Dear Readers,

As a member of the Editorial Board of the Indian Concrete Journal (ICJ), I am pleased to present this special July 2022 issue of the Journal, on the theme "Attaining Sustainable Concrete Structures".

Every citizen on this planet should realize that we have borrowed this beautiful earth from the future generations. It is our duty to pass on this planet to the future generations without affecting the pleasant environment and its resources. However, our planet earth is already under peril due to severe climatic changes. Increase in population coupled with urbanization has resulted in unprecedented problems to our cities. Unless urgent measures are taken on war footing, these problems will result in catastrophic consequences. The ever increasing demand for energy, due to population and urban growth, has resulted in energy crisis all over the world. The current use of fossil fuels, which may be depleted in another 40-50 years, has resulted in the release of huge amounts of green-house gases, especially carbon dioxide (CO_2), which is harmful to the environment. The unmindful use of resources has also resulted in huge amounts of waste products and only a few reliable and safe methods have been developed to dispose or recycle all of them [1,2]. This situation has resulted in the landfills of many countries overflowing, leading to many pollution problems. Due to the global warming, the climate in several areas of the world is changing, resulting in severe draught in some regions, and at the same time heavy rain and associated flooding in several other regions of the world. Thousands of hectares of forests, all over the world are also affected by wild fires. In addition, due to the limited resources of the world, there is severe scarcity of some building materials.

The construction industry makes a major positive contribution to the economy of all countries. The output of this industry worldwide is estimated to be $3,000 billion per annum. The industry creates employment for more than 110 million people, worldwide. At the same time, the built environment is responsible for the consumption of considerable global raw materials, energy, generation of solid waste, and greenhouse gas emissions. Construction industry accounted for 38 % of total global energy-related CO_2 emissions [1]. Cement production alone accounts for as much as 7 % of global CO_2 emissions. To address these challenges, there is a need to develop effective approaches for the management of constructions through life cycle considerations that will ensure sustainability in terms of improved physical performance, cost-effectiveness, and environmental compatibility. In order to be effective, sustainable design has to consider the three major aspects of sustainability: social, economic, and environmental. One should remember that sustainability is synonymous with durability.

To achieve sustainability in the concrete building industry, concrete mixes, concrete products and concrete structures should be designed to reduce negative impacts and to increase positive effects on the society, environment, and the economy. Holistic approach to sustainability of concrete structures must consider the following: component materials, mixture proportions, placement, consolidation and curing, and also structural design and detailing. This could be achieved through enhancement of the performance and life of concrete elements and structures by[3,4] (1) Designing structures for increased life, (2) Using improved design methods, (3) efficient design (optimized sections) and construction practices, (4) Reduced use of clinker in cement production, (5) Selection of proper ingredients for concrete (which will reduce porosity and result in optimized particle packing in concrete mixtures[5]), (6) Controlling cement content and use of supplementary cementitious materials, (SCMs) such as fly ash, GGBS, silica fume, ground glass, etc., (7) Proper care taken during concrete mixing, placing and compacting, in order to have dense and impervious concrete, (8) Proper control on water-cementitious ratio using super-plasticizers, (9) Proper curing of concrete, including the use of internal curing, (10) Providing impermeable cover (using controlled permeability formwork (CPF) systems), (11) Use of non-ferrous or non-corrosive reinforcement or epoxy-coated or galvanized rebars, (12) Using composite materials which will result in reduction of materials, (13) Upgrading of technology for concrete element production (such as precast concrete), (14) Use of self-compacting concrete (SCC), which will result in better quality concrete, (15) Innovations in construction techniques , such as 3-D printing, which will result in economy and quality products, (16) Repair and rehabilitation which will prolong the life span of structures (e.g. using GFRP or CFRP sheeting), (17) Use of recycled aggregates, aggregates produced from waste by-products, and (18) Using innovative materials like Limestone Calcined Clay Cement (LC^3), geopolymer concrete, shape-memory alloys, concrete canvas, nano-materials, smart materials, etc. There are also other methods which are under research such as carbon capture, utilization, and storage (CCUS), and using concrete surfaces as carbon sink.

Due to the limited space, we have included only a few papers in this issue. The first paper on "Utilization of air-cooled blast furnace slag as a 100 % replacement of river sand in mortar and concrete" by a team of authors from IITM and Tata Steel, evaluates the feasibility of using air-cooled blast furnace slag (ACBFS) as replacement of river sand in mortar and plain concrete at replacement levels of 0 %, 25 %, 50 %, 75 %, and 100 % by weight. They have conducted various tests on fresh, mechanical and durability properties of mortar and concrete samples at different replacement levels and found that ACBFS sand is suitable for even 100 % replacement of the natural sand in plain concrete. By using ACBFS in concrete, its problem of disposal as a waste, which can be a big challenge for steel manufacturing companies, will also be solved.

The next paper, "Flexural behavior of FA/GGBFS based reinforced geopolymer concrete beams" by Sanjay Kumar, Jeeva Chithambaram, deals with the experimental work done by the authors at the National Institute of Technology Jamshedpur, on the flexural behavior of beams made with geopolymer concrete (GPC),cured at room temperature. They have tested three GPC beam specimens, of size 150 mm × 200 mm × 1500 mm, with varying replacement of fly ash (10, 20, 30 and 40 %) with ground granulated blast furnace slag (GGBFS). Based on the slump and compressive strength tests conducted by them, it was found that the workability of GPC increases as the fly ash replacement by GGBFS increases. It was also found that replacing fly ash up to 30 % results in higher load carrying capacity.

The next paper by Pranoy Roy and Samanta of National Institute of Technology, Durgapur, reviews the behavior of joints under different loading conditions and summarizes their behavior. Unless proper consideration is given to the design and detailing of beam-column joints, they may fail during earthquakes and may even cause the failure of the whole structure. They concluded that the failure of the beam columns depends on the beam to column size ratio and the amount of transverse reinforcement at the junction. Proper joint reinforcement in the form of stirrups, cross ties, or headed bars improves the stress distribution in the joint core, delaying cracking and propagation of cracks. It also reduces the strength degradation, energy dissipation capacity, and displacement ductility of the specimens.

The paper "Load transfer mechanism for jointed plain concrete pavements: A review" by Khichad and Vishwakarma of MNIT, Jaipur, and Ingle of VNIT, Nagpur, reviews the load transfer mechanism at joints of jointed plain concrete pavements (JPCP). From their review of literature, it is seen that the dowel bars must be provided for thicker pavements carrying heavy traffic. Proper alignment of the dowel is necessary for better load transfer at the joints and misalignment of the dowel may lead to cracking and failure of the slab.

The last paper "Design and detailing of shear studs in composite beams: A critical review" by me explains the behavior of the shear studs with respect to composite slabs and composite slabs with profiled sheeting, which are often used in bridges and tall buildings. Although the draft IS 11384 contains equations for the design of shear studs for composite solid slabs, these equations are not applicable to composite slabs with a profiled deck. Hence, the provisions available in other national codes are provided. The rules for detailing shear studs based on empirical methods and also given in other national codes are compared.

Hope you will enjoy reading these papers!

Dr. N. Subramanian

Guest Editor for this Special Issue

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