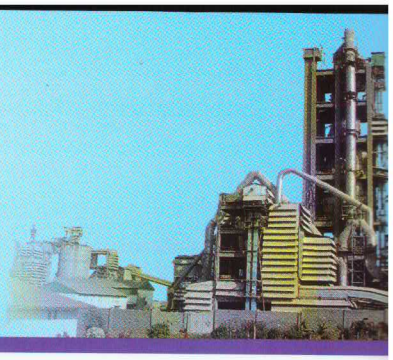
# HIGH STRENGTH LIGHTWEIGHT CONCRETE USING SINTERED FLY ASH AGGREGATES FOR STRUCTURAL APPLICATIONS

**Moghul Sirajuddin[1], Reetam Chaudhury[1], Hemantkumar Aiyer[1], Amit Chatterjee[1] and Devendra Pandey[2]**

*[1]Aditya Birla Science and Technology Co. Pvt. Ltd., India*
*[2]UltraTech Concrete, India*

Concrete is the second most consumed material after water. It is estimated that 25 billion tonnes of concrete is produced each year globally. Concrete usually contains 60 to 75% of aggregates out of which 50 to 60% is coarse aggregates. Which implies 8 to 10 billion tonnes of coarse aggregates are being utilized globally to produce such enormous quantities of concrete and these aggregates are natural resource. On the other hand, 300 million tonnes of fly ash is generated globally from thermal power plants and disposal of such huge quantities is also an environmental concern. Mostly, fly ash is consumed by cement and concrete industry as a supplementary cementitious material. In addition to this, it can also be absorbed by concrete industry in the form of coarse aggregates. Fly ash coarse aggregates are produced by sintering fly ash at high temperatures and these aggregates are known as sintered fly ash aggregates. If these artificially manufactured aggregates are used, the exploitation of natural resources can be minimized and also it is an effective solution for efficient utilization of waste. Aggregates manufactured by sintering are generally porous, consequently the particle and bulk density of sintered fly ash aggregates are lesser compared to conventional aggregates. This enables to produce light weight concrete of densities lesser than 2000 kg/m$^3$ without compromising its mechanical and durability performance, so that it can be used for structural applications. Utilization of lightweight concrete for structures reduces the dead weight of structure as well as reduces the risk of earthquake damages to a structure as the earthquake forces are dependent on weight of structures. Also, reduction in the dead weight of a construction could result in a decrease in the cross-section of columns, beams, plates and foundations. Additionally, higher strength/weight ratio, better tensile strain capacity, lower coefficient of thermal expansion and superior heat and sound insulation characteristics due to air voids of the lightweight aggregates are some of the many advantages of structural lightweight concrete. Owing to the above advantages, coupled with the increasing scarcity of good quality natural aggregates in many parts of the world, and the emphasis on more efficient use of materials in structures has widely increased the application of structural lightweight concrete in the past two decades. In spite of all these advantages, the use of lightweight concrete for structural applications is limited in India. This study focuses on producing high strength structural light concrete and to utilize it in construction of a building so that its awareness can be improved.

This paper discusses the production of lightweight concrete for structural applications using sintered fly ash aggregates with compressive strength of 40 MPa at a density less than 2000 kg/m$^3$ and evaluates its mechanical properties. The mechanical properties include compressive, tensile and flexural strengths.



# CHEMICALLY REINFORCED PERLITE BASED FIRE RESISTANT MORTAR FOR NON-STRUCTURAL APPLICATIONS

**R Chaudhury[1], M Sirajuddin[1], D Pandey[2], H Aiyer[1] and A Chatterjee[1]**

*[1]Aditya Birla Science and Technology Company Pvt Ltd, India.*
*[2]UltraTech Cement Limited, India*

Concrete is a good heat/fire-resistant material due to its inherent non-combustibility and poor thermal conductivity. Its pre-fire compressive strength often surpasses design requirements and it can tolerate a modest strength reduction during fire exposure. But, prolonged fire exposure or unusually high temperatures can reduce the overall load-bearing capacity of concrete so much that the material retains no useful structural strength. Long term fire exposure leads concrete masses to separate out from the body of the concrete element (spalling), thus decreasing its resistance to axial loads. Moreover, the reinforcement steel bars become exposed directly to high temperatures. In this study, a perlite based mortar having 5±2 MPa compressive strength is developed using Aluminium Powder (AP) and two well-known fire extinguishers viz. ATH and MDH and its heat resistant performance has been studied at a temperature of 1000±10°C.

The study reveals that different combination of percentages of AP, ATH and MDH gives rise to 7 to 15 % performance enhancement of the mortar cubes in terms of reduction in strength after firing inside a furnace. Perlite mortars, where there is no AP, a ~35 % strength reduction compared to its initial strength (~5 MPa) is observed. No strength reduction is there where there is 1% AP as compared to its initial compressive strength (~1MPa). On the other hand, a ~17% increment in strength is observed when 0.5% AP is used. A fourth mix design is also tried without AP to increase the initial compressive strength of the mortar cubes with the addition of ATH and MDH. A desirable 28 day strength of ~3 MPa was found with strength loss of ~47%. A comparison between the control sample and the other samples shows that all the perlite mortar cubes with or without AP and with different percentages of ATH and MDH, performed much better in heat resistance in terms of strength reduction as compared to ~62% strength reduction observed in the control sample.