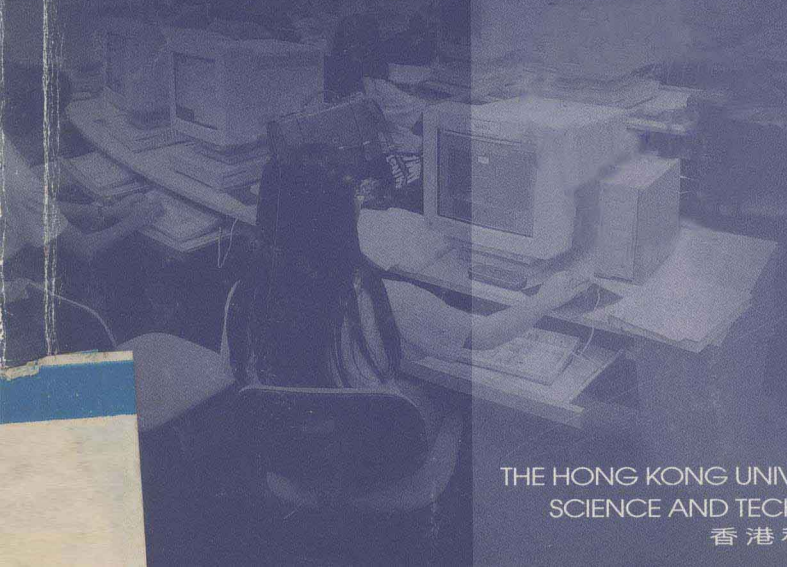
Postgraduate Studies 1997-98

DEPARTMENT OF

Civil Engineering



THE HONG KONG UNIVERSITY OF
SCIENCE AND TECHNOLOGY
香港科技大學

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Introduction

The Civil and Structural Engineering Department is devoted to improving the human environment for the purpose of making people's activities productive, safe, enjoyable, and aesthetically pleasing. The profession contributes directly to humanity's continued health and well-being by planning and designing systems that provide potable water free from disease-carrying waste, transportation, housing and other structures; and by mitigating and reducing both natural and human-made hazards.

In short, civil engineering is a broadly-based discipline which applies technical skill and humanistic perception in solving problems related to the creation, preservation, and advancement of civilisation. Almost any solution to every societal problem has some connection with civil and structural engineering, including the development, utilisation, and control of resources for the benefit of human beings. The Civil and Structural Engineering Programmes at the Hong Kong University of Science and Technology aim at providing students with advanced knowledge and intellectual stimulation to meet the challenges in the development of a modern society.

Academic Staff

Head of Department and Professor :

Wilson H. TANG (PhD, Stanford)

Professors:

Tse-Yung Paul CHANG (PhD, University of California, Berkeley)
Gerhard William HEINKE [Director of the Institute for Environmental Studies] (PhD, McMaster University)
Ju-Chang Howard HUANG (PhD, University of Texas, Austin)
Chih-Kang SHEN (PhD, University of California, Berkeley)
Yeou-koung TUNG (PhD, University of Texas, Austin)

Associate Professor :

Neil C. MICKLEBOROUGH [Associate Dean of the School of Engineering] (PhD, University of Tasmania)

Visiting Associate Professors:

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Assistant Professors/Lecturers:

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Visiting Assistant Professor :

Visiting Assistant Professor :

Parmeshwar L. SHRESTHA (PhD, University of California, Davis)

Visiting Scholar:

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Part-Time Lecturers :

Y.C. MOK (MSc, University of Hong Kong)
C. SIU (BSc, University of Hong Kong)

Postgraduate Programmes

The Department of Civil and Structural Engineering offers postgraduate programmes leading to the degrees of Master of Science (MSc), Master of Philosophy (MPhil), and Doctor of Philosophy (PhD) through full-time and part-time modes of study.

