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# Preservation of Sand and Building Energy Conservation

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**Abstract**

Due to developmental need of humankind, growing trend of energy generation and consumption results more and more Green House Gas emissions, which contribute significantly to the phenomena of Climate Change and Global Warming. The issue is further compounded by huge ash generation from thermal power plants. Judicious utilization of such waste in a greener way is another challenge. It is estimated that by 2030, 40.8% of Indian population shall be living under Urban environment, and huge no. of dwelling units would be required. Sand, being one of the conventional constituent of Concrete, and also the non-renewable soft mineral, is being mined mindlessly across the Globe. The energy consumed by building sector is around 40% of global energy use. HVAC load is the major contributor in overall energy profile in buildings situated under Hot & Humid climatic zones in tropical countries. Solar heat gain is resulted through building envelope, and the conventional concrete and plastered masonry surfaces contribute significantly to the same. An experimental work has been carried out to produce sustainable energy efficient concrete with Portland Pozzolana Cement, Sand, Coal Ash from Thermal Power Plant, Stone aggregate and water. Test samples are prepared with reducing quantities of Sand and increasing quantities of Coal Ash for a Design Mix Concrete. While characteristic strength of concrete could be achieved with replacement of Sand by Coal Ash, thermal conductivity value of concrete is reduced, while compared with normal concrete of same Mix.


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## 1. Introduction

### *1.1 Climate change and effect of thermal energy generation*

Human activities are influencing the climate and the trend in recent anthropogenic emissions of greenhouse gases is found to be the highest. Fossil fuel combustion and industrial processes together attributed around 78% of total Green House Gas (GHG) emission's increase during the period from 1970 to 2010. Considering the global scenario, population increase and economic growth are the two key contributors in CO2 emission from fossil fuel combustion. [1] Coal based thermal power plants contribute around 65% of the total electricity generation in India, and the ash content in the coal used in Indian thermal power plants vary between 25-45% [2]. Considering various sectors (Transport, Industry, Cooking, Building, Telecom, Pumps and Tractors) from electricity demand point of view in India, Building Sector demand is projected to touch 2287 TWh in 2047 from a figure of 238 TWh in 2012 (around 49% of total electricity demand shall arise from Building sector alone). The projected total installed capacity of Coal based power stations shall stand at 333 GW, which will generate around 1963 TWh of electricity in 2047 [3].

### *1.2 Coal ash generation and its impact*

In India, 130 Coal based power plants are producing around 165 M.T. of ash per year [4]. The pulverized coal when burnt, produces ash in the category of flay ash 80% and bottom ash (coarser variety) 20% [5]. The effective disposal of fly ash is a critical proposition. Fly ash is being used widely as constituent of Portland Pozzolana Cement, as Building Blocks / Bricks, Landfill and Embankment constructions, and to some limited extent for agriculture purpose. Disposal of ash in slurry state in low lying areas/dumping yards cause leaching and serious ground water pollution in adjoining areas. It also creates a state of suspended respiratory particulate matter under dry state in the air, which is extremely hazardous for human health.

### *1.3* Sand, a major constituent of concrete and masonry in construction industry

With the above projection in Building Sector, huge quantities of concrete would be required, and as a natural consequence, sand, one of the key ingredient would also be required in justified proportions. With the mindless sand mining from the river bed, ecological balances are disturbed in the form of depletion in ground water table, lesser availability of water for agricultural, industrial and drinking purposes, destruction of agricultural land, damage to roads and bridges etc.[6].

### *1.4 Other works and Energy conservation*

P. Aggarwal et al. [7] had investigated about the effect of bottom ash in concrete, as partial replacement of fine aggregate component. Dan Ravina et al. [8] had studied the role of Class F fly ash in properties of concrete as partial replacement of fine sand. Kadam et al. [9] had made an experimental study to see the effects of coal bottom ash as fine aggregates in place of sand in varying proportions in concrete and various physical parameters viz. Compressive strength, tensile strength, flexural strength, modulus of elasticity, density, water permeability etc. were noted. Fine aggregate replacement by low Calcium ash in plain concrete, and the resultant effect on mechanical properties of concrete was studied by Siddique et al.[10] Deo et al. [11] had undertaken long term comparative study on concrete mix design procedure for fine aggregate replacement by fly ash with the help of Minimum Voids Method and Maximum Density Method. Rajamane et al. [12] had evolved formulation with respect to prediction of compressive strength of concrete when sand is replaced by fly ash. Demirboga et al. [13] had noted the influential effect of mineral admixtures on thermal conductivity and compressive strength of mortar. To address the issues listed at 1.1-1.3, reduction in sand content and replacing the same by coal bottom ash can be proved beneficial from energy conservation point of view.