UNIVERSITY OF PERADENIYA
DEPARTMENT OF CIVIL ENGINEERING

POSTGRADUATE POGRAMME IN STRUCTURAL ENGINEERING YEAR 2022

INTRODUCTION

Postgraduate programme in Structural Engineering is one of the most in demand structural engineering programmes in the country conducted by the Department of Civil Engineering, University of Peradeniya, Sri Lanka. The course consists of compulsory and optional taught courses conducted through lectures, tutorials, assignments, laboratory and design classes and a research study. The optional courses can be selected as per eligibility requirement. The programme will commence from February 2022.

Department of Civil Engineering, University of Peradeniya has excellent laboratory facilities and a team of highly qualified academic staff. Facilities in the Engineering Library, Computer Aided Design Laboratory and Computing/IT Centre are also available for students in furthering their studies and research.

TEACHING PANEL OF THE POGRAMME

Prof. P. B. R. Dissanayake, BScEng, MEng, PhD, CEng, FIE (SL)
Prof. K. A. S. Susantha, BScEng, MEng, DEng, CEng, MIE (SL)
Mr Helarisi Aberuwan, BScEng, MPhil, CEng, MICE, MIEAust
Dr A. L. M. Mauroof, BScEng, DEng, CEng, MIE (SL)
Dr K. R. B. Herath, BScEng, MSc, PhD
Dr U. I. Dissanayake, BScEng, PhD, CEng, MIE (SL)
Dr L. C. Kurukulasuriya, BScEng, MEng, PhD
Dr (Mrs) S. R. Herath, BScEng, MEng, PhD
Dr H. D. Yapa, BScEng, PhD
Dr (Mrs) C. K. Pathirana, BScEng, MScEng, PhD, CEng, MIE (SL)
Dr K. K. Wijesundara, BScEng, MSc, PhD
Dr A. J. Dammika, BScEng, MEng, PhD
Dr M. C. M. Nasvi, BScEng, PhD, CEng, MIE (SL)
Dr J. A. S. C. Jayasinghe, BScEng, MEng, PhD
Dr C. S. Bandara, BScEng, MScEng, PhD, CEng, MIE (SL)
Dr S. K. Navaratnarajah, BScEng, MS, PhD
Dr H. A. D. Samith Buddika, BScEng, MEng, PhD
In addition, visiting experts will also assist in the programme in different components.

COURSE STRUCTURE

The course structure facilitates postgraduate candidates to follow any preferred level of programme in accordance Sri Lanka Qualification Framework (SLQF) as shown below.

SLQF Level	Diploma/Degree	Credit/GPA Requirements	Duration
SLQF Level 8	PG Diploma in Structural Engineering - **PG.Dip.**	A total of ***25 Credits*** earned with at least ***2.75 GPA*** from prescribed courses including an independant study of ***3 Credits***.	10 Months (Minimum)
SLQF Level 9	Master of Structural Engineering – **M.Eng.**	A total of ***30 Credits*** with at least ***3.0 GPA*** from the prescribed courses including an advanced study of ***5 Credits***.	12 Months (Minimum)
SLQF Level 10	Master of the Science in Structural Engineering - **M.Sc.Eng.**	A total of ***30 Credits*** from the prescribed courses with at least ***3.0 GPA*** and successfully completed a research study of ***30 Credits***.	2 Years (Minimum)

PG Candidates in each level need to earn ***18 Credits*** from ***Compulsory Courses*** (3 Credits x 6 Courses) and balance amount of taught courses credit requirements from the ***Optional Courses*** as per the programme requirements in addition to the Independent Study/ Advanced Study/ Advanced Research Study. The award of the Postgraduate degrees is subject to University rules and regulations including above excerpts. The list of courses to be offered in 2022 is shown below (subject to approval).

