College of Contract Management
United Kingdom

Advanced Diploma in Structural Engineering

Syllabus

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1. Course Structure and Rules of Combination

1.1 Rationale

Certificate in Structural Engineering

This level 4 Certificate in Structural Engineering is designed for Engineers and Assistant Engineers working in the construction sector who are progressing into a civil engineering or structural engineering role. This qualification develops the learner's knowledge and skills to design and develop projects, liaise with stakeholders, and oversee small to medium construction projects safely and efficiently.

Advanced Diploma in Structural Engineering

The Level 5 Advanced Diploma in Structural Engineering is designed for Engineers working in the construction sector who are progressing into managing larger and more complex construction projects. The qualification develops the learner's knowledge and skills to design and develop projects, liaise with stakeholders, and oversee large or complex construction projects safely and efficiently. The Level 5 Advanced Diploma in Structural Engineering is also designed for construction professionals who wish to study for a Bachelor Degree (BSc or BEng) in a 2-year top-up course.

Expert lecturers, with decades of experience, deliver informative theoretical knowledge and provide practical learning examples based on their extensive professional experience. This course has been designed to deliver education that not only furthers your understanding but demonstrates how this knowledge can be applied in practice. Learners will gain an understanding of realistic challenges the industry professionals face and will become equipped with the right skills to navigate and overcome them.

1.2 Qualification Progression

This course provides the underpinning knowledge and understanding for the Advanced Diploma in Structural Engineering. It also enables students to study towards a university degree, as once they achieve the Level 5 Diploma they can progress to our partner universities and study for a Bachelor Degree.

1.3 Course Rules of Combination

The course is comprised of two qualifications; the Level 5 Advanced Certificate in Structural Engineering and the Level 5 Advanced Diploma in Structural Engineering.

The course can be completed in 2 years (approximately 24 months), and includes an assessment at the end of each module. Each module is worth 10 credits.

Year 1:

- Fundamentals of Engineering Drawings
- Construction and Civil Engineering Technology
- Structural Fundamentals
- Soils and Foundations
- Fluid Mechanics and Hydraulics
- Engineering Mathematics and Modelling

Year 2:

- Structural Analysis
- Structural Design of Concrete
- Structural Design of Steel
- Advanced Structural Design
- Design and Computing
- Structural Engineering Design Project

To achieve the Level 4 Certificate, candidates are required to undertake:

- All six modules from Year 1

To achieve the Level 5 Diploma, candidates are required to undertake:

- All 12 modules - 6 modules from Year 1 & Year 2

1.4 Entry Requirements

- Minimum 18 years old **and** one of the following:
- Minimum Grade C in GCSE Mathematics and English (or equivalent) **or**
- Level 3 qualification in Engineering/Science including Mathematics **or**
- If you have relevant experience, please contact us on enquiries@theccm.co.uk with your CV (CV's must be up to date with your most recent experience).

1.5 Module and Assessment Grades

The Assessor will award a grade for the achievement of each module (Fail, Pass, Merit or Distinction). Grades apply to overall performance in modules and assessments.

Indicative marking descriptors for differentiating between levels of achievement when marking assessments are provided below (Section 1.8).

The overall grade for a qualification is calculated using a points system. Each module grade attracts points as follows:

Fail	0 points
Pass	1 point
Merit	2 points
Distinction	3 points
Module Exemption	1 point

1.6 Assessment

The assessment process is set by the College of Contract Management, defining the requirements learners are expected to meet in order to demonstrate that a learning outcome has been achieved. All learning outcomes must be achieved in order to gain attainment of credit for that module.

All completed assessments are marked and verified internally, and are subject to approval by our partner universities or awarding bodies.

The assessment criteria are based on 3 areas:

1. **Task Achievement** - This is a measure of how well the candidate answers the question/ questions and can identify the important aspects of the task.
2. **Technical Content** - — This is a measure of how well the candidate identifies, describes and evaluates the technical aspects of the task.
3. **Presentation** - This is a measure of how well the candidate presents the assessment, including the quality of the structure and paragraphing, the quality and relevance of visual or graphical content and the referencing used for quoted sources.

