



Bruce Johnston

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1905-1989

By Lynn S. Beedle

Bruce G. Johnston, a world-renowned authority on the behavior and design of steel structural members and frames, died on October 11, 1989, in Tucson, Arizona, two days before his eighty-fourth birthday. He directed early research work on torsion of beams, behavior of semirigid connections, plastic design of steel frames, and the inelastic strength of beams and columns. In the field of plastic design, he pointed research toward the development of specification requirements that were instrumental in its acceptance as a design tool. Dr. Johnston developed the postwar research program in structures at the Fritz Engineering Laboratory, Lehigh University. He was a leading figure in the organization of the Structural Stability Research Council.

Dr. Johnston was born in Detroit, Michigan, on October 13, 1905. He married Ruth Barker in August 1939, and they had three children: Sterling, Carol, and David. His father was a structural engineer and a specialist in the planning of construction and erection of large bridges. Dr. Johnston spent his early youth in such widely separated places as Ontario, Florida, North Carolina, and Kansas. His four years of high school were spent successively in Colorado, Utah, Missouri, and Kansas.

In 1925 he completed his first year at Kansas City Junior College, and he wrote of that experience:

My one year in the class of '25 of KCKJC and the prior year in KCKHS were the most influential and inspirational school years of my life. Under the influence of such teachers as Christine Wenrich I found for the first time a real challenge in studies. The fundamentals of English usage and the basics in mathematics were invaluable preparation for later work.

In the spring of 1925, after much mental floundering, my goals narrowed to civil engineering. This was the field in which my father, self-taught, had found such a satisfying career. In the summer of 1925, I went to the University of Illinois.

In 1927 he worked as a testing inspector on the Coolidge Dam in Arizona. In 1928 he returned to the University of Illinois, from which he graduated in 1930 with a B.S. in civil engineering. Upon his graduation from Illinois, he received the Ira O. Baker First Place Award in Civil Engineering.

His two earlier years of work on the Coolidge Dam in Arizona had turned his interests toward concrete, and in 1930 with graduation pending from the University of Illinois, he sought and found an opening in the field of concrete design with the Roberts and Schaefer Engineering Company of Chicago. He described the transition of his interest from concrete to steel in the following way:

Shortly before graduation from Illinois, in talking with one of my professors, the noted Hardy Cross, about this prospect, he said "Go ahead and take the job, but you will end up in steel because you have a mind that thinks in terms of steel." This forecast has always amazed me as I had spoken but little to Professor Cross during the previous term.

In 1932 came the opportunity to return to school (at Lehigh University) to work on a research fellowship project on a topic suggested by the Bethlehem Steel Corporation—"structural beams in torsion." This work, involving both the application of Prandtl's soap film analogy and tests of actual members in torsion, resulted in the development of formulas that eventually permitted the accurate calculation and tabulation of St. Venant's torsion constant for rolled WF and I sections in the AISC (American Institute of Steel Construction) Manual. Some 30 years later the advent of the electronic computer permitted the improvement of these formulas by the difference-equation procedure and their extension to channel and angle shapes.

He received his M.S. at Lehigh in 1934 and became an instructor at Columbia University. He sought the advice of his father, Sterling Johnston, as to needs in steel structures research. Sterling had helped to plan the Quebec Bridge construction many years before and had noted a problem involving the dishing of thin pin-connected links. This led to work on that topic, which later resulted in changes to the AISC specifications.

Columbia awarded Bruce Johnston the Ph.D. in 1938. He describes his extra curricular experiences at this time of his life as follows:

In 1937, to Africa on a decrepit freighter for a summer in French Cameroun. Thirty-eight days enroute, with shore stops at Dakar, Conakry, Monrovia, Abidjan, Accra, and Lagos. Learned how to splice rope and make a sling from a sailor. Inland to Bafia, in high grass country, to build and erect roof trusses for a church with a crew of 125 Bulu people—one generation removed from cannibalism.

Back to Columbia via German banana boat. As we neared Hamburg the captain and crew went increasingly into their "Heil Hitler" form of greeting. On the last night the captain gave a speech on German-American friendship. It was 1937. Everywhere in Germany the people were exhorted by posters to fear the dangers of world communism. It was a prelude to devastation.

Met Ruth, an art teacher at Skidmore College in Saratoga Springs, New York. 1938—received Ph.D. at Columbia and was offered an Assistant Professorship and Assistant Directorship of Fritz Engineering Laboratory at Lehigh University. Moved to Bethlehem, Pennsylvania.

As assistant director, then associate director, and finally as director, Dr. Johnston was in charge of structural research programs at Lehigh's Fritz Engineering Laboratory from 1938 until 1950, except for a two-year interruption during World War II while he was first a design engineer for the U.S. Navy Bureau of Yards and Docks and then engaged in the study of vibration and shock-load problems related to the development of the proximity fuse and naval gun directors at the Johns Hopkins Laboratory of Applied Physics.