	Compulsory Subjects	
Course Code	**Course Title**	**Credits**
CE6501	Advanced Concrete Technology	3
CE6502	Design of Steel Structures	3
CE6503	Design of Reinforced Concrete Structures	3
CE6504	Finite Element Methods in Structural Mechanics	3
CE6505	Structural Dynamics	3
CE6509	Advanced Foundation Engineering	3
	Optional Courses	
Course Code	**Course Title**	**Credits**
CE 6506	Wind Engineering	2
CE 6507	Earthquake Engineering	2
CE 6508	Engineering Materials	2
CE6510	Prestressed Concrete Design	2
CE6511	Nonlinear Analysis of Frame Structures	2
CE6512	Forensic Investigations, Repair and Retrofitting of Structures	2
CE6513	Numerical Methods for Civil Engineers	2
CE6514	High-Rise Buildings	2
CE6515	Bridge Engineering	2

Research/Project related Courses				
SLQF Level	**Course Code**	**Course Title**	**Credits**	**Diploma/Degree**
SLQF Level 8	CE6102	Independent Study	3	PG Diploma in Structural Engineering
SLQF Level 9	CE6103	Advanced Study	5	Master of Structural Engineering
SLQF Level 10	CE6104	Advanced Research Study	30	Master of the Science in Structural Engineering

(Course contents are given at the end of the documents)

The taught subjects will continue over ***Two Semesters*** on ***Saturdays*** and ***Sundays*** from ***8.30 AM to 6:00 PM and*** timetable has been prepared as shown below by facilitating every category of candidates to earn minimum credits requirement within two semesters. Essentially some of the optional courses may be conducted in parallel as number of time slots available are lesser that number of optional courses in the list. The research component will also be commenced within the first semester and will be continued till the end of the third semester. Examinations of the courses taught in a semester will be held within the semester, and the progress of the research/design projects are continuously evaluated during and at the end of each semester.

Time Slot	Saturday	Sunday
8.30 AM – 11.30 AM	Compulsory (3 Credits)	Compulsory (3 Credits)
12.30 AM – 3.30 PM	Compulsory (3 Credits)	Optional (2 Credits)
4.00 AM – 6.00 PM	Optional (2 Credits)	Optional (2 Credits)

ADMISSION REQUIREMENTS

PG Diploma in Structural Engineering (SLQF Level 8)

(a) A first Degree in Engineering/Science (SLQF L5) acceptable to the Faculty Higher Degrees Committee or
(b) Such other qualification equivalent to a first Degree in Engineering/Science (SLQF L5) as may be recommended by the Faculty Higher Degrees Committee as suitable for candidature for PG.Dip., in a field related to the programme of study.

Master of Structural Engineering (SLQF Level 9)

(a) A first Degree in Engineering of at least 120 credits (SLQF L6) with First or Second Class Honours or

(b) A first Degree in Engineering of at least 120 credits (SLQF L6) with acceptable postgraduate qualifications or a minimum of one year's experience after obtaining the Degree, in a field related to the programme of study or
(c) Such other qualification equivalent to a first Degree in Engineering of at least 120 credits (SLQF L6) as may be recommended by the Faculty Higher Degrees Committee as suitable for candidature for the M.Eng. Degree with a minimum of one year's experience, after obtaining such qualification, in a field related to the programme of study.

Master of the Science in Structural Engineering (SLQF Level 10)

(a) A first Degree in Engineering of at least 120 credits (SLQF L6) with First or Second Class Honours or
(b) A first Degree in Engineering of at least 120 credits (SLQF L6) with acceptable postgraduate qualifications or a minimum of one year's experience after obtaining the Degree, in a field related to the programme of study or
(c) Such other qualification equivalent to a first Degree in Engineering of at least 120 credits (SLQF L6) as may be recommended by the Faculty Higher Degrees Committee as suitable for candidature for the M.Sc.Eng. Degree with a minimum of one year's experience, after obtaining such qualification, in a field related to the programme of study.

COURSE FEE

- Rs.350,000.00 for PG Diploma in Structural Engineering (SLQF Level 8).
- Rs.400,000.00 for Master of Structural Engineering (SLQF Level 9)
- Rs.475,000.00 for Master of the Science in Structural Engineering (SLQF Level 10)

In addition to above fee a refundable library deposit of Rs. 10,000.00 and Standard Library Deposit of Rs. 4,000.00 should be paid at the time of the registration for the postgraduate programme.

