Professor Emeritus David P. Billington (1927 – 2018)

See:
http://www.princeton.edu/cee/people/display_person/?netid=billingt
http://www.princeton.edu/cee/people/display_pubs/?netid=billingt
http://www.worldcat.org/identities/lccn-n81-17316
http://www.amazon.com/David-P.-Billington/e/B001HCY1BO
http://www.barnesandnoble.com/c/david-p.-billington
http://videolectures.net/david_p_billington/
http://www.goodreads.com/author/show/5563361.David_P_Billington_Jr_

Gordon Y.S. Wu Professor of Engineering
Civil and Environmental Engineering
Princeton University

Obituary by John F. Abel and Maria E. Moreyra Garlock:

The global structural engineering community lost an outstanding advocate for creative structural design with the death of David P. Billington. However, his legacy survives through both his writings and his many colleagues and former students whose ideas, practice, scholarship and teaching have been indelibly influenced by this remarkable colleague and mentor.

During his 50 years as a professor at Princeton University, Billington continually enlarged the scope of his teaching and scholarship and became legendary within the university and widely respected internationally. He started with a focus on concrete structures, especially thin shells, and successively engaged in a growing diversity of humanistic studies such as art, history, politics, economics and the contributions of engineering to contemporary culture. Particularly notable was his demonstration in his book, The Tower and the Bridge (1983), that creative structural designers should be considered artists; indeed, the subtitle of this book is The New Art of Structural Engineering. Readers and students became familiar with his tripartite alliterative aphorism that structural design should be "efficient, economic and elegant." In an approach atypical of engineers, he extended his ideas to laypeople not only by his writings, courses and public lectures but also by developing multiple art exhibitions that traveled widely.

After graduating from Princeton in 1950 with a degree in basic engineering, Billington received his first exposure to civil structural engineering through a two-year Fulbright scholarship in Ghent, Belgium with Prof. Gustave Magnel, a pioneer in prestressed concrete. Thereafter, he entered structural design practice in New York City with Roberts & Schaefer Co., where one of his valued mentors was Anton Tedesko who was widely acknowledged as having introduced concrete thin shells in the U.S. (and who was named an IASS Honorary Member in 1979).

In 1960, after having delivered occasional lectures at Princeton, Billington was invited to join the civil engineering faculty to teach structural engineering. He embarked on research with several graduate students, including studying thin-shell behavior by means of micro-concrete models. In 1965, he published the textbook Thin Shell Concrete Structures, which became the leading English-language design reference in this area over the next decades – and was followed by a significantly transformed edition in 1982. This transformation, which included more historical background, more photographs of actual shells and an introduction to structural art, is indicative of Billington's expanded philosophy and approach that was born from seminal teaching experiences of the late 1960s.

It was the challenge of teaching graduate structural engineering courses for Princeton architecture students that provided the stimulus for Billington to dramatically enlarge the focus of his teaching, writing and research. Specifically, the architecture students vociferously asked why structures should be taught with stick figures of hypothetical structures rather than with real examples, especially aesthetically pleasing ones. As examples, they pointed out the concrete bridges of the Swiss engineer Robert Maillart that were featured in the book by Sigfried Giedion, Space, Time and Architecture. This spark ignited Billington's long-lasting interest in Maillart that encompassed some of his books and exhibitions and that culminated with a definitive biography, Robert Maillart: Builder, Designer, Artist (1997).

More broadly, learning of Maillart's skill and artistic expression was one stimulus that inspired Billington and his Princeton colleague Robert Mark to establish a program in Humanistic Studies in Engineering. A central goal of this program was to identify and study the best examples of historical and contemporary structural engineers and to synthesize the qualities of "structural art" and "structural artists": The structural artist is responsible for establishing a rational form of the structure to serve its function safely and sustainably (efficiency), for minimizing the use of material while considering a feasible and appropriate construction method (economy), and for expressing aesthetic intent (elegance). Examples of those identified are Gustave Eiffel, Othmar Ammann, Christian Menn, Fazlur Khan, and a number of honored members of the IASS including Pier Luigi Nervi, Felix Candela, Anton Tedesko, Heinz Isler and Jack Christiansen. All of these, and many more, populate Billington's writings, illustrated lectures, and art museum exhibitions. The designs of many of them have been the subjects of theses written by Princeton students guided by Billington or his colleagues, and the results of these studies enrich the scholarship and lectures on structural art.

