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Editorial

One often wonders why a mundane, down-to-earth construction material such as concrete should attain international usage, global adaptability and fame (or, in some cases, infamy). The answer most probably lies in its versatility, the ready availability of its basic constituents, and its ability to be proportioned and fabricated into every conceivable shape and structural system for applications in all fields of living such as infrastructure, transport and habitation. It is therefore no wonder that the material is quite rightly identified with a nation's stability and economic progress, and indeed, the quality of human life. The most valuable asset of concrete is its inherent alkalinity, which provides a non-corroding environment for the safe and long-term functioning of the steel reinforcement embedded in it. In sheltered conditions, and in normal environments, where aggressive and deteriorating agents are not abundant, concrete therefore can, and is known to, give reliable and durable service life for a very long time. Indeed, even in moderately aggressive environments, concrete can give long, trouble-free service life, provided care and control are exercised in its production and usage, followed by regular inspection and rectification of mistakes and malfunctioning.

However, our notion of concrete's apparent indestructibility, and its supposedly everlasting durability — of its ability to remain impermeable whatever its exposure environment and however it is made — is simply not true. Unfortunately — and this is no fault of the material — it is inherent in the nature and manufacturing process of concrete in the field that we can never produce a totally impermeable material that will always and completely prevent, throughout its life, the ingress of potentially harmful agents. This has led to widespread deterioration of many different types of concrete structures, and sometimes premature failure, when the concrete has been exposed to de-icing salts or marine environment or aggressive, climatic, salt-laden exposure conditions.

The need to ensure durability has led to the concept of high performance concrete (HPC). Many recent innovations in advanced concrete materials technology have led to this new development — the ability to produce concrete with exceptional performance characteristics. But what exactly is HPC? Is high strength concrete necessarily also high performance concrete? Does it imply that the special performance requirements of HPC cannot be achieved by conventional materials and normal mixing, placing and curing practices? Need HPC be expensive, and is expensive concrete automatically highly durable? What is the key to high performance and long-term durability? Is compressive strength the most important parameter to distinguish HPC from normal concrete? How do we characterize durability: low porosity; low permeability; improved resistance to chemical attack; low water to cementitious materials ratio; good resistance to freezing and thawing?

The current perception of HPC appears to be based on high strength and high cost. Whether these are necessarily the two key parameters for HPC remains to be seen. It is clear, however, that engineers have the capability to formulate, fabricate and place high performance concrete that can and will withstand the aggressive environments in which they have to live and carry loads safely, strongly and durably. It is also clear that there is no single, so-called HPC for all situations and applications, irrespective of the environments in which they have to survive. HPC, for example, designed to resist the aggressive environment of the Gulf region, will not improve performance in seismic regions!

Despite the perceived parameters of high strength and high cost as the basis of HPC, one instinctively feels that durability through strength is not a reliable criterion for design or structural performance. On the other hand, strength through durability alone has to be the basis on which durable structures can be designed or built. Design for durability has to be the key word for high performance structures of the future, and the desired strength can always be achieved depending on the requirements of load and environment.

On this basis we need to redefine our concept of high performance concrete, and the Editor's definition will be as follows: 'A high performance concrete element is that which is designed to give optimized performance characteristics for a given set of load, usage, and exposure conditions consistent with the requirements of cost, service life, and durability.'