Ajoy K. Mullick

Demand-driven concrete research

Dr. Ajoy Mullick is a Cement and concrete technology consultant, based in New Delhi and Visiting Professor at JP University of Engineering and Technology, Guna (M.P.). He has over 45 years' experience in research, design, consultancy, teaching and R&D management. He has successively occupied positions of Director General of National Council for Cement and Building Materials (NCB); Director (Research and Technical Services) of Saurashtra Cements, Mumbai; Chief Technical Adviser, Vasavadatta Cements, Sedam (Karnataka); besides being Advisor/ Consultant to Grasim Industries (Cement Marketing Division), ELKEM (India), BEKAERT Industries (India), E.I. DuPont (India), SINTEF Building and Infrastructure, Norway, and many other organisations.

Dr. Mullick graduated in Civil Engineering from Patna University and obtained MSc (Engg.) and PhD degrees from the University of Calgary, Canada, with financial support from National Research Council (NRC), Canada and University of Calgary Dissertation Fellowship. Prof. A. M. Neville was his Guide for MSc (Engg) thesis, and Prof. R. H. Mills and Prof. B. R. Gamble in PhD work. His PhD topic was 'Effects of stress history on the microstructure and creep properties of maturing concrete'.

After his return from Calgary, Canada, Dr. Mullick joined National Council for Cement and Building Materials (then known as Cement Research Institute of India) as Scientist. Corporate concrete technology research in India has been demand–driven, often mundane - what the state-of-art of the profession required. Even after returning back to India, Dr. Mullick would receive information from his Professor abroad on the research being carried out at the University and suggestions on what more should be done, till the Professor had to be told respectfully, " the research I did with you for my Doctorate is not required in my present job; the research I am doing at present may not fetch a PhD at the University".

Nevertheless, such research work can be very meaningful and worthwhile, as Dr. Mullick found in his carrier. In addition, technology transfers through standardization and consultancy/trouble-shooting offer immense scope in improving the field practices. As long as these efforts help in ensuring quality in constructions, preventing failure or premature decay of the structures and make the concrete sustainable, the pursuit is worthwhile and satisfying. Some simple examples will illustrate the point.

Emphasis on conservation and rational utilization of cement was paramount during the Seventies and Eighties, because of shortfall of domestic production over demand. Quality assurance (QA) and quality control (QC) were recognized as the vital steps. To enable the profession, which was accustomed to nominal mixes, to switch over to concrete mix design, suitable guidelines for concrete mix design were evolved (IS 10262:1982). Mixes typical of that period – M40 grade or lower, low workability, and no use of admixtures – were covered. It had necessarily to be reviewed later in the present day context.

Variability of cement characteristics was another area of concern. Those days, cement for a construction project could be 'allotted' from manufacturing unit anywhere in India, with attendant variability in cement characteristics. Test and statistical analysis of samples of entire cement

production in the country for two years led to 'strength-grading' of cements into 33, 43 and 53 Grades. This was much earlier than the present classification of EN 197-1 into 32.5, 42.5 and 52.5 strength classes. On the basis of data on concrete having different mix proportions and made with different cements, a series of strength ~ water-cement ratio curves corresponding to different cement strength was established. This enabled a more precise estimate of water-cement ratio required for the concrete strength, once the strength of cement was known. The search in wilderness was narrowed down to a smaller precinct. Adoption of accelerated strength tests in mix design reduced the required time to three days!

Nearly half of the co-efficient of variation in concrete strength tests are contributed by that of cement. It would, therefore, be helpful if the co-efficient of variation in cement strength between consignments is limited. In the construction of Sardar Sarovar Project in Gujarat, the International aid-giving agency insisted that co-efficient of variation in cement strength should not exceed eight percent, and if such cement were not available indigenously, it be imported. Dr. Mullick and his colleagues in NCB did the spadework to usher in the concept and assessment of cement plants in India on the basis of co-efficient of variation. Although there is no requirement of uniformity in Indian Standards at present, many cement manufacturers started making available data on the extent of variability, along with the mandatory test certificate.

Use of mineral admixtures in blended cements and concrete was another focus area of R&D. Dr. Mullick has been in the forefront of advocating the use of fly ash; granulated slag and silica fume in cement and concrete and pave their adoption in Codes of Practices and Specification.

Development of CRI – Non-shrink Grout for use in machinery foundations was a path-breaking research aimed at import substitution. This patented product has been used in foundation grouting in a number of fertilizer plants in place of imported products.

The concern for durability of concrete in the structures is worldwide, the major causes being corrosion of reinforcement and alkali-silica reaction (ASR) in concrete. The problem of corrosion of rebars came into sharp focus with the incidence of severe cracking and distress in RCC columns and other elements in a medical college building soon after construction. The problem of corrosion in prestressed concrete was highlighted due to the collapse of Mandovi Bridge in Goa in late eighties, which was investigated by a multi-disciplinary team of experts including NCB. The research emphasized the importance of quality of concrete and its ingredients, the service environment and adequate cover thickness, and guidelines incorporated in national codes.

In India, the problem due to ASR were believed to be non-existent, till the distress to Hirakud dam in Orissa after nearly two decades in service were diagnosed to be due to ASR in the early Eighties. Incidence of ASR was established through path-breaking research carried out by Dr. Mullick and his colleagues in NCB. The reactivity was due to the presence of 'strained' quartz in aggregate, showing undulatory extinction. Many other countries now report occurrence of ASR due to such aggregates, which, in lighter vain, has been called 'Mullick's rocks'!

ASR problems in Rihand dam in U.P. followed soon. Since then, almost all the major concrete dams taken up for construction in India have been investigated by NCB team to avoid incidence of ASR. A contemporary approach to investigate concrete aggregates for potential reactivity and safeguards to avoid occurrence of ASR have been evolved, and incorporated in BIS Codes. That, no new construction has exhibited ASR, is testimony to the research efforts of Dr. Mullick and his colleagues.

Consultancy and research in recent years include protection of a concrete dam in Meghalaya exposed to acidic reservoir water, M60 grade self compacting concrete for Signature Bridge in Delhi, first use of high performance concrete in pavement (in NH 4), strain-hardening FRC for joint- less bridge decks, and use of waste materials as aggregate in concrete. His research on ternary cement blends, especially in high performance concrete, is now well accepted in practice in India.

He has been active in standardization activities of BIS, IRC and RILEM, Paris. Dr. Mullick has designed and taught Cement Technology for final year Chemical engineering degree level, Advanced Concrete Technology and Hydropower Engineering for final year Civil Engineering Degree level, and Sustainable Construction, for M.Tech course in Civil Engineering. He is known to be a popular teacher.

Dr. Mullick was chairman of 9th ICCC (International Congress on Chemistry of Cements) in 1992; the first person from India invited to deliver Fulton Memorial Lecture in South Africa (1995), and first person invited to deliver Plenary Presentation at 10th ICCC at Goteborg, Sweden (1997). Dr. Mullick is recipient of ICI-FOSROC Award for Outstanding Concrete Technologist (2001). He received ICI Lifetime Achievement Award for 2010. Has authored 170 papers, two books and two book chapters; co-inventor of six patents. He has travelled to 26 countries.