Master of Science (MSc) in Civil and Structural Engineering

This programme is for students who intend to pursue a career involving engineering practice along with management responsibilities. The MSc is a coursework degree which normally requires one-and-a-half years of full-time study. Each student is required to complete at least 30 credits of approved subject work. Six of the credits must be a design project under the supervision of a qualified advisor from either the Department and/or industry. The average course grade obtained for satisfying degree requirements must be B.

Master of Science (MSc) in Environmental Science and Engineering

This is an interdisciplinary coursework degree programme which is part of the MSc in Environmental Science and Engineering programme at HKUST. The purpose of this programme is to prepare graduates to contribute to solving many of the urgent environmental problems in Hong Kong. HKUST is in a particularly unique position to offer such a programme because of its strong science and engineering base as well as the extensive expertise in various areas of environmental research. The participating engineering departments in this programme are the Civil and Structural, Chemical, and Mechanical Engineering Departments. Several science departments also contribute to the overall programme. Students are required to take the General Core Courses (9 credits) which include Environmental Management, Environmental Chemistry and Microbiology, and Measurements of Pollutants. In addition, 12 credits of the Engineering Foundation Courses, 3 to 6 credits of Electives and 3 to 6 credits of an MSc project are required.

Master of Philosophy (MPhil) in Civil and Structural Engineering

The MPhil programme differs from the MSc programme in that students are required to complete at least 15 credits of postgraduate course work. In addition to course work, students must complete a thesis to demonstrate competence in engineering research. The student is supervised by a research supervisor who is a faculty member of the Department. If the student participates in an industrial project and writes his/her thesis on a work-related topic, the thesis will be supervised jointly by a faculty member of the Department and a representative from the participating company. The MPhil degree normally takes one and a half

years to complete, but time required depends on undergraduate preparation. The average course grade obtained for satisfying degree requirements must be B.

Doctor of Philosophy (PhD) in Civil and Structural Engineering

The PhD degree is awarded upon the successful completion of an advanced study programme which includes a minimum of 30 credits of postgraduate subjects and a thesis of significant original research. Students entering with a Master's degree in engineering may, with the approval of the Department, be granted an equivalent of up to 15 credits towards fulfilling the PhD credit-hour requirements. The average course grade obtained for satisfying degree requirements must at least be B+.

The doctoral programme usually takes a minimum of three years of full-time study beyond the bachelor's degree, or a minimum of two years beyond the Master's degree.

Six months after a student enters the PhD programme, the student is required to approach a faculty member for his/her research supervisor and doctoral guidance committee will also be established to supervise his/her programme of study and thesis work. To become a doctoral candidate, the student must pass a qualifying examination within the first year and a half of his/her PhD study. The qualifying examination consists of two parts: a written examination and an oral examination. The written component covers undergraduate and first-year postgraduate materials and evaluates the student's preparation for doctoral postgraduate study in civil and structural engineering. The oral examination is given by the doctoral supervision committee after the student passes the written examination. The purpose of the oral examination is to establish the student's ability to formulate and conduct original research in his/her chosen discipline.

Upon completion of the postgraduate study programme and the thesis, the candidate is required to defend the thesis before a thesis examination committee.

Postgraduate Courses

The following is a list of postgraduate courses with subject content given. They are offered in different semesters. The figures in [ ] represent weekly lecture hours, tutorial hours, lab hours and the credit value of the course.

CIVL 511 Simulation In Civil Engineering [3-0-0:3]
Use of computer simulation in the analysis of civil engineering systems with emphasis on the simulation of stochastic water resource systems.
Background : COMP 102, MATH 241 and MATH 243 (or MATH 244); or equivalent.

CIVL 512 Finite Element Methods [3-0-0:3]
FEM formulation; variational and Galerkin principles for continuum; element technology; numerical integration scheme; solution of large systems of linear equations; applications to structural mechanics, fluid flow and heat transfer problems.
Exclusion : MECH 593

CIVL 513 Numerical Methods For Civil Engineers [3-0-0:3]
Finite difference (FD); method of characteristics (MOC); mixed FD and MOC; upwinding; problem of discretization; equivalent differential equations; accuracy, stability, consistency and convergence; emphasis on fluids, structures and geotechnical problems.