APPLICATION PROCEDURE

The applications should be submitted online through
http://pgciviladmissions.eng.pdn.ac.lk/login on or before 22nd of November 2021.

The following documents should be uploaded along with the duly completed application:

(a) Degree/Diploma/Professional membership certificates and Academic Transcript.
(b) Two Referee Reports (Online). At least one should be from the applicant's teacher at the University.
(c) Birth certificate and National Identity Card.
(d) Letter of consent on granting leave to engage in PG study from the employer (where applicable).
(e) Application processing fee - Proof of payment (deposit slip)
(f) Recent colour photograph (passport posture)

In the event of any discrepancy between the names appearing in the applicant's academic/professional/birth certificates and the name given by the applicant in the application, an affidavit to the effect that the applicant is the one and the same person known by such names should be available. The originals of the documents should be produced on request/at the time of interview. Also, applicant should arrange to send the official transcripts directly by the educational institutions concerned to the **Assistant Registrar, Faculty of Engineering, University of Peradeniya, Peradeniya**.

A payment of Rs. 2,000.00 has to be done to the below account as the non-refundable application processing fee.

Bank : Bank of Ceylon
Branch : Peradeniya
Name of Account : Research and Fund Account
Account Number : 001274688

Application which are received late/or incomplete in any respect are liable to be rejected. **Only shortlisted applicants will be called for an interview.**

The applicants will be informed of their acceptance/non-acceptance to the particular postgraduate programme for which admission has been sought. The University may at its discretion refuse admission to any applicant.

For further details contact:
Dr. A. J. Dammika (Mobile: +94 77 414 5640; Email: dammikaaj@eng.pdn.ac.lk), the Coordinator of the Postgraduate Programme in Structural Engineering, Department of Civil Engineering, University of Peradeniya, Peradeniya.
or Course Secretory (Mobile: +94 71 769 1566).

DETAILS OF THE COURSES OFFERED

CE 6501: ADVANCED CONCRETE TECHNOLOGY (Compulsory)

Cement production: Constituents; method of production; chemical reactions. **Types of cement:** Cement types; classification. **Chemical and mineral admixtures:** Characteristics; applications. **Aggregate:** Types; classifications; testing. **Proportioning of concrete mixes:** Mix design methods; self-compacting concrete design; zero-slump concrete design. **Concept of high-performance concrete:** Materials; attributes; mix design. **Properties of fresh and hardened concrete:** Fresh/hardened concrete properties; concrete testing. **Compliance criteria, Production of concrete.** Mixing; transporting; compaction; curing. **Temperature effects in concrete:** Temperature development; adiabatic temperature; temperature prediction; temperature control. **Durability of concrete and maintenance:** Carbonation; sulphate attack, ASR/ACR reactions. **Assessment of working life:** Carbonation assessment; half-cell potential assessment. **Special types of concrete and their applications:** Roller compacted concrete; fibre reinforced concrete; shotcrete. **Testing of concrete in structures;** Non-destructive and semi-destructive testing. **Evaluation of concrete in structures, Planning and design of concrete repair , Materials and methods for repair and rehabilitation.**

CE 6502: DESIGN OF STEEL STRUCTURES (Compulsory)

Introduction: Introduction to design of steel structures, materials behaviour, properties of structural steel, steel grades, steel sections. **Limit state design and code of practice:** Simple and continuous structures, limit state design, code of practice, cross section classification, section properties, holistic behaviour of structures. **Design of structural members:** Design of tension members, compression members, restrained and unrestrained beams, stocky and slender columns, special types of struts, columns in simple structures, columns under combined axial loads and moments. **Design of connections:** Connections in simple and continuous structures, design of bolted and welded connections, design of column bases. **Design of portal frames:** Plastic analysis, frame stability, local buckling, lateral distortion, torsional restraints, design of haunches. **Design of plate girders:** Sizing plate girders, section classification, moment and shear capacities, design of end panels and intermediate stiffeners. **Steel – concrete composites:** Design of steel - concrete composite members.