1.7 Assessment Policies

1. All submission of assessments must include:
   a. a copy of the full brief given by the Examinations Officer or Course Administrator;
   b. all source material must be cited in the text and a full bibliography of source material (including author, title, publisher, edition and page) listed at the end of the submission.
2. All submissions must be submitted into our system as instructed by the Examination Officer or Course Administrator.
3. All submissions under the student's name must only be the work of that student. All information sources must be acknowledged. There is the **possibility of failing the modules if the content of the assessment are deemed be plagiarised** as set out in the rules and regulations of the College.
4. All submissions should be in pdf format (unless software files are specified) and students must keep a copy of all submitted work for reference purposes. Receipt will be acknowledged by the College once the work is submitted via our online exam portal.
5. Whenever a candidate submits work after the approved deadline without an authorised extension, a maximum "Pass" grade will be awarded.
6. The Assessor will comment on the quality of the work for learning purposes.
7. Application for an extension must be requested prior to the submission deadline. Submissions must be made on the exam portal for each module extension request. A primary extension (two weeks) request can be made without the submission of any evidence or reasoning, any further extension requests will require submission of supporting documentation. All requests must be addressed to the Examination Officer or Course Administrator.

1.8 Indicative Marking Descriptors

Note: Please note that the bands below describe indicative characteristics only. An overall holistic approach is required when assessing a candidate's work and assigning a grade. Please read these grading bands in conjunction with the College of Contract Management Assignment Policy.

Grade	Task Achievement - The Relevance of the Response	Inclusion of Relevant Technical Knowledge in Content	Presentation/Coherence
Distinction			
70%+	The work demonstrates a comprehensive understanding of the task. All relevant information is included. The main issues are effectively identified and analysed. There is evaluation and some analysis of solutions to issues relevant to the task. The response shows control of content within the word count.	The work demonstrates a strong understanding of a wide range of technical issues relevant to the task. There is analysis of the advantages/disadvantages of possible choices, risks and potential outcomes.	The work is appropriately structured, and the argument is developed coherently. There is a recognised form of source referencing which supports the points in the task. Paragraphing and titling are used effectively to assist the reader. The use of visual/graphical information is clear and effective in assisting the reader. The graphical information is relevant to the task and is accurate.
Merit			
60-69%	The work demonstrates a clear understanding of the main issues relevant to the task. The issues are explained effectively and potential solutions identified. There is some attempt to analyse the merits of the solutions to the task. The task is broadly achieved within the word count, if relevant to assignment.	The work demonstrates an understanding of the key technical issues of the task. There is clear description of relevant technical aspects with some attempt to evaluate the merits of these as appropriate to the task.	Demonstrates an awareness of presentation and an attempt to present the information with clarity and coherence. There is referencing of sources and use of paragraphing and titling to assist the reader. There is use of clear graphical information to support the assignment which has broad relevance to the task. There may be some limited inaccuracies/ omissions in these.
Pass			
40-59%	The work demonstrates an understanding of the task. The main points are identified and the task is achieved. There is no attempt to evaluate or analyse the solutions. There may be some inaccuracies, omissions and irrelevant content. There may be lack of control in relation to the word count.	The work demonstrates an understanding of the main technical issues which are identified. This may be limited to description with little evidence of evaluation. There may be some omissions and inaccuracies in the detail. There may be some irrelevant details.	There is an attempt to structure the information. There is evidence of paragraphing and titling which is not always appropriate. Some basic graphical information may be included which is of some assistance to the reader. There may be some omissions or inaccuracies. The work is generally coherent but there may be occasional lapses in coherence and structure.
Fail			
0-39%	The work shows a poor understanding of the task. Frequent inaccuracies. Failure to identify important aspects of the task. Much of the information is irrelevant to the task. There may be evidence of copy and paste from external sources. The response may be limited to lists of words with no attempt to explain the relevance/merits of these to the task. The assignment falls short of the word count.	The work demonstrates a lack of understanding of the technical aspects. There are omissions of important technical information. Errors are evident in the technical content. There is no attempt to explain the relevance of the technical content to the task.	Lacks structure and may be limited to lists of points which are not developed. Disorganised in structure causing difficulty for the reader to understand the points. The response is Illegible or incoherent in places. No referencing of external sources. The graphical illustrations are of poor quality or absent. They may be irrelevant. There may be errors and a lack of clarity causing difficulty for the reader to understand.