CIVL 514 Instrumentation Systems for Civil Engineers [2-0-1:3] *
This course will introduce the theoretical and practical knowledge of the basic components of an instrumentation system including transducers, signal conditioning, data acquisition, noise elimination, and signal processing.

CIVL 521 Advanced Reinforced Concrete [3-0-0:3]
Presents an up-to-date treatment of reinforced concrete theory and practice; includes ultimate limit state design for bending, shear, torsion, combined bending and compression, serviceability requirements, plates and slab, art of detailing.
Background : CIVL 231 and CIVL 232; or equivalent.

* Subject to the approval of the relevant University authority.

CIVL 522 Advanced Prestressed Concrete [3-0-0:3]

Basic concepts, design for serviceability and time dependent analysis, ultimate strength limit states, anchorage zones, statically indeterminate structures, two-way slabs, compression and tension members.

CIVL 523 Behaviour And Design Of Steel Structures [3-0-0:3]

Provides a solid understanding of theory and design of steel structures; includes design philosophies, basic member design, plate girders, beam-columns, connections, semi-rigid frames, stability, plastic design, design optimization of steel frameworks.

Background : CIVL 232 and CIVL 335; or equivalent.

CIVL 524 Advanced Concrete Technology [2-0-1:3]

High strength concrete, high-workability concrete, fiber-reinforced concrete, shrinkage-compensating concrete, structural lightweight concrete, concrete bond properties, concrete fracture behaviour and modelling.

Background : CIVL 111 and CIVL 112; or equivalent.

Exclusion : CIVL 323

CIVL 531 Structural Analysis And Design Of Tall Buildings [3-0-0:3]

Integrated treatment of analytical methods and technical aspects in design of tall building structures; includes structural modelling, frames, shear walls, outrigger-braced systems, core-walls, tubular structures, and special topics.

CIVL 532 Structural Dynamics [3-0-0:3]

Basics, lumped mass systems with various degrees of freedom, energy methods, modal analysis, frequency domain, numerical methods, continuous systems, earthquake engineering, wind loading and aerodynamic effects on buildings.

CIVL 533 Advanced Mechanics Of Materials [3-0-0:3]

Analysis of stress and strain; elastic and inelastic behaviour of materials: formulation of BVP; beam on elastic foundations; torsion of noncircular thin-walled members; deformation of cylinders and spheres; inelastic analysis.

CIVL 534 Optimal Structural Design [3-0-0:3]

Advanced techniques for design optimization; includes linear and nonlinear mathematical programming techniques, approximation concepts, sensitivity

analysis, optimality criteria method for large-scale structures; special topics on optimal tall building design.

CIVL 535 Elasticity and Plasticity [3-0-0:3]

[Previous Course Code: CIVL 600E] Stress and strain tensor; compatibility; Hook's Law and equilibrium equations; plane stress and plane strain; two-dimensional problem in polar co-ordinates; elastic wave; failure criteria; flow rule; upper and lower bound; applications of plasticity.
Background : CIVL 112
Exclusion : MECH 501

CIVL 541 Physical And Chemical Wastewater Treatment [3-0-0:3]

Principles of treatment for removing contaminants from drinking water and municipal wastewaters; includes equalization, neutralization, precipitation, coagulation and flocculation, sedimentation, filtration, air stripping, carbon adsorption, disinfection.
Background : CIVL 242; or equivalent.

CIVL 542 Biological Waste Treatment [3-0-0:3]

Principles of secondary, biological treatment processes; includes sewage sand filters, trickling filters, activated sludge plants, lagoons, ponds, rotating biological contactors, aerobic and anaerobic digesters, and biological nutrient removal.
Background : CIVL 242; or equivalent.