CE 6503: DESIGN OF REINFORCED CONCRETE STRUCTURES (Compulsory)

Introduction: Objectives and methods of analysis and design, Properties of concrete and reinforcing steel, Design concepts. **Limit State Design:** Limit state of collapse, Limit state of serviceability. **Design of RC beams:** Flexure -Singly/doubly RC beams, Flanged beams. Shear design.Bond, anchorage, development length and torsion. Serviceability limit state check. Curtailment. Deep beam design. **Compression Members:** RC Short column, RC Slender column. **Reinforced Concrete Slabs:** One-way slab, Two-way slab, Yield line theory, Serviceability limit state check, Pile cap design. **Design of Water Retaining Structures**

CE 6504: FINITE ELEMENT METHODS IN STRUCTURAL MECHANICS (Compulsory)

Introduction to finite element method: Review of displacement based finite element method – 1D element. **2-Dimentional plane stress/strain element formulation:** Problem differential equation, constant strain triangular (CST) element formulation, 4-node quadrilateral element formulation using isoparametric formulation, Numerical integration; Gauss Quadrature, Gauss point, Higher order elements, shear locking. **Plate bending element formulation:** Derivation of problem differential equation, 4-node rectangular element formulation (one of the earliest plate bending formulation), 4-node quadrilateral plate bending element formulation using Mindlin and Reissner plate theory. **Shell element formulation: Solid element formulation:** 8-node solid element formulation using isoparametric formulation, Higher order elements. **Use of general-purpose finite element programs:** Pre-processor, mesh generation, renumbering for efficiency, post-processors, use of finite element methods in CAD/CAE, applications of general-purpose finite element programs.

CE 6505: STRUCTURAL DYNAMICS (Compulsory)

Dynamics of Simple Structures (Single-Degree-of-Freedom systems) Equation of motion, Free vibrations, Response to harmonic force, Response to periodic force, Response to arbitrary dynamic force. **Multi-Degree-of-Freedom Structures:** Formulation of matrix equations of motion, Analysis of free vibrations, Modal analysis and forced vibrations, Steady state response. **Continuous Structures:** Partial differential equations of motions (for strings, bars, beams), Modal analysis. **Random Vibrations:** Probability theory, random processes, Correlation and spectral density functions, Response to stationary random excitations, Crossing, peak distributions, extreme value analysis, evaluation of fatigue life, Application to wind engineering. **Control of Dynamic Response:** Overview of vibration control, Tuned Mass Dampers, Active control. **Applications of Structural Dynamics:** Model validations, Vibration based structural health monitoring.

CE 6506: WIND ENGINEERING (Optional)

Introduction to Wind Engineering: The nature of wind from meteorological viewpoints, Wind induced damage. **Wind Characteristics:** Description of wind characteristics from engineering viewpoints. **Wind Loading and Bluff-Body Aerodynamics:** Introduction to bluff-body aerodynamics, Aerodynamic drag (CD), lift (CL), moment (CM) and pressure (CP), Effects of viscosity and Reynold number (Re) to flow pattern around bluff-body, Factors affect the aerodynamics coefficients (CD, CL, CM and CP), Periodic vortex induced forces, Random wind forces caused by random wind velocity fluctuations. **Aeroelastic Phenomena:** Classification of wind effects on structure, Static wind load effects, Vortex induced oscillation, Galloping induced oscillation, Flutter induced oscillation. **Wind Resistant Design:** Tall buildings, Long-

span bridges, Wind tunnel tests, Aerodynamic and mechanical approaches to suppress wind-induced responses.

CE 6507: EARTHQUAKE ENGINEERING (Optional)

Nature of Earthquakes; Sources of earthquake ground motions, measures of earthquake intensity and damage potential, seismicity in and around Sri Lanka, effects of earthquakes on structures: lesson learned from past earthquakes. **Response of Simple Structures to Earthquake Ground Motions;** equation of motion for base excitation, solution of the SDOF system, earthquake response spectra. **Seismic Analysis Procedures (Force-based procedure);** linear elastic design spectrum and inelastic design spectrum, analysis procedures for building structures, basic design principles and performance requirements. **Seismic Design Principles for RC Structures;** structural systems/ types of buildings, capacity design principles, ductility in reinforced concrete, capacity design procedure. **Force-Based vs. Direct Displacement-Based Design: Damage Avoidance Design;** base isolation, rocking precast structural systems.

