



The Donald M. Burmister Lecture
 Department of Civil Engineering and Engineering Mechanics
 Columbia University

The Foundation of High-Rise Buildings with CO₂-minimized Foundation Technology

Prof. Dr.-Ing. Rolf Katzenbach
 Technical University of Darmstadt, Germany

April 28, 2022 (16:30-17:30 EDT)

April 28, 2022					April 29, 2022				
Los Angeles	New York	London	Frankfurt/Paris/Rome	Tel Aviv	New Delhi	Nur-Sultan	Beijing	Tokyo	Sydney
13:30 -	16:30 -	21:30 -	22:30 -	23:30 -	2:00 -	2:30 -	1:30 -	5:30 -	6:30 -

Room 633, S.W. Mudd (Columbia University)

Zoom information (300 max): <http://www.columbia.edu/cu/civileng/ling/burmister>



ABSTRACT The reduction of CO₂ emissions is from the technical and environmental perspective currently all over the world one of the biggest challenges. In that context the question arises, what we can do from the geotechnical side, to reduce the CO₂ emissions during construction and during operation of our buildings. There are, for example, the following possibilities, especially in the area of the foundation of high-rise buildings:

- i) intelligent and optimized application of deep foundations (pile groups) by taking into account the interaction between raft (pile cap) and piles and designing a Combined Pile-Raft Foundation (CPRF).
- ii) science-based and thorough analysis, evaluation and interpretation of large scale pile-load tests.
- iii) using piles as energy-piles, which means, that the piles of a deep foundation are used twice: as construction element, carrying the load into the ground, and as heat exchanger, using the thermal capacity of the soil.

All these aspects are described in the Burmister Lecture 2022, starting with the long-term monitoring of the first generation of the shallow founded high-rise buildings in Frankfurt. There settlements of 20-34 cm (8-13 inches!) occurred in the settlement-active Frankfurt Clay, which led to a lot of problems, regarding serviceability. So we developed the environmentally friendly CPRF as deep foundation with piles in the sense of Ralph Peck's "settlement reducers". By application of the CPRF it is possible to reduce the CO₂ emission of the construction of the deep foundation significantly; in addition we save a lot of money and a lot of time by using the CPRF technology and can use the piles as energy piles. For practitioners the essentials of "ISSMGE Combined Pile-Raft Foundations Guideline" are presented.

In the Burmister Lecture 2022 the theoretical basis, the monitoring results and the practical application of our above mentioned future-oriented developments for the reduction of CO₂ emissions are described in detail and by practical examples of a lot of ready built high-rise buildings, including the highest high-rise buildings of the world in the United Arab Emirates and in Saudi Arabia.

About the Speaker Professor Dr.-Ing. Rolf Katzenbach is since 1993 Full-Professor of the Technical University of Darmstadt, Germany, and is CEO of his Consulting Office "Ingenieursozietät Professor Dr.-Ing. Katzenbach GmbH". He is Past-Chairman of TC 212 Deep Foundations and of TC 215 Environmental Geotechnics of the International Society for Soil Mechanics and Geotechnical Engineering (ISSMGE) and Board Member of several other international and national organisations. He is member of the Chamber of Engineers and publicly certified official Expert of Geotechnics and Independent Checking Engineer working with his expertise for national and international courts of justice, the International Chamber of Commerce (ICC, Paris) arbitration committees, insurance companies, state ministries, building authorities and big national and international financial institutions and investors. Professor Katzenbach is involved in a lot of national and international projects, regarding value engineering and the safety and serviceability of buildings and structures. Due to his outstanding expertise and knowledge Professor Katzenbach was for example appointed by the Building and Construction Authority (BCA) Singapore to carry out the independent Peer Review for the new Metro Line DTL3 in Singapore. The Kingdom of Saudi Arabia appointed Professor Katzenbach as an internationally recognized expert to check the safety of the foundation of the 1,007 m high Jeddah Tower (former name: Kingdom Tower) in Jeddah which will become the highest high-rise building of the world. On behalf of the UNESCO Professor Katzenbach evaluated the interaction between the World Heritage Properties Basilica Sagrada Familia and Casa Mila the very close high-speed railway tunnel in Barcelona/Spain and calculated the safety and serviceability of these extraordinary World Heritage Properties. Professor Katzenbach is responsible for the successful application of the Combined Pile-Raft Foundation (CPRF) at important projects all over the world and is a worldwide accepted specialist for the cost-optimised and CO₂-minimized foundation of high-rise buildings, including the application of energy piles for the use of Geothermal Energy.



The late Prof. Donald M. Burmister (1895-1981) is one of the pioneers in the field of Soil Mechanics and Geotechnical Engineering. He established the Soils Laboratory at Columbia University in 1933. He was a faculty member for 34 years before retiring in 1963. During his tenure at Columbia University, he investigated earthworks and foundations for over 400 projects. Most notably among these were the Brookhaven National Laboratory, the Throgs Neck, Tappan Zee and Verrazano Narrows Bridges, the First New York World Fairs at Flushing Meadows, and the reconstruction of the White House in 1950. He has developed several soil testing methods and his soil classification system is still widely used. He also contributed to the first use of digital computer in conjunction with his theory of the layered pavement system.