CIVL 543 Aquatic Chemistry [3-0-0:3]

Chemistry applied to reactions occurring in water and wastewater; includes inorganic solution chemistry, chemical equilibrium, acids/bases, co-ordination chemistry, chemical kinetics, colloid chemistry, solubility and precipitation, oxidation-reduction potential.
Background : CIVL 242; or equivalent.

CIVL 544 Process Design Of Water And Wastewater Treatment Systems [3-0-0:3]

Complete design of water or wastewater treatment plants with emphasis on careful iterative accounting in terms of solids mass balances, flow sidestreams, hydraulics and pumping.
Prerequisites : CIVL 541 and CIVL 542; or equivalent.

CIVL 545 Hazardous Waste Treatment And Site Remediation * [3-0-0:3]

Regulatory aspects of the handling and disposal of hazardous wastes, and innovative technologies for the treatment of hazardous wastes and contaminated soils such as stabilization/solidification, bioremediation, soil vapour extraction and soil washing will be included.
Background : CIVL 344; or equivalent.

CIVL 546 Solid Waste Management and Disposal [3-0-0:3] *

Practical aspects of solid waste collection methods and equipment, current available disposal techniques with more emphasis on complete engineering design of landfill systems, and landfill leachate treatment will be included.
Background : CIVL 141 and CIVL 271; or equivalent.

CIVL 547 Industrial Wastewater Treatment [3-0-0:3]

Procedures for industrial surveys; includes waste sampling, waste characterization, treatability studies, selection of treatment methods for achieving cost-effective operation, case studies of selected types of industrial waste treatment.

CIVL 551 Fluid Transients In Systems [3-0-0:3]

Unsteady flow problems in complex pipe or channel systems with emphasis on boundary condition representation; pipe networks, pumps, valves, reservoirs; open channel systems, irrigation, storm and sanitary sewers.
Background : CIVL 151; or equivalent.

CIVL 552 Water Resources Systems Analysis [3-0-0:3]

Systems approach to the area of water resources management; includes water resources systems within the context of public investment systems, criteria and design of water management schemes.
Background : ECON 111 and MATH 281; or equivalent.

CIVL 553 Wastewater Disposal [3-0-0:3]

Disposal of wastewater in rivers, lakes and oceans; includes water quality standards, wastewater collection and treatment, outfall hydraulics, transport and dispersion of conservative and non-conservative pollutants.

* Subject to the approval of the relevant University authority.

CIVL 555 Modelling Fluid Systems [3-0-0:3]
Physical processes in water resource systems, their mathematical representation and numerical solutions; includes Newton's second law, equations of mass and energy conservation applied to closed-conduit, open-channel and groundwater flow problems.

CIVL 561 Urban Transportation Networks Analysis [3-0-0:3] *
Provides an overview of transportation planning models and traffic analysis; examines the assignment of traffic flow on a network according to the user-equilibrium and system optimal objectives; addresses common formulation methods and solution techniques.
Background : CIVL 261 and IEEM 201

CIVL 562 Traffic Demand Analysis [3-0-0:3] *
Overview of transportation planning process; population/employment forecasting techniques; discrete choice models; simplified transportation demand models.
Background : CIVL 261; or equivalent.

CIVL 571 Advanced Soil Mechanics [3-0-0:3]
Selected topics from recent advances in theoretical and experimental development in soil mechanics; includes stress-strain behaviour of soil, consolidation settlement, drained and undrained strength, slope stability problems.
Background : CIVL 372; or equivalent.

CIVL 572 Advanced Foundation Design [3-0-0:3]
Current practice of foundation design and analysis; includes design and analysis of bulkheads, deep excavation, tieback systems, tunnelling in soft ground, buried conduits, lateral pile loading, pier foundations.
Background : CIVL 372; or equivalent.

CIVL 573 Theoretical Soil Mechanics [3-0-0:3]
Recent advances in numerical methods in geotechnical modelling; includes boundary conditions, constitutive laws, critical soil state mechanics, bounding-surface and hypoplastic concepts, diffusion and consolidation problems.
Background : CIVL 372

* Subject to the approval of the relevant University authority.