CE 6508: ENGINEERING MATERIALS (Optional)

Introduction: Introduction to materials, material classes and properties, price and availability of materials, material efficient designs. **Polymers:** Generic polymers, GFRP, CFRP and KFRP, mechanical behaviour of polymers, polymer composites, advance engineering applications of polymers and polymer composites. **Ceramics and glasses:** Classes of ceramics and glasses, cement and concrete, rocks and minerals, mechanical properties, high performance ceramics, ceramic composites, ceramic matrix composites (CMC), advanced engineering applications of ceramics, glasses and composites. **Metals:** Ferrous and non-ferrous metals, alloys, light alloys, mechanical properties of metals and alloys, metal matrix composites (MMC), selection of metals and alloys for designs. **Materials and energy:** Energy economy, material contents in products, alternative materials, production process. **Advanced Materials:** Carbon-carbon composites, cellular solids and foams, micro-composites, Nano-materials. **Construction Materials:** Sustainability of construction materials Local and regional materials, Alternative materials for construction.

CE 6509: ADVANCED FOUNDATION ENGINEERING (Compulsory)

Shallow foundations: Bearing capacity theories, Shallow foundation design using Eurocode 7, eccentric and inclined loads, bearing capacity on slopes, Bearing capacity of layered soils, foundation settlements. **Design of combined and raft foundations:** flexible and rigid design of combined. footings and raft foundations. **Machine foundations:** Types of machines, design criteria, elements of vibration theory, governing equations. **Deep foundations:** Introduction, bearing capacity of group piles, Quality Control and Quality assurance of pile foundation, Design of deep foundations using Eurocode 7, Negative skin friction, Pile group settlement,

Rock socketed piles, Laterally loaded piles, Piles subjected to uplift, Design of Caissons in sand and clay. **Design Exercise:** Design of foundation of a building.

CE 6510: PRESTRESSED CONCRETE DESIGN (Optional)

History of prestressed concrete: Use of prestress in non-concrete structures; application on concrete structures; characteristics; attributes. **Prestressing systems:** Pre-tensioning systems; post-tensioning systems; anchoring systems. **Principles of prestrssed concrete design:** Stress calculation; stress limits. **SLS and ULS design:** Magnel diagram; tendon profile; deflection; ULS. **Composite section design: Prestress loss assessment:** Short-term losses; long-term losses. **Continuous beam design:** Parasitic forces; concordant profile. **Prestressed concrete slab design. New materials:** Fibre reinforced polymer.

CE 6511: NONLINEAR ANALYSIS OF FRAME STRUCTURES (Optional)

Introduction to nonlinear frame analysis: Failure modes observed in reinforced concrete and steel frame structures; plastic hinge development due to moment-axial interaction, shear failure of short element, large displacement induced by torsional response. **Nonlinear frame models:** Frame element with lumped plasticity; plastic hinge, Frame element with distributed plasticity; Displacement based formulation, force-based formulation, Numerical integration; Gauss Quadrature and Gauss Lobatto, Section models, Uni-axial material constitutive models for nonlinear hysteretic response. **Incremental-Iterative solution strategies:** Load control method, Displacement control method; Newton Raphson, Modified Newton Raphson, Krylow Newton Raphson, Arc length method; Convergence criteria. **Analysis of nonlinear geometry:** Co-rotational formulation.

