC, TG and DSC analysis) and microstructural (XRD, ESEM and MIP) testing after 28 and 56 days of conventional curing. Investigation of results disclosed that the use of hybrid fibres significantly helped to improve the ambient temperature compressive and flexural strength of UHPFRCC, which was found to be 80 MPa and 14.3 MPa respectively. However, the optimum residual compressive strength was marked by UHPFRCC–CP (with PP fibres only), equally after both curing days (28 and 56 days), i.e. 41%. In addition, the highest residual flexural strength, after 28 and 56 days of curing, was marked by UHPFRCC–CP and UHPFRCC–CB2 (1 kg/m$^3$ of PP fibres + 1% of basalt fibres) i.e. 39% and 48.5% respectively.

Through statistical analysis by response surface methodology (RSM), regression models were also developed for UHPFRCC based on the factors affecting residual mechanical strength. After residual mechanical testing, UHPFRCC-CP and UHPFRCC-F2B1 were selected as best mix to be cladded over full scale Carbon fibre reinforced polymer (CFRP)-strengthened and unstrengthened columns. Among both types of claddings, UHPFRCC-CP found to be the most effective in protecting unstrengthened as well as CFRP-strengthened columns. Besides, it also increased the time to reach the $T_f$ of CFRP composite by 20 minutes as compared to the unprotected CFRP-strengthened column.

Torsional response characteristics of forty building models of elastic and inelastic asymmetric reinforced concrete buildings were studied by analyzing the near-fault and far-fault ground motions recorded during seven-pairs of recent earthquakes. The strength and stiffness eccentricities are the main parameters used in the present study contributing to the strength and stiffness distributions of building models under five main-elements, and eight sub-modules, respectively. The displacement demands of all buildings under the stiff and flexible sides were obtained from the analysis due to different values of fundamental period of vibrations as well as behavior factors by using RUAMOKO-3D program before raw data of lateral displacement at each node were extracted using FORTRAN program. All data were then summarized in accordance to the strength and stiffness distributions in order to determine the impact of either strength distribution or stiffness distribution to the torsional behavior of one-story asymmetric reinforced concrete buildings. The torsional behavior of all building models were presented in terms of the normalized displacements at the stiff and flexible sides by the ratio of the maximum lateral displacement at the stiff and flexible sides to the maximum lateral displacement at the center of the building models. The results were finally analyzed by using MINITAB software for statistical analysis. The results of this study indicate that the torsional behavior of asymmetric reinforced concrete buildings were mainly depend on the stiffness distributions of lateral load resisting elements in the buildings rather than the strength distributions. The results of these investigations also indicate that the fundamental period of vibrations and behavior factors may increase the lateral displacements depending on the strength and stiffness distributions of buildings. Besides, the displacement demand was found insignificant regardless of the elastic and inelastic systems due to both near and far-fault ground motions. The normalized displacements were found significant to visualize the torsional behavior of asymmetric reinforced concrete building. Nevertheless, the value of elastic and inelastic normalized displacement at stiff and flexible sides was conservative regardless of different fundamental period of vibrations as well as behavior factors, which obey Equal Displacement Rule as used in all seismic design provision including Eurocode 8, considered in this study.