CIVL 574 Ground Improvement And Geosynthetics [3-0-0:3]
A state-of-the-art examination of the use of geosynthetics and ground modification techniques in geotechnical engineering; includes soil densification, preloading, vertical drain, grouting, ground freezing, soil nailing, and the use of geosynthetics in geotechnical design.
Background : CIVL 372; or equivalent.

CIVL 575 Soil Dynamics [3-0-0:3]
Examines basic principles of soil dynamics and site response analysis; includes theory of vibration and elastic wave propagation, time discretization, earthquake excitation, soil behaviour under dynamic loading, liquefaction, machine foundations.
Background : CIVL 372; or equivalent.

CIVL 576 Marine Geotechnical Engineering [3-0-0:3]
Investigation of marine soil properties and geotechnical testing, ocean wave and earthquake loading, seafloor slope stability, foundations for offshore structures.
Background : Soil mechanics and foundation engineering.

CIVL 577 Unsaturated Soil Mechanics [3-0-0:3] *
Basic principles, stress state variables, permeability, pore pressure parameters, shear strength theory and measurements, plastic and limit equilibrium analyses, volume change theory and measurements, critical state framework and applications.
Prerequisite: CIVL 372; or equivalent.
Background: a first degree in civil engineering.

CIVL 581 Engineering Risk, Reliability And Decision [3-0-0:3] *
Advanced reliability methods in engineering decision; Bayesian methods, system reliability and design, risk analysis, probabilistic observational method, Markov and availability models, random field, large-scale system simulation, decision with multiple objectives.
Prerequisite : CIVL 281; or equivalent.

CIVL 600 Special Topics [3-0-0:3]
Selected topics of current interest. May be repeated for credit if different topics are covered.

* Subject to the approval of the relevant University authority.

CIVL 610 Directed Studies [3-0-0:3]
Specialist courses where instruction is generally on a one-to-one basis.

CIVL 612 Advanced Topics in Finite Element Analysis [3-0-0:3]
Variational formulation of nonlinear boundary-valued problems with material and geometric nonlinearities; solution methods for nonlinear systems of equations; solutions for plastic and viscoplastic problems.
Background : CIVL 512

CIVL 680 Civil and Structural Engineering Seminar [1-0-0:1]
Discussion of current graduate research, and guest lectures on recent advances in civil and structural engineering. The course may be repeated for credit. Up to a maximum of 3 credits can be earned by any single student. (Graded either P or F).

CIVL 698 MSc Project [6 credits]
An independent research project carried out under the supervision of a faculty member. This compulsory project for MSc students will normally be completed by the end of the course of study.

CIVL 699 MPhil Thesis Research
Master's thesis research supervised by a faculty member. A successful defence of the thesis leads to the grade Pass. No course credit is assigned.

CIVL 799 Doctoral Thesis Research
Original and independent doctoral thesis research. A successful defence of the thesis leads to the grade Pass. No course credit is assigned.

Major Research Areas

The research focus of the Civil and Structural Engineering Department lies in two broad areas: infrastructure development and planning, and environmental and water resources studies. There are many subgroups under each of these two areas. A brief description of each area is given below. It is likely that research emphases will shift as new areas of technology emerge.

Infrastructure Development and Planning

The major technological support for infrastructure development lies within the civil engineering disciplines, including the traditional specialty fields of structural engineering, construction management and technology, geotechnical engineering, harbour and coastal engineering, water resources systems, and the interdisciplinary, broad-based approach of transportation systems engineering, regional development and planning, etc. The infrastructure facilities now being developed under the Port and Airport Development Scheme (PADS) in Hong Kong are having a very strong and positive impact on our postgraduate programme in terms of research and technological development. Major research areas identified include building-system design and analysis, geotechnical engineering and soil-structure interaction, construction materials, transportation system modelling and operation, integrated risk and reliability assessment, and infrastructure system development.

