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Guest Editorial

We live in a difficult and troubled world. The state of the infrastructure in a country is a reflection of its stability and economic progress, and indeed, of the quality of its peoples' lives. It is a matter of fact that a substantial proportion of the world's population live without the basic necessities of life in terms of housing, sanitation, water supply and transportation, which form the foundations of a society's infrastructure. It is equally true that in our desire to dominate lives and peoples, there is almost a wanton destruction of whatever little infrastructure we hold on to. However, much more important to material scientists and engineers is that in spite of the tremendous strides we have made in our understanding of construction material systems and their performance in practice, rapid and premature deterioration of materials and structures has become a major world-wide problem, and there is widespread concern about the lack of durability, in particular, of concrete and other cement-based materials.

In spite of this concrete is, in many respects, a wonder material of this century. Of all construction materials, it has the best ecological profile for a given engineering property such as strength or elastic modulus. It is probably the most widely and extensively used building material in the world, due to its relatively low cost, easy availability of constituents, versatility and adaptability. It is easily prepared and fabricated into many conceivable shapes and structural systems in the realms of infrastructure, transportation and habitation that the material is often identified with a nation's prosperity and economic progress, and indeed, the quality of life.

The most outstanding asset of the material is its inherent alkalinity, providing a passivating mechanism, and a safe, non-corroding environment for the steel reinforcement embedded in it. Long experience and a good understanding of the material have confirmed that concrete is a reliable and durable construction material, when it is exposed to normal or even moderately aggressive environments. Thus in a rapidly changing world, the concrete industry and technology can offer one of the best ways forward to satisfy the social and human needs and aspirations.

The great advantage of concrete is that it is possible to choose its constituents, and then it is up to us to exploit and optimize the unique properties of each of these components to develop a wholesome, high quality, durable construction material. This freedom to choose the constituents, this opportunity to "**DESIGN**", rather than merely proportion, concrete to suit any load, any usage and any environment is probably one of the unique qualities of concrete and other cement-based materials. Such a "**CONCRETE**" can provide the best "**HOME**" for cement replacement materials such as fly ash and slag, for fibres of all kinds, and for polymer emulsions, to name a few, and this interaction between the basic concrete and the "foreign ingredients" can bring two outstanding benefits — engineering and economic. From an engineering point of view, a judicious combination of these materials can, in the fresh state, reduce segregation, bleeding and the tendency for plastic shrinkage, and enhance flowability and pumping qualities. In the hardened state, these additional constituents can refine the pore structure and thus reduce the permeability, whilst at the same time enhance resistance to thermal cracking, improve crack control, and impart properties of ductility and energy absorption. From an economic point of view, utilization of industrial by-products can directly contribute to conservation of material resources, savings in waste handling and waste disposal, better energy usage and protection of the environment. Concrete can thus provide the ideal building material combining efficiency, environmental friendliness, and a cost-effective solution to maintain the quality of life. Some of these ideas are illustrated below.

However, in order to achieve this and to develop new infrastructure systems, and renovate and rehabilitate those deteriorating with age and environmental effects, we need to adopt a new and innovative approach to design and construction — "**A HOLISTIC DESIGN STRATEGY**" — which will integrate material characteristics with in-situ performance, in order to optimize the usage of materials and ensure their trouble-free service life. The major factor contributing to the deterioration of materials and structures is their own micro-environment, and the global climatic conditions in which the structures live and perform their intended purpose. Hot/dry and hot/wet salt-laden environments, for example, provide one of the most aggressive forces that undermine material stability and structural integrity. When the severity of the environment is compounded with poor selection and quality of materials, and/or defective design and construction practices, the process of deterioration becomes interactive, cumulative and very rapid, like a cancerous growth that cannot be easily stopped. Our overall aim should be to emphasize that in infrastructure development and rehabilitation, we need new material technologies but adopt a global design/management strategy which alone will enable cost-effective solutions with durable service life.