

# Concrete Then and Now – Has much changed?

The National Ready Mixed Concrete Association and the National Sand and Gravel Association initiated the Stanton Walker Lectureship at the University of Maryland in 1962 to honor Mr. Walker on his retirement as director of engineering of the Associations. Several prominent people were invited to provide the distinguished lecture. It is interesting to read those lectures and consider that almost 50 years later, we seem to be discussing the same issues.

The first lecture was presented by A. Allan Bates, then the chief of the Building Research Division of the National Bureau of Standards (NBS), now National Institute of Standards and Technology (NIST). Below are some excerpts from the lecture by Mr. Bates delivered on November 20, 1963 at the University of Maryland in College Park. The complete lecture is available on request from NRMCA.

The title of the lecture:

## COMPOSITES IN CONSTRUCTION: PROBLEMS AND CHALLENGES

A composite implies the act of *composition*. Man's earliest structures were necessarily simple and made use of natural materials, stone, wood, reeds and mud. He found out at a very early stage, however, that each material had its strengths and weaknesses, its advantages and disadvantages. By shrewdly combining two or more materials he could frequently augment the advantages and offset the disadvantages of each. Straw fibers added to clay resulted in a composite plastic mass which made a superior sun-baked brick.

It was the Romans, the greatest builders of antiquity, who first extensively developed



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that composite of composites which today has become so infinitely varied as to defy definition even though we vaguely use the one term, concrete, to cover all of its forms and manifestations. As has recently been said, concrete is not a material, it is a process. Perhaps it may even more usefully be regarded as a concept, which any interested party may alter to suit his purposes-and almost everyone does. Therein lies a host of challenges and an equally numerous array of problems. Since "concrete" is not only so many things to so many men but is *made of* so many things *by* so many men, the assignment of *responsibility* for it can become extremely tenuous. By contrast, a fairly definite group of companies which comprise the "steel industry" can reasonably be held responsible, in a general way, for quality, availability and progress in steel.

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Anyone who has had much to do with portland cement concrete is aware of the peculiar vulnerability of that complex mixture to damage by irresponsibility. But there has, perhaps, been an inadequate analysis of, and emphasis upon, the nature of that irresponsibility. There have indeed been too many cases of flagrant dishonesty and deliberate malpractice on the part of producers of concrete and concrete components which have caused disastrous failures and required expensive repairs. Nevertheless, the total number of major failures so caused has been extremely small in proportion to the number of concrete structures built. Viewed in these terms the record of concrete is good.

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Originally hidden from view in its ancient uses and still destined to continue its career as a brute working material in many of its modern tasks, concrete has understandably been very often looked upon as a crude concoction which could be made quite well enough by unskilled and careless workers. Fortunately or unfortunately, this has been true much of the time. A great deal of the ancient Roman concrete, for example, which has endured for two thousand years was actually pretty poor stuff. All too frequently, even today, the same worker who makes crude concrete for low grade uses also makes concrete for refined and exacting applications. Nor from where he stands in the ranks of the construction crew is he apt to see much reason for differentiating the low grade from the high.

But responsibility for good or bad quality concrete does not rest principally on the laborer. The architect, the design engineer, the specifications writer, the many materials producers, the admixture suppliers, the contractor and subcontractors, the inspector, the testing laboratory, the writers of building codes and standards, the banker, the insurance underwriter, the speculator and the ultimate owner, all share the responsibility in some degree. All, wittingly or unwittingly, have had something to do with the kind of concrete that goes into our buildings. All have put something into the concrete but more importantly, each must get something out of it-a profit. Solomon, in his wisdom, found it rather easy to determine which was the mother of the little child. But fortunately for his reputation, in Solomon's day it was never necessary for him to decide who was the father of a concrete beam cast in place.

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The opportunities for accident; miscalculation, irresponsibility, incompetence or downright dishonesty to intervene between the gravel pit and the structural formwork are greater than we like to admit. It is fortunate indeed that most concrete mixtures can suffer

grievous abuse and still retain enough strength and virtue to serve us well.

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Relative to concrete, one of the early and still very important manifestations of this revolution is that homely monster, the ready-mix truck. It is an itinerant factory into which go controlled streams of raw materials and out of which comes a new plastic product with unique and wonderfully useful qualities. Primitive as it is, the ready-mix truck embodies most of the fundamental advantages and purposes of industrialization. It uses standardized materials, treats them by standardized processes, employing machine power instead of muscle to manufacture a standardized product for which the producer can, up to a point, be held fairly responsible. From a single source it delivers its product to a widely scattered and diversified lot of consumers who are usually in a position to buy from alternative competitive sources if they wish.

