Recent investigations have indicated that concrete containing high-volume low calcium fly ash can be manufactured for structural applications. This research was primarily carried out to investigate performance of structural grade concrete incorporating high volumes of fly ash obtained from three different electric power plants in Wisconsin. Class F fly ashes were obtained from Oak Creek Power Plant and Valley Power Plant, and Class C Fly was obtained from Pleasant Prairie Power Plant. Portland cement, ASTM Type I, was used in all concrete mixes. Concrete mixes were designed to have 28-day compressive strength of 7000 psi (48 MPa). cement replacement by fly ash was varied from 0-70% by weight. Under the lab experimental conditions, water to cementitious ratio was maintained constant and the desired workability was achieved by using a superplasticizer.

Concrete was tested for compressive strength, splitting tensile strength, and modulus of elasticity in accordance with ASTM test methods. Compressive strength and splitting tensile strength of concrete were determined at ages 1, 7, and 28 days whereas modulus of elasticity was determined at 7 and 28 days.

Replacement of cement by low-calcium fly ash in concrete caused reduction in compressive strength and splitting tensile strength and modulus of elasticity within the experimental range. Compressive strength of fly ash concrete was slightly lower than the reference concrete up to fly ash addition of 50% and age of 28 days. Test data further revealed that concrete incorporating class F fly ash attained 28-day compressive strength high enough for use in concrete structures.

Inclusion of fly ash C in concrete at replacement ratio of 1:1.25, showed lower values of compressive strength and splitting tensile strength at early ages up to 7 days. Beyond 7 days, concrete incorporating class C fly ash exhibited consistently higher compressive strength compared to the reference concrete at all the tested levels of fly ash up to 70% of cement replacement.

Based upon the data obtained, it was concluded that superplasticized concrete containing high volumes of either low calcium or high calcium can be designed to meet strength requirements for structural grade concretes.