Environmental and Water Resources Studies

The 1990's are generally recognised as the decade of environmental awareness. HKUST is committed to devoting its resources and expertise in fundamental and applied research to the development of advanced technology to improve the quality of life and to minimize environmental hazards. Research areas in which civil and environmental engineering will play a leading role include contaminated sediment transport; innovative physical, chemical, and biological water and wastewater treatment processes; mathematical models for environmental quality management; mixing and transport phenomena of pollutants in natural and man-made systems; and water resources management and engineering.

Facilities

The University has a number of central facilities providing equipment to support teaching and research. These facilities include an electronic support shop, instrumentation pool, machine shop, CAD/CAM laboratory, and the Materials Characterisation and Preparation Centre. The University also maintains state-of-the-art academic computing facilities.

In addition to these, the Department of Civil and Structural Engineering itself also supports the following laboratories for instruction and research:

Computational Laboratory

This laboratory is equipped with Pentium PC's, a variety of workstation platforms, high-resolution graphics terminals, plotters and laser printers all connected by a LAN to the University network with access to Internet. In addition, many general-purpose and engineering application software packages are installed for:

- undergraduate and postgraduate teaching
- students' assignments
- computational research
- industrial training

Construction Materials Laboratory

The Construction Materials Laboratory is equipped with state-of-the-art facilities, including 450-metric-ton digital controlled MTS machine, 25-metric-ton digital controlled dynamic MTS machine, Acoustic Emission (AE) Measurement systems, Extruder, and Speckle measurement system.

The laboratory provides a good environment for both undergraduate and postgraduate teaching and research. The undergraduate students conduct cement, aggregate, normal strength concrete, high strength concrete, and fiber reinforced concrete experiments here all the year round. The research programs conducted in the laboratory include: application of AE technique in early detection of reinforcing steel, bond properties between smooth surface rebar and cement, tensile behaviour of short fiber reinforced cementitious composite, high performance concrete, investigation of bond failure for ceramic tile system, fly ash concrete, rubber particle concrete, impedance measurement of cementitious composites, and composite reinforced concrete. The research programmes are applicable to both civil engineering and construction industries.

Environmental Engineering Laboratory

The Environmental Engineering Laboratory (450m^2) at HKUST is fully equipped with modern instrumentation, plus a full range of standard equipment for performing routine environmental analyses (such as pH, DO, COD, BOD, N, P, hardness, conductivity, alkalinity, bacteriological analyses, etc.). Sophisticated instrumentation includes gas chromatograph with mass spectrometer and flame ionization detector; high performance liquid chromatography; ion chromatograph; UV-Visible spectrophotometer with diode array detector; atomic absorption spectrophotometer; automatic ion analyser; aerobic/anaerobic respirometer; coulter counter; TOC analyzer; Zeta meter; anaerobic gas analyzer; dual-solvent extractor and research microscopes, etc. In addition, numerous complete and functional water and wastewater treatment models are available for both teaching and research purposes. Two walk-in temperature control rooms and one large cold storage room are also available for research studies.

Fluid Mechanics Laboratory

There are two Fluids Laboratories supporting research and teaching activities in the field of environmental fluid mechanics. A teaching laboratory (135m^2) is equipped to perform a large variety of experiments, ranging from the classic experiments of Osborne Reynolds on laminar and turbulent flow to more applied experiments such as the performance characteristics of pumps and turbines. A research laboratory (275m^2) contains two large scale research facilities: a large towing tank (15m long, 2m wide and 1.6m high) and a recirculating flume (working section 12.5m long, 0.3m wide and 0.5m high). These facilities provide support for research in a number of areas including contaminant dispersion, open channel hydraulics, stratified flows and sediment transport. The facilities are supported with sophisticated data acquisition and image analysis equipment as well as other standard instrumentation.

Geotechnical Engineering Laboratory

The testing facilities available in the research group are mainly located in two areas : the Geotechnical Engineering Laboratory and the Geotechnical Centrifuge Centre, the latter of which is being constructed.