



Imperial College  
London

# Post-Tensioning

Design and Construction

A 2 day programme **25 - 26 April 2012**

Optional Hands-on Computer Workshop **27 April 2012**

**Course Director**

**Dr Bijan O. Aalami**

Professor Emeritus  
of San Francisco State University



School of Professional Development Programme

## Purpose and Background

This course provides the know-how and tools for efficient and economical designs of post-tensioned structures. It presents the latest developments in construction technology, code provisions, design procedures, and software tools. After a brief introduction to current post-tensioning systems and construction practice, the course continues with the economics of both grouted and unbonded options, and covers the practical design concepts and design procedures for beams, one-way and column supported two-way flat slab construction. Each step is supplemented with well-documented literature, examples, and computer simulations.

The course continues with the state-of-the-art methods for graphical modelling of structures for analysis and design of floor systems, including the efficient use of AutoCad drawings, Revit Structure © and ADAPT's model generation tools in bringing BIM within reach of everyday consulting work. It presents an integrated and seamless process for generating structural calculations, post-tensioning and reinforcement drawings, shop (fabrication) drawings and the estimate of quantities. The course demonstrates the efficient integration of analysis results, obtained from third party software, for the overall stability of a structure under wind and earthquake, with the gravity design using ADAPT software system. The course also covers short and long-term deflections, cracking, crack width calculation, and vibration evaluation and control.

## Learning Objectives

This programme will include:

- Current post-tensioning systems and construction practice in buildings and parking structures
- Economic advantages of post-tensioning in building construction
- Design concepts, procedures and detailing of post-tensioned structures
- Latest design code provisions for design of post-tensioned structures (EC2, ACI 318-2008, International Building Code-2009)
- Overview and application of TR43 Report
- Short and long-term deflections; cracking and crack width calculation
- Detailed long hand calculations for post-tensioning design and design verification
- Evaluation of concrete floors for vibration and vibration control
- Equivalent frame and Finite element application to design of post-tensioned buildings
- Structural modelling of post-tensioned buildings and design, using ADAPT software system, AutoCad and Revit Structure ©
- Time-dependent behaviour and creep analysis of pre-stressed concrete beams/slabs
- Hands-on software and design training workshop

## Course Benefits

Course attendees will receive comprehensive course notes and reference material including detailed design examples.

- Find out about the latest developments in post-tensioning systems, its construction practice, and economical advantages
- Understand the requirements of EC2, BS8110, ACI, IBC (International Building Code) building codes, TR43 Report, and their impact on your design
- Learn how to avoid costly errors by using an integrated approach in design from architectural drawings to structural documents
- Become skilled in tendon layout and detailing for good construction practice
- Examine the possibilities of using powerful software tailored for the design of post-tensioned and conventionally reinforced concrete, including modelling and design through ADAPT software system and Revit Structure ©
- Learn to optimize the design process for efficiency and economy
- Learn how to integrate effectively the lateral analysis of buildings with the gravity design of their floors

# Content

## Day 1 - 25 April 2012

- Introduction to post-tensioning, post-tensioning systems, and post-tensioning hardware
- Construction technology of post-tensioned structures; preferred construction practice
- Economics of post-tensioned construction and quantities
- Review of design concepts of concrete floors with specific reference to post-tensioning
- Building Code Requirements of EC2, BS8110, ACI, IBC and TR43 Report, and their impact on design of post-tensioned structures
- Long hand design example of a post-tensioned column supported floor structure
- Equivalent Frame Method and computer applications for design of post-tensioned floor systems and beam frames (using ADAPT-PT)
- Questions and discussion

## Day 2 - 26 April 2012

- Time-dependent behaviour and creep analysis for pre-stressed members
- Structural modelling of post-tensioned members for analysis and design
- Finite element design of post-tensioned floor systems using ADAPT-Floor Pro; a case study of design of a flat slab floor system; efficient use of AutoCad drawings and Revit Structure ©
- Design for restraint and crack mitigation in post-tensioned structures
- Deflections
- Vibrations
- Design of post-tensioned floor systems in high seismic and wind regions
- Questions and discussion

## Day 3 - 27 April 2012 (Optional Hands-On Computer Workshop)

### Purpose and Format

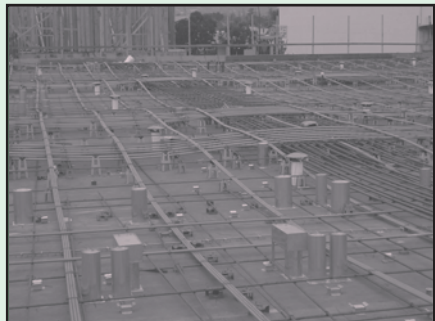
The workshop is for those interested in hands-on training in design of post-tensioned buildings. Each participant will be working on a dedicated computer with the latest ADAPT analysis and design software. Starting with an architect's drawing, participants will be guided through the design process to the creation of the construction and fabrication drawings. They will learn how to start and in a short time conclude, with an efficient design. Each participant will receive a CD with the educational versions of ADAPT software.

