Fly ash is one of the most potential supplementary cementing material (SCM) widely used with ordinary Portland cement (OPC) concrete. In spite of proven benefits of its use in concrete and in the production of other materials, still very large quantities of fly ash remain unutilized or wasted globally. Of the two recognized Classes of fly ash, (Class C and Class F), Class C has both cementitious and pozzolanic properties. Review of reported investigations on the above Classes of fly ash has revealed that not much research on the use of Class C fly ash has been carried out, in spite of its distinct advantageous property. One of the reasons, which come in the way of large scale utilization of fly ash, is the slow-rate of strength-gain, especially, during the early-age of concrete, which can be overcome by ‘activation’ of fly ash. Even though, some studies on the use of fly ash with lime and gypsum, as a binder, for producing concrete has been reported, systematic and comprehensive studies on the strength and durability of the above binder-based concrete, have not been carried out.

In this study, lime (from a natural source) and gypsum (by-product from a nearby fluoride industry, Cuddalore, Tamil Nadu, India) were used for the activation of high-calcium (lignite) fly ash (obtained from the thermal power plant, at Neyveli, Tamil Nadu, India) and its use in concrete.

Preliminary investigations were carried out on the activation of the fly ash using the above two activators and three blends were studied, namely, fly ash – lime (F-L), fly ash – gypsum (F-G), and fly ash – lime – gypsum (F-L-G). Based on the compressive strength of mortar and concrete specimens of the above blends, it is inferred that addition of lime (external) to the above fly ash, is not necessary. Hence, for the subsequent studies, only gypsum was used as an activator with the fly ash. Further, the effect of ‘moist’ and ‘immersion’ curing regimes on the strength development characteristics, were also studied. It was observed that F-G blend is insensitive to the above two types of curing.

In order to obtain a suitable mix proportioning method, three relationships were established among the parameters, W/C, A/B, and workability. Based on the
above, two procedures are suggested to arrive at a suitable F-G concrete mix, within a few trials. The suggested procedures are illustrated with numerical examples.

Various properties of F-G concrete like, elastic modulus (E), Poisson’s ratio (m), abrasion resistance, modulus of rupture; thermal properties like coefficient of thermal expansion and coefficient of thermal conductivity; some of the durability properties, like, the effect of acids (organic / inorganic), sulphates, and the effect of elevated temperature, were evaluated. From the results, it was observed that the F-G concrete is less rigid when compared to OPC concrete and the resistance to abrasion was found to be on par with that of OPC concrete. Only lactic acid, among the four acids considered, did not show any adverse effect on the compressive strength. Linear relationship is found to exist between the compressive strength of specimens, cured under normal and accelerated curing regimes. It was observed that there is no appreciable strength-loss up to 100° C in F-G concrete. However, about 36% loss in compressive strength is observed, at 250° C.

An attempt was also made to study the suitability and adoptability of F-G concrete as a road pavement material, by conducting a plate load test on F-G concrete slabs placed on a confined granular sub-grade. The results obtained were compared with numerical studies, using the finite element method (FEM).

The results obtained indicate that F-G concrete has the potential to be used as a construction material, where, moderate strength is desired.