1.9 Calculating Overall Qualification Grade

To calculate the overall qualification grade, the individual module grades should be added together and compared to the tables below:

Level 4 Certificate in Structural Engineering

Candidates must pass 6 modules of the course, which must include the 3 mandatory modules from Year 1, as defined above, and may include any of the remaining 9 modules from Year 1 or 2.

Total Points for all 6 Modules	Overall Grade
18	**Distinction**
17	
16	
15	
14	**Merit**
13	
12	
11	
10	
9	**Pass**
8	
7	
6	
5 or fewer	**Fail**

Candidates must achieve at least a pass in (or hold exemption from) all 6 modules to be awarded the Certificate.

Level 5 Advanced Diploma in Structural Engineering

Candidates must pass the remaining 6 units modules of the programme. Modules for the Diploma must be different to those undertaken as part of the Certificate.

Total Points for all 6 Modules	Overall Grade
18	**Distinction**
17	
16	
15	
14	**Merit**
13	
12	
11	
10	
9	**Pass**
8	
7	
6	
5 or fewer	**Fail**

Candidates must achieve at least a pass in (or hold exemption from) all 6 modules to be awarded the Diploma.

Level 5 Diploma in Structural Engineering

Candidates must pass all 12 modules of the course.

Total Points for all 12 Modules	Overall Grade
36	**Distinction**
35	
34	
33	
32	
31	
30	
29	
28	**Merit**
27	
26	
25	
24	
23	
22	
21	
20	
19	**Pass**
18	
17	
16	
15	
14	
13	
12	
11 or fewer	**Fail**
Candidates must achieve at least a pass in (or hold exemption from) all 12 modules to be awarded the Diploma.	

1.10 Mandatory Modules

Module Reference	Title	LH	Credit Value
SE401	Fundamentals of Engineering Drawings	100	10
SE402	Construction and Civil Engineering Technology	100	10
SE403	Structural Fundamentals	100	10
SE404	Soils and Foundations	100	10
SE405	Fluid Mechanics and Hydraulics	100	10
SE406	Engineering Mathematics and Modelling	100	10
Year 2			
SE501	Structural Analysis	100	10
SE502	Structural Design of Concrete	100	10
SE503	Structural Design of Steel	100	10
SE504	Advanced Structural Design	100	10
SE505	Design and Computing	100	10
SE506	Structural Engineering Design Project	100	10

SE401: Fundamentals of Engineering Drawings

Learning outcomes: The learner will	Assessment criteria: The learner can
1. Have a sound understanding in engineering language and fundamental drawings and design principle.	1.1 Comprehend the types of sectional views, cutting plane or sectional plane. 1.2 Determine the layout of drawing sheet, margin, border lines, title block, list of parts, scales, uses of scale, sizes of scale, dimensioning.
2. Understand various civil engineering design options and able to apply dimensions on engineering drawings.	2.1 Identify the purpose of construction drawing, drawing lines and shapes, views and dimensions. 2.2 Clearly present the representation of materials, doors, windows, and first and third angle projection.
3. Be able to apply the features and functions of typical CAD systems for producing CAD drawings.	3.1 Determine the plans, elevations, structural elements, elevations, component drawings and engineering drawings. 3.2 Read symbols indicating materials and drawings for trade information. 3.3 Prepare detailed structural and service drawings. 3.4 Create 2D drawings using Auto CAD.
4. Understanding BIM Tools.	4.1 Navigate BIM Tools. 4.2 Demonstrate quantification using the BIM process.

