High performance concrete (HPC) offers high strength, better durability properties, and good construction.Moreover, Nehdi et al. also studied the durability of SCC with high volume replacement materials (FA and ground granulated blast furnace slag), and concluded that SCC with 50% replacement with Portland cement of FA and slag can improve the workability and durability [18].Therefore, one solution to reuse such industrial wastes and reduce the cost of SCC is the use of mineral admixtures such as limestone powder, natural pozzolans, GGBFS and FA. The amount of FA in concrete for structural use is generally limited to 15–25% of the total cementitious materials.By combining the characteristics and advantages of HPC and SCC, high performance self-compacting concrete (HPSCC) can be produced which possesses the advantages in both forms of fresh and hardened concrete, i.e. while presenting higher strength and durability, it has a good workability and rheological properties [4–6].Among these materials, fly ash (FA), a by-product of thermal power plants, and ground granulated blast furnace slag (GGBFS) have been reported to improve the mechanical properties and durability of concrete when used as a cement replacement material [12,13].In order to maintain sufficient yield value and viscosity of fresh mix of SCC, and to reduce bleeding, segregation and settlement, the common practice is to use new generation high range water reducers, to limit the maximum coarse aggregate size and content, and to use low water powder ratios or use viscosity modifying admixtures.Kulakowski et al. [21] reviewed the silica fume influence on reinforcement corrosion in concrete and the effect of metakaolin on transport properties of concrete were also investigated by Shekarchi et al. [22].There are also some works on incorporating nanoparticles into concrete specimens to achieve improved physical and mechanical properties which most of them have focused on using SiO2 nanoparti However, this would not be achieved without studying its performance before being widely adopted in construction.This paper investigates the effects of silica nanoparticles, silica fume and Class F fly ash on rheological, mechanical, thermal, transport and microstructural properties of HPSCC with different binder contents.The HPC offers significant economic and architectural advantages over NSC in similar situations, and is suited well for constructions that require high durability.Thermal properties were evaluated by thermogravimetric analysis and transport properties were evaluated by water absorption, capillary absorption and chloride ion penetration tests.Moreover, the consumption of natural resources and carbon dioxide emissions associated with cement production can cause serious environmental impacts.Concretes containing large amounts of FA were initially developed for mass concrete applications to reduce the heat of hydration [15].