### Workshop Benefits:

- Obtain hands-on experience and exposure to the efficient design of post-tensioned buildings
- Become closely familiar with the latest design tools and methods
- Receive detailed information, literature and design examples of common post-tensioned buildings

### Who Should Attend?

- Structural engineers engaged in concrete and/or post-tensioning design
- Contractors interested in the design of post-tensioned structures
- Engineers responsible for the review of post-tensioned designs
- Academics and students having an interest and background in concrete design
- Building officials and city plan checkers
- Engineers charged with retrofit of post-tensioned buildings
- Forensic engineers who deal with post-tensioned structures



# The Presenters



**DR. BIJAN O. AALAMI**, a Life Member of the Post-Tensioning Institute and ASCE, is Professor Emeritus of San Francisco State University, Chartered Engineer, and CEO and Founder of ADAPT Corporation - a structural engineering firm in California specialising in the design of concrete structures. He has been actively engaged in the design and construction of numerous notable post-tensioned buildings, bridges and special structures. A renowned world leader and teacher in the design of concrete buildings, bridges, special structures and post-tensioning, through his worldwide educational seminars, Dr. Aalami has enriched the practice of many engineers in North and Latin America, Far East, Europe and the Middle East. His extensive publications on concrete design, in particular post-tensioning, are regarded as primary resources for practical design of post-tensioned buildings and bridges. For over twenty years, Dr. Aalami has been the project leader of the ADAPT software suite of programs that are serving concrete design engineers in over 75 countries worldwide.



**DR. FLORIAN AALAMI** earned a bachelor's degree in civil engineering from the University of California, Berkeley and both a master's degree in structural engineering and a doctoral degree in construction technology from Stanford University. Florian's extensive career in AEC software development began at Stanford's Center for Integrated Facility Engineering and extended to his founding of BuildPoint Corporation, where he served as CTO and Vice President of Business Development. As a specialist in construction technology, his interest and involvement in post-tensioned structures, is driving ADAPT's global activities as a leading provider of software and speciality consulting services for the concrete design industry.



**DR. NEIL TSANG** is a senior lecturer in the Department of Built Environment at Coventry University. Dr Tsang is a graduate of the University of Sheffield, worked for the Babbie Group, and became a Chartered Structural Engineer before moving to Imperial College London. He undertook research on problems associated with the time dependent behaviour of concrete structures and integral bridges. He was the recipient of both a Mott McDonald PhD Scholarship and a Croucher Foundation Fellowship. He has lectured at the University of Strathclyde and at Imperial College London before his current position at Coventry University. He has published papers on the time and temperature dependent behaviour of concrete structures and mechanics of granular soil. He is also co-author of a book on Integral Bridges.



**DR. TONY JONES** leads the "Structural Development and Support" team with Arup. He is responsible for providing day to day guidance to Engineers constructing some of the most exciting structures in the world; his area of expertise is structural concrete including all aspects of prestressing. He is Chairman of the Concrete Society Design Committee and was an active member of the group that redrafted Concrete Society Technical Report 43, "Post Tensioned Concrete Floors: Design Handbook". He also sits on the BSI committee responsible for the structural concrete design codes and is head of delegation for the UK on the equivalent Eurocode committee. Prior to joining Arup in 1997, Tony worked for the British Cement Association carrying out and managing research projects

in various aspects of concrete construction; The University of Birmingham, where he worked as a Research Assistant investigating structural deterioration in concrete; and for Costain as a Site Engineer, where he gained first hand experience of the need for good design.

## Participating Organisations

*Organisations that have been represented on previous courses include:*

- Buro Happold ■ WSP Buildings ■ Bovis Lend Lease Ltd ■ ODIN Consulting Engineers Ltd
- JSA Consulting Engineers ■ CTT Stronghold ■ Atkins ■ Robinson Consulting Ltd
- FaberMaunsel ■ Finnmap Consulting ■ JLE Eng ■ Halcrow ■ Campbell Reith
- Jacobs GIBB Ltd ■ Nolan Associates ■ Alan Baxter & Associates ■ Cameron Taylor Bedford
- Appleby Group Ltd ■ Arab Enterprise ■ Esteyco ■ Elliott Wood Partnership ■ Skanska
- Bunyan Meyer & Partners Ltd ■ Clarke Nicholls & Marcel ■ Gyoury Self Partnership ■ MLM
- BBR ■ VSL ■ Freyssinet ■ MC4

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