Recommended Reading

1. Bichard, A. and Styles, K. (2004) *Working Drawings Handbook.* 4th ed. Routeledge.
2. Huth, M. (2018) *Understanding Construction Drawings.* 7th ed. Cengage Learning.
3. Kilmer, R. and Kilmer, W.O. (2021) *Construction Drawings and Details for Interiors.* 4th ed. Wiley.

SE402: Construction and Civil Engineering Technology

Learning outcomes: The learner will	Assessment criteria: The learner can
1. Be able to manage and mitigate health, safety and environmental (HSE) risks.	1.1 Perform risk assessment. 1.2 Create management plans for safe working practices. 1.3 Manage and mitigate HSE risks at pre and post contract stages. 1.4 Show quantitative and qualitative risk techniques.
2. Comprehend health, safety and environmental law and obligations in construction and the application of current Construction Design and Management (CDM) regulations.	2.1 Identify HSE hazards in construction. 2.2 Manage emergency management procedures in accident preventions and investigations. 2.3 Identify and apply the legislation, standards and best practice to prevent accidents. 2.4 Navigate Reporting of Injuries, Diseases and Dangerous Occurrences Regulations (RIDDOR). 2.5 Determine obligations of all parties involved in construction according to the HSE law.
3. Design foundations and substructure and able to design and operate with suitable technology.	3.1 Determine types of foundation (e.g. reinforced strip, piles, raft foundations). 3.2 Manage basement construction. 3.3 Monitor excavations and ground works.
4. Determine the superstructure in building construction and able to design and operate with suitable technology.	4.1 Identify types of frames in multi storey buildings. 4.2 Apply sustainable technologies in multi storey buildings construction. 4.3 Maintain exterior envelope of multi storey buildings 4.4 Provide appropriate building materials and selection.
5. Understand the technology in design process of the built environment.	5.1 Identify architectural innovations. 5.2 Manage environmental legislations. 5.3 Assess Planning and Building Regulations. 5.4 Determine other impacts in construction design.
6. Be able to select and operate building services and systems in a multi stories building.	6.1 Monitor heating and ventilation. 6.2 Enforce fire safety and building security requirements. 6.3 Provide energy efficient buildings and select suitable technology in installation of services such power, gas, telecommunications, water, drainage, wastewater, etc.

Text Book

1. Cotgrave, A. and Riley, M. (2014) *Construction Technology 2: Industrial and Commercial Building.* 3rd ed. Bloomsbury Visual Arts.

Recommended Reading

1. Hughes, P. (2015) *Introduction to Health and Safety in Construction.* 5th ed. Taylor and Francis.

SE403: Structural Fundamentals

Learning outcomes: The learner will	Assessment criteria: The learner can
1. Identify structures, structural materials and structural systems.	1.1 Classify types of structures and structural components. 1.2 Design criteria and philosophy. 1.3 Provide structural materials and the properties of structural materials. 1.4 Assess structural Systems and idealisation.
2. Maintain core structural engineering principles.	2.1 Provide critical concerns of structural engineering. 2.2 Identify types of loads and load distribution in structures. 2.3 Recommend basic analytical tools of structural analysis (equilibrium, determinacy). 2.4 Understand internal forces of structural members.
3. Understand the basis of structural design and able to apply structural engineering knowledge for various structural elements.	3.1 Determine types of Truss structures. 3.2 Analyse two-dimensional trusses. 3.3 Provide structural actions on cables and arches. 3.4 Calculate deflections.
4. Be able to contribute to the construction design process.	4.1 Understand beams and other bending members. 4.2 Stabilise and determinacy of beams. 4.3 Manage displacement and deformation of beams.