The average contractor, who once set up a mixing plant of sorts on every concrete job he undertook, could not afford to do research work on the theory, mechanics and efficiency of the mixing operation. But the average ready-mix producer *can* usually exert at least a *little* effort on such studies; and, if he combines his resources with those of many other ready-mix operators in a voluntary common pursuit of technical progress, the result may be very far-reaching. This is the *ultimate expression of responsibility in our free enterprise system*. Without an adequate exercise of such responsibility free enterprise as we know it will not long endure.

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The very fact that the ready-mix operator has a closer control over his product also means that he is subject to greater temptation to turn out concrete which barely meets specifications. Furthermore, since he delivers a complex product in which the ingredients are difficult to measure and identify, he is always vulnerable to doubts about the strict necessity of adhering to the exact letter of the specifications. Under the hot breath of his aggressive competitors for the elusive profits which are his only means of survival the ready-mix producer must at times be a modern St. Anthony. The devil may appear to him in exceedingly strange forms, such as an extra gallon of water or as a vanishing half sack of cement. Such temptations can sometimes look like the only alternative to



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economic extinction. A stern sense of responsibility can then seem too much of a burden to bear.

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The society which has developed in North America is profoundly different from any other in human history. It began in a new world essentially untouched by man. This new world was immensely rich in natural resources. ... Rapid *change* and *growth* became the *most characteristic features* of the *new nation*. ... During the last 75 years it has been the exploitation of science and technology which has most profoundly affected American society. The continent had limits. Science has none. Science is a self-fertilizing plant. The bigger it grows the faster it grows. There is no way of declaring a moratorium on science because it has become man's most inexorable and commanding activity. The American nation cannot impede its constantly increasing rate of economic and social change without becoming a fundamentally different nation. ... The more America changes the more it stays the same. The final responsibility for any industry is to make up its collective mind concerning the extent to which it will participate in the processes of change and help guide it to the benefit of the nation.

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The magnitude of the concrete industries in the United States can be only very roughly stated but, as a sufficient first approximation for our purposes, annual sales of some five *billion* dollars may be taken as a very conservative measure of their size. It is doubtful whether these industries spend as much as five *million* dollars a year on research, even when "research" is generously defined. This is one-tenth of one percent of sales budgeted for technical improvement by an industry of immense importance and of great future promise. No other industry of consequence spends so little for this purpose.

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The problems that need solving are big, complex and urgent. Concrete buildings continue to crack much too frequently. Concrete surfaces continue to deteriorate too soon too often. We know that concrete can and probably should be much stronger than it is. Yet

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we do not even have a useable theory as to why concrete has strength at all or why it fails. The basic research which might provide this fundamental information limps along on miserly budgets. Probably less than *one-hundredth* of one percent of the concrete sales dollar is spent on finding out why concrete *is* concrete. Will we know how to make superior concrete ... in 1985-or even in 1975? The answers to these formidable questions will be discovered in such excellent laboratories as those founded here at the University of Maryland by the two great industrial associations which Stanton Walker served so well. I would suggest that if by 1975 those laboratories were 10 times as big and productive as they now are the sand-gravel and the ready-mix concrete industries would thus make Stanton Walker even happier than he may be with the tribute paid him through these lectures. Furthermore, these industries would thus be doing themselves and the nation the greatest service of all - that of providing assurance to the men and women living in America that this will remain a land of change and growth and opportunity. ■

And so it goes...

*Dr. A. Allan Bates' career involved academic, industrial and organizational achievement. He received a degree of Doctor of Science in 1931 from the University of Nancy, France. Honorary degrees of Doctor of Science were awarded by Stevens Institute of Technology and Rose Polytechnic Institute. Dr. Bates was a president of ACI and ASTM. He served on the advisory board of the National Academy of Sciences. He was vice president of research and development for 15 years at the Portland Cement Association and director of New York University's University Valley Project, before he served as at NBS. He carried out assignments for industry and the government in Latin America and Europe. He served as chairman of an American Delegation to the Soviet Union for the U.S. Department of State and the National Academy of Sciences.*



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