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Editorial

Concrete is still considered, all over the world, to be a wonder material of this century. What endears the material to engineers and builders alike is its ecological profile compared to all other construction materials. For a given engineering property such as strength or elastic modulus, concrete still gives the best value for money. It is the most widely and extensively used building material in the world, due primarily to its relatively low cost, easy availability of constituents, versatality and adaptability. It is easily prepared and fabricated into many conceivable shapes and structural systems in the realms of infrastructure, transport, and habitation such that the material is often identified with a nation's stability and economic progress, and the quality of human 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. We have now a sufficiently long experience, and a good understanding of the material to know that high quality concrete is a reliable and durable construction material when it is exposed to normal or even moderately aggressive environments.

In spite of these intrinsic and technical advantages of the material, and in spite of the many scientific advances that have been made in our understanding of its microstructure and engineering properties, deterioration of concrete has become a major global problem, and there is widespread concern about its lack of durability. In many parts of the world, reinforcement corrosion has become the main cause of early and premature deterioration, and sometimes failure, of reinforced concrete structures. One of the major factors contributing to this deterioration process is the environment and climatic conditions to which a concrete structure is exposed. Hot/dry and hot/wet salt-laden environments probably provide the most aggressive forces that undermine the stability and durability of concrete structures. When the severity of environments is compounded with poor quality concrete, and/or defective design and construction practices, the process of deterioration becomes interactive, cumulative and very rapid, and a cancerous growth that cannot be easily stopped.

This paradoxical situation poses one of the greatest challenges to engineers, designers and builders – how do we design and construct structures that will have a long and durable service life, and which will require a minimum of repair and retrofitting? In other words – how do we develop designs and build structures which will give optimum performance for a given set of load conditions and usage in harsh salt-contaminated environments, consistent with the requirements of cost, service life and durability?

Experience tells us that it is in the nature of concrete as a material, and construction as a technology, that there is no single approach which will ensure long-term concrete material stability and structural integrity when structures are exposed continuously to severely aggressive environments. The only solution open to us is to adopt a Global Design Strategy – a Holistic Approach – a spectrum of activities which will involve a judicious integration of material properties and structural design which alone will give a structure its prescribed and specified durable service life. Such a strategy will involve four distinct operations, namely,

Development of a Highly Impermeable Concrete,
Protection of Concrete,
Protection of Reinforcement, and
Design for Structural Integrity.

In very aggressive environments, particularly where long-time exposure to chlorides and sulfates is inevitable, all those distinct design stages need to be incorporated, and close attention will have to be paid to all these aspects if structures are to function efficiently and effectively. There is no easy solution, but a determined and calculated approach to modify our concepts and design in construction. It demands vision of what time and exposure to the vagaries of the environment can do to materials and structures. Are we prepared to meet this challenge in the next millennium?

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