59TH RANKINE LECTURE

Wednesday 20th March 2019 at 5.30pm

The Great Hall, Sherfield Building, Imperial College London, Exhibition Road, SW7 2AZ

(Additional seating in the Clore Lecture Theatre, Huxley Building, Imperial College – see No 13 on map overleaf)

Benefits of Unconventional Seismic Foundation Design

Professor George Gazetas

National Technical University of Athens

George Gazetas has been Professor of Geotechnical Engineering at the National Technical University of Athens for 30 years, following an academic career in the US, where he taught at SUNY-Buffalo, Rensselaer (RPI), and Case Western Reserve University. His main research interests have focused on the dynamic response of footings, piles and caissons; the seismic response of earth dams and quay-walls; soil amplification of seismic waves; and soil–structure interaction problems. Much of his research has been inspired by observations after destructive earthquakes. An active writer and teacher, he has been a consultant on a variety of (mainly dynamic) geotechnical problems. The recipient of prestigious awards for his research contributions, he has given the Coulomb (2009) and Ishihara (2013) Lectures, and received the Excellence in University Teaching Award in Greece (2015).

ABSTRACT

Current seismic geotechnical practice has embraced concepts inspired by pseudo-static thinking and force-based methodologies. The result is often over-designed foundations that, in addition to being uneconomical and difficult to implement, might unexpectedly lead to poor technical performance of foundation–structure systems.

The lecture will address the benefits of drastically changing the established philosophy in seismic foundation design. Emphasis will be given to *"foundation rocking and soil failure"* of tall slender structures, the foundations of which we deliberately under-designed to ensure that during strong shaking substantially nonlinear and inelastic soil-foundation interaction takes place — uplifting of footing from the supporting soil, along with mobilisation of bearing-capacity failure mechanisms in the soil. Thanks to the *kinematic* nature of seismic shaking, allowing such unconventional response limits the accelerations transmitted up into the super-structure. Hence it reduces the inertia loading which "returns back" onto the foundation in the form of overturning moments and shear forces. Owing to its *cyclic* nature, seismic response generates a significant amount of damping in the soil, while exceedance of the ultimate capacity acts (only) momentarily and alternatingly. The two phenomena contribute towards decreased response intensity and acceptable levels of residual deformations (displacements and rotations). Deformations are further diminished by the beneficial contribution of gravity to *re-centering* of the foundation.

Physical experiments, analyses, and field observations, involving a variety of structural systems and foundations, will illustrate the technical advantages of such unconventional designs. Analysis of two historic seismic case histories, involving failure of bridge piers and overturning of buildings, will further demonstrate the potential benefits (as well as the limitations) of this new paradigm in seismic soil–foundation–structure interaction.

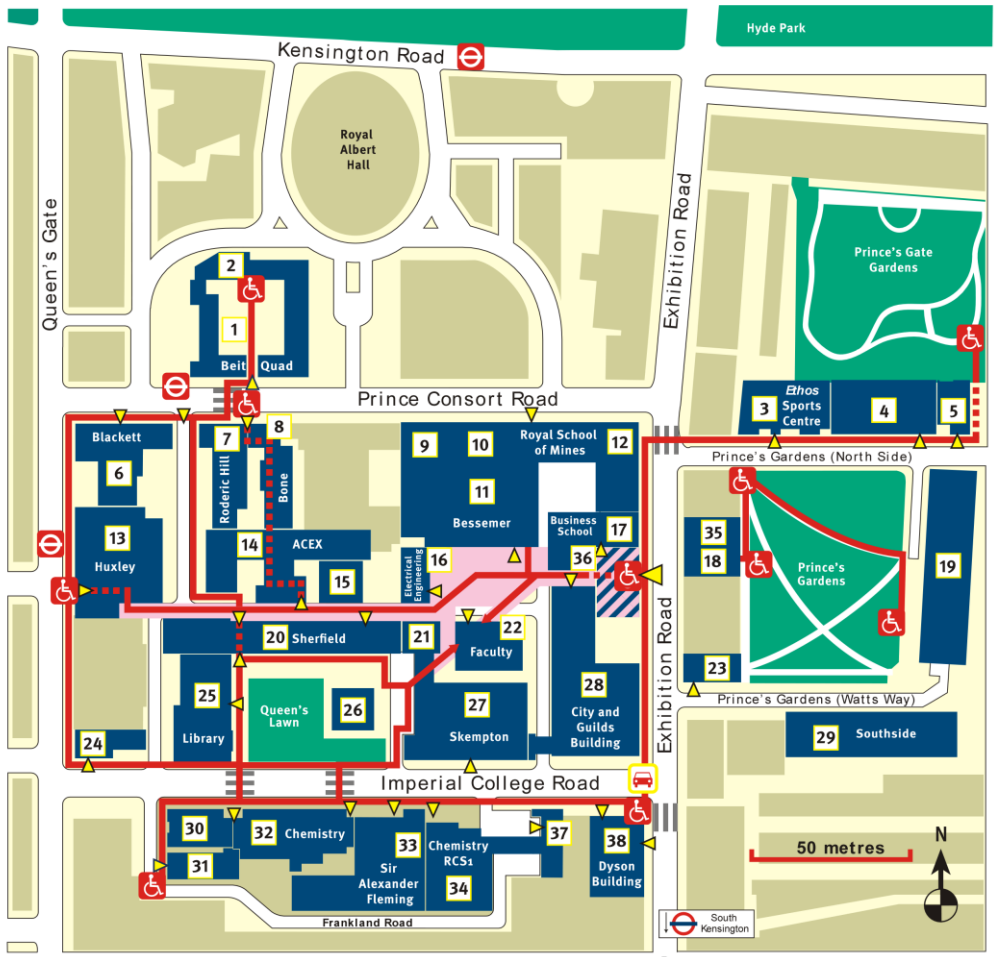
The lecture will be broadcast live and the link made available via the BGA website just before the event.

BGA · THE BRITISH · GEOTECHNICAL ASSOCIATION

ice Institution of Civil Engineers

Imperial College London

South Kensington Campus



Main walkway
Main entrance
Accessible route
Buildings where wheelchair accessis not possible at this time

South Kensington Underground
Bus stops
Building entrances
Vehicle entrance

1	Beit Quadrangle
2	Imperial College Union
3	Ethos Sports Centre
4	Prince's Gdns, North Side
5	Weeks Hall
6	Blackett Laboratory
7	Roderic Hill Building
8	Bone Building
9	Royal School of Mines
10	Aston Webb
11	Bessemer Building
12	Goldsmiths Building
13	Huxley Building
14	ACE Extension
15	William Penney Laboratory
16	Electrical Engineering
17	Business School
18	53 Prince's Gate
19	Eastside
20	Sherfield Building
	Student Hub
	Conference Office
21	Grantham Institute – Climate Change and the Environment
22	Faculty Building
23	58 Prince's Gate
24	170 Queen's Gate
25	Central Library
26	Queen's Tower
27	Skempton Building
28	City and Guilds Building
29	Southside
30	Sir Ernst Chain Building – Wolfson Laboratories
31	Flowers Building
32	Chemistry Building
33	Sir Alexander Fleming Building
34	Chemistry RCS1
35	52 Prince's Gate
36	Alumni Visitor Centre
37	Observatory Building
38	Dyson Building of Design Engineering