Billington's study and teaching of structural art reached full fruition with the development of the course "Structures and the Urban Environment." First offered in 1974, it was intended for engineers and non-engineers alike. Because the course included laboratory and computation sections, it satisfied the science requirement for arts and humanities students. Within a short period, it became the largest and most highly rated course at the university, thanks to both its content and Billington's dynamic and inspiring lecture style. Many students have described taking this course as a transformative personal experience, and as a consequence several changed their enrollments to civil engineering. Similarly inspired were the graduate teaching assistants. The result has been an extended following of colleagues and former students who have entered teaching, research, or design practice, spreading wide Billington's influence and approach. Moreover, he generously shared the course materials with others interested.

In the 1980s, Billington extended this teaching approach to develop another new course, "Engineering in the Modern World," intended to introduce the impact of civil, mechanical, electrical and chemical engineering on current American culture. This course has joined "Structures and the Urban Environment" as among the most successful and effective courses at Princeton University. Both courses continue to be taught today by

Billington's colleagues and successors and thus they remain a significant part of his legacy.
Billington's honors and awards are too numerous to list fully here, but perhaps most significant are his elections as Member of the National Academy of Engineering (1986) and as Fellow of the National Academy of Arts and Sciences (1998). Three honorary doctorates, from Union College, Grinnell College and the University of Notre Dame, preceded the fourth and most symbolic: the Honorary Doctor of Science by his alma mater, conferred in 2015 to recognize the devotion of over 50 years service on the Princeton faculty with great distinction. Finally, Billington was also an honorary member of ASCE, ACI and the IASS.
Although Billington was active in the leading American civil engineering societies – for example, he served terms as chair of the ACI-ASCE Committee on Concrete Shell Design and of the ASCE Committee on Aesthetics in the Design of Structures – the IASS aligned particularly closely to his interests. He will be remembered for his several plenary lectures and papers delivered at IASS symposia; his research and consulting on concrete cooling towers found a natural home in Working Group 3; and he wrote the first two history chapters of the IASS Jubilee Book and was cited in others.
The writers and their colleagues intend to honor Billington's IASS legacy by organizing one or more memorial sessions at IASS 2019 in Barcelona.
\- - - - - - John F. Abel and Maria E. Moreyra Garlock

Personal:
Born June 1, 1927, Bryn Mawr, PA
Married Phyllis Bergquist, 1951, six children

Education
Princeton University, BSE, 1950
Fulbright Fellowship, Louvain, Belgium, 1950-51 and Renewal of Fellowship, Ghent, Belgium, 1951-52: to study post-war innovations in bridge construction, structural design theory, and prestressed concrete

Courses Taught:
EE102 Engineering in the Modern World
CEE262 Structures and the Urban Environment
CEE263 Rivers and the Regional Environment
CEE540 Thin Shell Concrete Structures

Research Areas:
Mechanics, Materials & Structures
Structures and Structural Art

Design & Consulting
Professional Engineer, State of New Jersey
Structural Designer, Roberts & Schaefer Co., New York, 1952-1960 for bridges and buildings including aircraft hangers, piers, thin-shell tanks, and missile-launch facilities
Member, Delegation to observe Concrete Construction in the Soviet Union, 1958
Consulting engineer, 1970-date on Thin Shell Concrete Cooling Towers, Highway Accident Analyses, Thin-Shell Silos, Bridge Design, on France's Largest Overland Bridge and for a study of Federal Dams