Text Book

1. Connor, J.J. and Faraji, S. (2013) *Fundamentals of Structural Engineering.* Springer.

SE404: Soils and Foundations

Learning outcomes: The learner will	Assessment criteria: The learner can
1. Gain appreciation of the formation of various kinds of rocks and soils.	1.1 Identify of rocks and minerals. 1.2 Determine the origin of igneous, sedimentary and metamorphic rocks. 1.3 Monitor weathering of rocks and formation of soils. 1.4 Comprehend the importance of soils in construction industry.
2. Demonstrate understanding of soil classification and their properties.	2.1 Manage site investigations. 2.2 Determine particle size analysis of soils. 2.3 Assess earthworks classification, testing and soil properties. 2.4 Appreciate fineness, particle shape and plasticity of soils. 2.5 Value the phase relationships of soils.
3. Interpret the effect of water seepage on the engineering properties and behaviour of soils.	3.1 Become competent in Bernoulli's Equation and hydraulic conductivity. 3.2 Assess Darcy's law and permeability tests. 3.3 Monitor seepage through embankments. 3.4 Case studies.
4. Appreciate the factors affecting load carrying capacity of soils and evaluate bearing capacity.	4.1 Identify modes of bearing capacity failures of soils. 4.2 Apply bearing capacity equations. 4.3 Determine effect of water on bearing capacity. 4.4 Plate-Load test as per BS EN1997-2.
5. Apply the methodology for designing shallow foundations.	5.1 Assess ground conditions affecting foundation design 5.2 Determine types of shallow foundations. 5.3 Design of isolated and combined pad foundations. 5.4 Design of mat foundations. 5.5 Case Studies.
6. Gain an appreciation for some of the latest developments in soil stabilisation and foundation engineering.	6.1 Prepare soil improvement techniques. 6.2 Monitor slope failures and prepare stabilization techniques. 6.3 Enforce deep foundations. 6.4 Case studies.

Text Book

1. Smith, I. (2017) *Smith's Elements of Soil Mechanics.* 9th ed. Wiley Blackwell.

Recommended Reading

1. Das, B.M. and Sobhan, K. (2017) *Principles of Geotechnical Engineering.* 9th ed. Cenage Learning.
2. Craig, R.F. and Knappet, J.A. (2012) *Craig's Soil Mechanics.* 8th ed. Spon Press.

SE405: Structural Mechanics

Learning outcomes: The learner will	Assessment criteria: The learner can
1. Comprehend the physical meaning of Vectors and Statics and resolve problems.	1.1 Review Vector Algebra. 1.2 Determine resolution of Forces. 1.3 Identify moments, couples and torsion. 1.4 Analyse Stresses and Strains including hoop, longitudinal and radial
2. Develop an understanding of the properties of fluids and solve mathematical problems.	2.1 Identify types of fluids. 2.2 Determine properties- density, specific gravity, and surface tension. 2.3 Report on viscosity — kinematic and dynamics. 2.4 Manage fluid pressure- atmospheric, gauge
3. Evaluate and apply the methodology for evaluating forces on submerged surfaces.	3.1 Comprehend Hydrostatics. 3.2 Determine pressure and total force on submerged plane surfaces. 3.3 Maintain pressure and total force on submerged curved surfaces 3.4 Enforce the importance of hydrostatics - case studies.
4. Determine and apply the methodology for analysing fluids in motion.	4.1 Assess laminar and Turbulent flow. 4.2 Evaluate discharge and velocity. 4.3 Perform conservation of mass, momentum and energy. 4.4 Comprehend Bernouli's equation. 4.5 Evaluate the action of flow through pipes.
5. Understand experimental analysis in Fluid Mechanics and Hydraulics.	5.1 Measure fluid pressure. 5.2 Maintain measurement of velocity and discharge in open channel flow. 5.3 Prepare of technical reports.
6. Develop an appreciation for civil engineering works that involve principles of hydraulics.	6.1 Assess the importance of Dam engineering. 6.2 Interpret hydropower, pumps and turbines. 6.3 Provide sustainable water resource management.

Text Book

1. Chadwick, A., Moffett, J. and Borthwick, M. (2013) *Hydraulics in Civil and Environmental Engineering.* 5th ed. CRC Press.

