PHILLIP L. GOULD

In step with the abounding vitality of the time, structural engineer **Fazlur Rahman Khan** (1929-1982) ushered in a renaissance in skyscraper construction during the second half of the 20th century. Fazlur Khan was a pragmatic visionary: the series of progressive ideas that he brought forth for efficient high-rise construction in the 1960s and '70s were validated in his own work, notably his efficient designs for Chicago's 100-story John Hancock Center and 110-story Sears Tower -- the tallest building in the United States since its completion in 1974.

Fazlur Rahman Khan

Lehigh endowed a chair in structural engineering and architecture and has established this lecture series in Khan's honor. It is organized by **Professor Dan M. Frangopol**, the university's first holder of the Fazlur Rahman Khan Endowed Chair of Structural Engineering and Architecture, and sponsored by the Departments of Civil & Environmental Engineering, and Art, Architecture & Design.

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ATLSS

Spring 2020 Khan Distinguished Lecture Series

The Fazlur Rahman Khan Distinguished Lecture Series honors Dr. Fazlur Rahman Khan's legacy of excellence in structural engineering and architecture

Initiated and Organized by **PROFESSOR DAN M. FRANGOPOL**
The Fazlur Rahman Khan Endowed Chair of Structural Engineering and Architecture
Department of Civil and Environmental Engineering, ATLSS Engineering Research Center,
Lehigh University
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PHILLIP L. GOULD

Distinguished Adjunct Professor, St. Louis University and Senior Professor, Washington University, St. Louis, MO

"From Slide Rule to FEA: Some Stops Along the Way"

Friday, March 20, 2020 – 4:30 pm

Location: Whitaker Lab 303, Lehigh University, 5 E. Packer Avenue, Bethlehem, PA

http://www.lehigh.edu/frkseries

Phillip Gould, Ph.D., P.E., S.E., Dist. M ASCE, joined Washington University in 1966 after completing his B.S. and M.S. at the University of Illinois, enjoying a short but rewarding career as a structural engineer, and finishing doctoral studies at Northwestern University. He was the Harold D. Jolley Professor of Civil Engineering from 1981 until 2010 and served as department chair for 20 years. His research activities have centered on shell analysis with applications to finite element modeling, biomedical engineering, earthquake engineering, and the structural design of thin-shell structures. Dr. Gould is the author of numerous papers and several books and is the founding editor of the prestigious journal, ENGINEERING STRUCTURES and has served as a consultant to industry and government organizations.

From Slide Rule to FEA: Some Stops Along the Way. Brief comments on the author's professional career, from an aspiring structural designer of buildings and bridges to further graduate study and then an academic and research career, are offered. In deference to the namesake of this lecture, based on recollections of a junior engineer working closely with Fazlur Khan, Dr. Gould offers some observations on Khan's early career. Dr. Gould's subsequent academic and professional activities initially focused on thin -shell analysis, especially the emerging field of hyperbolic cooling towers. The advanced capabilities of the SHORE family of computer programs that were developed in the course of the shell research provided an important tool in the design and explanation of some unique extreme loading situations for both cooling towers and chimneys. As his career progressed, he became very involved in earthquake engineering with strong focus on education and mid-America issues. In the course of teaching graduate subjects, he authored several textbooks and enabled the dissemination of current knowledge as editor of the journal ENGINEERING STRUCTURES.

Moving on to applications of the research of Dr. Gould and his students, potentially destructive loading conditions that have impacted chimneys and cooling towers are briefly described. While chimneys and cooling towers of increasing height have been successfully constructed for decades, in the present context of resiliency they both possess an undesirable structural characteristic in that they are globally statically determinate. Dr. Gould's studies of extreme events that caused a severely damaged cooling tower and a collapsed chimney are used to illustrate selected aspects of their structural performance. The response of each structure is examined with the objective of validating and augmenting design characteristics that may improve their behavior under any imaginable loading condition. The application of nonlinear analysis techniques that may be useful in predicting the response of such structures to multi-hazard design conditions beyond current code requirements is suggested.

FAZLUR RAHMAN KHAN (1929 - 1982) One of the foremost structural engineers of the 20th century, Fazlur Khan epitomized both structural engineering achievement and creative collaborative effort between architect and engineer. Only when architectural design is grounded in structural realities, he believed — thus celebrating architecture's nature as a constructive art, rooted in the earth — can "the resulting aesthetics … have a transcendental value and quality." His ideas for these sky-scraping towers offered more than economic construction and iconic architectural images; they gave people the opportunity to work and live "in the sky." Hancock Center residents thrive on the wide expanse of sky and lake before them, the stunning quiet in the heart of the city, and the intimacy with nature at such heights: the rising sun, the moon and stars, the migrating flocks of birds. Fazlur Khan was always clear about the purpose of architecture. His characteristic statement to an editor in 1971, having just been selected Construction's Man of the Year by *Engineering News-Record*, is commemorated in a plaque in Onterie Center (446 E. Ontario, Chicago): ***"****The technical man must not be lost in his own technology. He must be able to appreciate life; and life is art, drama, music, and most importantly, people."*

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1 PDH will be awarded to eligible attendees for each lecture

Please contact the Khan Chair office at 610-758-6123 or Email: infrk@lehigh.edu with any questions.