Educational & Professional Activities
Assoc. Professor, Princeton University, 1960-1964,
Professor, Princeton University, 1964-date
Visiting Professor, Technical University Delft, 1966-67
Chairman, ACI-ASCE Joint Committee on Concrete Shell Design & Construction, 1973-79
Visitor, Institute for Advanced Study, Princeton, 1974-75, 1978-79
Chairman, ASCE Committee on Aesthetics in Design of Structures, 1978-85
Visitor, Federal Tech. Inst. Zurich, Summers 1980-83
Elected to Executive Council of the Society for the History of Technology, 1985-88
Invited to visit Japan and Write Detailed Aesthetic Evaluation of its New Bridges, 1989

Director, Princeton Program on Architecture and Engineering, 1990-2008
Named the first Gordon Y. S. Wu Professor of Engineering, 1996-date

Recent Honors

Dexter Prize for an outstanding book in the History of Technology, 1979
Phi Beta Kappa Visiting Scholar, 1984-85
History and Heritage Award, American Society of Civil Engineers, 1986
Elected Member, National Academy of Engineering, 1986
Honorary Doctor of Humane Letters, Union College, 1990
Honorary Doctor of Science, Grinnell College, 1991
George Winter Prize, American Society of Civil Engineers, 1992
Andrew D. White Professor-at-Large, Cornell University, 1987-1993
Usher Prize for the Best Scholarly Work, Technology & Culture (with Jameson Doig), 1995
Honorary Member, Princeton Class of 1995 and Princeton Class of 1979
Honorary Doctor of Engineering, Notre Dame University, 1997
Election as a Fellow of the American Academy of Arts & Sciences, 1998
Election as an Honorary Member of the American Society of Civil Engineers, 1999
Sarton Chair 1999-2000 and Sarton Medal, University of Ghent, Belgium, 1999
Election as an Honorary Member of the American Concrete Institute, 2003
National Science Foundation Director's Distinguished Teaching Scholar Award, 2003
Election as an Honorary Member of the International Association of Shell Structures, 2004
A Symposium in Honor of David P. Billington, Dept. of Civil & Environmental Eng., 187 pages, 2004.

Selected Publications:

Billington, D. P.: Thin Shell Concrete Structures, second edition, McGraw-Hill, NY 1982
Billington, D. P.: Thin Shell Concrete Structures, McGraw-Hill, New York 1965

Yung-shih Wang and David P. Billington (Dept. of Civ. and Geological Engrg., Princeton Univ., Princeton, NJ), "Buckling of Cylindrical Shells by Wind Pressure", ASCE Journal of the Engineering Mechanics Division, Vol. 100, No. 5, September/October 1974, pp. 1005-1024
ABSTRACT: An analytical method is developed to solve approximately the bifurcation buckling load of a circular cylindrical shell under nonaxisymmetrical lateral pressure. The assumption of semi-inextensible deformation is made, which sets the circumferential strain to zero and simplifies the system of equations as well as the boundary conditions. In order to investigate the accuracy of the new method, solutions are first obtained for a cylindrical shell under uniform lateral pressure with either simple-simple or clamped-free boundary conditions. Comparisons are made in the former case to Flugge's theory and, in the latter case, to a finite element analysis. Agreement in both cases is very good. The theory is then applied to find the buckling load of a clamped-free cylindrical shell under nonaxisymmetrical lateral pressure created by wind. Disagreement with a previous theory by Langhaar and Miller is examined. Comparisons with results of some experiments are also made and possible reasons of the discrepancies are considered.

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(1) Laboratorium H. Hossdorf, Basel, Switzerland
(2) Department of Civil Engineering, Princeton University, Princeton, New Jersey, USA
(3) Department of Structural Engineering, Cornell University, Ithaca, New York, USA
"Buckling of Cooling-Tower Shells: Bifurcation Results", ASCE Journal of the Structural Division, Vol. 101, No. 6, June 1975, pp. 1205-1222
ABSTRACT: This paper describes studies of bifurcation buckling of hyperboloids used for large-scale cooling towers. Those studies include the effects of flexible supports, combined loadings from wind, dead weight, and temperature, shell cracking, different variations in the wind pressure distribution, and changes in the shell thickening. Comparisons are made between numerical and wind-tunnel results. The finite element formulation used is examined and results are presented for the tower at the Trojan Nuclear Power Plant on the Columbia River, Oregon.