In 1950 he accepted the call of the University of Michigan

and became professor of structural engineering. For the ensuing eighteen years, he devoted his attention to research, teaching, and professional activities.

In 1968 he retired and was named professor emeritus of the University of Michigan. The following is from the memoir adopted by the Regents:

In professional circles, Professor Johnston enjoyed the unique distinction of presiding, at different times, over both the Structural and the Engineering Mechanics divisions of the American Society of Civil Engineers and of twice winning the Society's James J. R. Croes Medal. In addition to monographs, he wrote some sixty professional papers, many of them an extraordinary seminal value. He visited and lectured widely, furthermore lending his authoritative counsel to innumerable engineering groups—public and private, industrial, military, and academic.

Professor Glen Berg, one of his Ph.D. students at Michigan wrote, "He was one of the great persons in his field. With characteristic generosity he shared his wisdom and sound judgment freely with his colleagues".

Dr. Johnston then accepted a call from the University of Arizona to lecture in civil engineering.

Early research at Lehigh in the 1940s stimulated his interest in attaining a better understanding of metal column behavior, a topic that thereafter became a primary thread of interest.

One of my earliest projects at Lehigh concerned the behavior of eccentrically loaded steel columns, a study sponsored by the American Institute of Steel Construction. In developing this work I discovered, to my chagrin, that in spite of three university degrees, including the Ph.D., I really understood next to nothing about the behavior of metal columns. Much of the next 40 years involved attempts to remedy this deficiency through diversified research projects at both Lehigh and the University of Michigan as well as through active participation in the work of the Column Research Council. These studies were, in part, an expression of my deeply held feeling that a University must not only fulfill its educational role of disseminating

knowledge, but must maintain a position on the creative forefront of knowledge in the fields of industry in which its young graduates go out to serve.

It was with this policy in mind that Dr. Johnston developed a strong graduate studies program in structural research at Lehigh. He initiated research at Lehigh on the effect of residual stress on column strength and conceived the importance of the strain-hardening modulus of structural steel in relation to the behavior of steel columns. He also developed Lehigh's initial research program on plastic design, directing it towards a delineation of design rules essential to successful application in practice.

In 1944 Dr. Johnston assisted in the organization of the Column Research Council (now known as the Structural Stability Research Council). He served as its chairman from 1956 to 1962. He has been editor and part author of the successive editions of the council's *Guide to Design Criteria for Metal Compression Members*, more conveniently known as the *CRC Guide*. In 1960 the first edition provided backup for important changes in the AISC specifications. Through his service on the Executive Committee, the council continued to have his guidance. He received American Society of Civil Engineers' (ASCE) Ernest E. Howard Award in 1974.

In the 1950s Dr. Johnston participated as a project supervisor in studies of the effects of atomic blast during tests at Yucca Flats, Nevada. He was in charge of the evaluation of test results for one group of industrial and commercial buildings under a contract with the Federal Civil Defense Administration.

During the 1960s and early 1970s, he was active as a consultant to the Association of Iron and Steel Engineers, assisting in the development of structural specifications for steel mill ladles, overhead traveling cranes, and mill building structures. He was a member of the Specification Advisory Committee of the AISC. From 1961 to 1963, he was a member of the Civil Defense Panel of the President's Science Advisory Committee.

He was one of the 1969 charter steering group members of the Joint Committee on Tall Buildings (now the Council on Tall Buildings and Urban Habitat). He served as cochairman of its editorial committee.

He was coauthor of the *Steel Design Manual* published by the U.S. Steel Corporation in 1968, and coauthored a beginning text *Basic Steel Design* first published in 1974. In 1969 he received the ASCE's highest award, that of honorary member. In 1979 he was elected to the National Academy of Engineering. In 1981 he received the "Alumni Honor Award for Distinguished Service in Engineering" from the University of Illinois.

Dr. Johnston was author or coauthor of more than seventy papers on structural research. He has always tried to consider both the values and limitations of theory and research on the one hand, the problems of the practicing engineer on the other, and how to bridge the gap between the two.

His retirement was a rich and rewarding time with his family in a relationship that all admired. As his daughter, Carol Snow, described in the memorial service to her father,

Dad's life work was as engineer and educator. In the academic world, he was (as they say) "well published." But I want to share a different instance of being published that also pleased him. In June 1981 in *Golf Digest*, his short poem "The Numbers Game" was published. It goes:

When Ruth requests some household chore,
My age bears down at seventy-four.
But when I stand out on the tee,
I suddenly find I'm forty-three.

