Compared to the Conventionally Vibrated Concrete (CVC), the Self-Compacting Concrete (SCC) possesses enhanced qualities and improves productivity and working conditions due to the elimination of compaction. SCC is a highly flowable and non-segregating concrete that can spread, into place, fill the formwork and encapsulate the reinforcement without any mechanical vibration. The SCC’s usage will lead to a substantial improvement in the quality, durability and reliability of the concrete structures and eliminate some of the possible human errors during placing and compaction.

SCC generally has higher powder content than the CVC, and thus it is necessary to replace some portion of the cement with additions to achieve an economical and durable concrete. Fly ash is one such addition. The estimated quantity of yearly fly ash generation in India is expected to reach 225 million tons by 2017, out of which around 15-20% is utilized in cement production and cement/concrete related activities. In order to increase its percentage of utilization, an investigation was carried out on using the SCC whilst maintaining its satisfactory properties. Moreover, the established benefits of the use of high volumes of fly ash in CVC, and the utilization of large volumes of fly ash in various SCC applications is becoming a more general practice. It is also felt that in India, public awareness about the use of SCC in general construction, and the realization of the potential economic and environmental benefits of this technology is lacking.
The objective of this research is to improve the understanding of the properties of SCC containing Class F fly ash with different fineness measurements, and different ratios, using the SNF grade superplasticizer. By the use of fly ash in SCC, the Portland cement content is reduced, and therefore, the embedded carbon foot print is also reduced. Additionally, this work aims to provide necessary information that can be used for the commercialization of SCC, to the manufacturers.

The results indicate that it is possible to develop a SCC containing Class F fly ash for its high performance in its fresh state, that resembles the characteristics of CVC in the hardened state. The use of fly ash in SCC effectively replaces the cement content and fills the voids to form a thick non-porous matrix. Furthermore, the addition of processed fly ash is found to reduce the superplasticizer dosage, increase its workability, and increase the overall chloride permeability resistance.

To design the SCC for a specific performance, it is required to have a statistical design method, based on the material characteristics for various strength grades based on minimum lab trials. Therefore, using these results, to produce SCC mixes by an analytical technique, a regression model was developed for the fresh properties and for the hardened properties, according to the specified target value. The above analytical technique was used to evaluate the effects of different factors in a statistically sound manner with a minimum number of mixes. Regression models are fitted to the results of each measured response.
The present study can lead to the better utilization of a higher volume of processed fly ash in SCC, which results in widening the possibility of the use of SCC at less cost, saving landfill, and reducing CO₂ emissions by the use of less cement, and consequently conserving the natural resources for the generations to come. The significance of this work lies in its attempt to provide the performance data of fly ash based SCC, so as to draw the attention of end users to the possible potential of fly ash based SCC.