CE 6512: FORENSIC INVESTIGATION, REPAIR AND RETROFITTING OF STRUCTURES (Optional)

Introduction: Role of expert witness, forensic investigation, damage assessment techniques. **Failures in Civil Engineering Structures:** Technical, structural and non-structural failures. Natural hazards and unusual loads: effects on the built environment. **Failure Mechanisms and Guidelines:** Failure mechanisms in concrete and steel elements and structures. Guidelines for Failure Investigation. **Forensic Investigation and Damage Assessment:** Investigation of damaged or failed structures, assessment of damage, case studies. **Strength Evaluation of Existing Concrete and Steel Structures:** Preliminary investigation (review of existing information and condition survey and evaluation). Assessment of loading conditions and selection of evaluation method. **Methods for Assessing Properties of Concrete and Steel:** Visual inspection. Detailed investigation: Stress-wave propagation methods, Infrared thermography, Ground-penetrating radar (GPR), Electrical and magnetic methods for reinforcement, Surface hardness test and coring for concrete, tensile, impact and hardness testing for steel, microstructure and crack investigation of steel, corrosion, fatigue testing. **Repair of Concrete and Steel Elements:** Causes, control and evaluation of cracking of concrete, methods of crack repair. Fatigue assessments, evaluation of crack initiation and

propagation of steel, repair methods. **Strengthening and Stabilization of Concrete and Steel Structures:** Techniques consideration, beam shear capacity strengthening, shear transfer strengthening, stress reduction techniques, column strengthening, flexural strengthening, connection stabilization and strengthening, design and construction of externally bonded FRP systems.

CE 6513: NUMERICAL METHODS FOR CIVIL ENGINEERS (Optional)

Solutions to nonlinear equations: bisection method; method of false position; fixed-point iteration; Newton-Raphson's method; secant method. **Numerical solutions to systems of linear equations:** Gaussian elimination; Jacobi method; Gauss Seidel method. **Interpolation: Linear interpolation;** Newton interpolation; Lagrange interpolation; Spline interpolation. **Approximation and curve fitting:** Linear regression; polynomial regression; **Numerical solutions to ordinary differential equations:** Initial value problems: Eular method, Runge-Kutta methods; Boundary value problem: Finite difference method. **Numerical solutions for partial differential equations: Finite difference method:** Elliptic equations:1D and multi-dimensional problems; parabolic problems; **Integral Equation Methods:** Collocation method, Galerkin method and Weighted Residual method; Numerical Quadrature: Gaussian Quadrature.

CE 6514: HIGH-RISE BUILDINGS (Optional)

Introduction to High-Rise Building: What is "High-Rise building"?, Different High-Rise building systems, Function of service core, Required professional skills, Special consideration of High-Rise building design. **Design Process and Philosophy:** Structural design considerations, Overall design process, Structure design process, Design philosophy and process, Proportioning for safety, Philosophies in current use, From serviceability to performance. **Building Systems:** Knowledge model for system selection, Determining system suitability, Evaluating system suitability, Assigning suitability values, Selection of structural system, Typical characteristics of residential buildings and commercial buildings, The building structural system (physical and conceptual). **Structural Load Resisting Systems:** Vertical load resisting systems, Lateral Load Resisting Systems, Selection of Lateral Load Resisting Systems. **Performance based Concept for High-Rise Buildings:** Performance based design of new High-Rise buildings, Performance based evaluation of existing High-Rise buildings. **Modeling, Analysis and Design for Lateral Loads:** Computer modeling for accurate analysis (SAP 2000), Analysis and design of shear walls, Analysis and design of transfer girders and deep beams, Analysis and design of High-Rise building for wind loading, Analysis and design of High-Rise building for seismic loading.

CE 6515: BRIDGE ENGINEERING (Optional)

Design considerations: Economical consideration; site selection; aesthetics; geotechnical investigations; hydrological and hydraulic considerations; safety considerations. **Alternative structural configurations and systems:** Use of different materials, Constructability, Modern concepts, FEM applications, Construction methods. **Bridge deck loading and analysis:**

Guidelines and Codes of Practices in highway and railway bridge design including Sri Lankan practices. **Design of superstructure:** Reinforced concrete bridges; Pre-stressed concrete bridges: Steel bridges; Steel-concrete composite bridges. Design exercise is based on a selected bridge type. **Design of substructure:** Abutments; piers; piles and other foundations. **Design of bearings and joints:** Design of Elastomeric bearing, Bridge expansion joints. **Dynamic Analysis of Bridges:** Structural dynamics for bridges, seismic effects, wind effects. **Maintenance of bridges:** Scheme of inspection; identification of defects and repair methods.