Recommended Reading

1. White, F.M. (2016) *Fluid Mechanics.* 8th ed. McGraw-Hill.

SE406: Engineering Mathematics and Modelling

Learning outcomes: The learner will	Assessment criteria: The learner can
1. Recognise and be able to apply mathematical tools and techniques to solve engineering- based problems.	1.1 Understand the functions of multiple variables and partial differentiation. 1.2 Recognise limits, sequences and series. 1.3 Perform differential equations including 1st and 2nd order ODE analytical methods. 1.4 Comprehend the numerical methods for ordinary differential equations and partially differential equations.
2. Recognise and be able to apply probabilistic and statistical tools and techniques to solve engineering-based problems.	2.1 Apply the summary statistics, probability distributions, the use and characteristics of the main probability distributions with illustrations. 2.2 Interpret the hypothesis testing for examination of significant differences between samples of data. 2.3 Manage basic regression modelling including interpretation of diagnostic statistics.
3. Understand and apply computer programming concepts and methods using MATLAB and SageMath.	3.1 Monitor and use MATLAB and SageMath to solve the engineering and mathematics problems, and present the results in a proper shape.
4. Be able to develop models for problems related to Civil Engineering, and gain experience using computational tools to solve engineering problems.	4.1 Translate the real-world Civil Engineering problems into mathematic functions, and to solve the problems using the learnt computational tools.

Recommended Reading

1. Croft, A. and Davison, R. (2019) *Mathematics for Engineers.* 5th ed. Pearson.
2. Booth, D. and Stroud, K.A. (2020) *Engineering Mathematics.* 8th ed. Red Globe Press.

SE501: Structural Analysis

Learning outcomes: The learner will	Assessment criteria: The learner can
1. Review material and section properties of structural elements.	1.1 Identify material properties including Young's Modulus, Modulus of Rigidity and Poisson's Ratio. 1.2 Record centroids of plane and composite sections. 1.3 Determine elastic section properties of regular and composite sections. 1.4 Assess plastic section properties of regular and composite sections.
2. Analyse pin-jointed frames using Virtual Work method.	2.1 Review pin-jointed frames. 2.2 Provide a concept of Virtual Work. 2.3 Evaluate of deflection in pin-jointed frames. 2.4 Supply an evaluation of indeterminate frames.
3. Resolve statically indeterminate beams.	3.1 Review of static indeterminacy. 3.2 Provide analysis of propped cantilevers. 3.3 Perform analysis of two-span continuous beams.
4. Understand the nature of buckling instability in structural elements and analyse effects.	4.1 Demonstrate knowledge in Euler's theory of buckling. 4.2 Interpret the Perry-Robertson approach. 4.3 Analyse compression curves in Eurocodes.
5. Analyse three-pin frames and rigid-jointed frames.	3.1 Perform analysis of three-pin frames. 3.2 Record analysis of rigid-jointed frames with no-sway. 3.3 Interpret analysis of rigid-jointed frames with sway.
6. Analyse structural elements subjected to torsional effects.	3.1 Demonstrate an understanding of torsion in solid cross-sections. 3.2 Monitor torsion in hollow circular and non-circular cross-sections. 3.3 Case studies of torsional failure in civil engineering structures.

Text Book

1. McKenzie, W.M.C. (2013) *Examples in Structural Analysis.* 2nd ed. CRC Press.

Recommended Reading

1. Kassimali, A. (2011) *Structural Analysis.* 4th ed. Cengage Learning.
2. Williams, M.S. and Todd, J.D. (2000) *Structures: Theory and Analysis.* Palgrave Macmillan

SE502: Structural Design of Concrete

Learning outcomes: The learner will	Assessment criteria: The learner can
1. Develop a deeper understand of concrete as a structural material.	1.1 Evaluate the manufacture and properties of cement. 1.2 Identify properties of fresh and hardened concrete. 1.3 Perform experimental analysis of concrete.
2. Design reinforced concrete beams.	2.1 Limit state design philosophy. 2.2 Comprehend BS EN 1991 & BS EN 1992. 2.3 Assess the design of singly reinforced (simple) beams. 2.4 Evaluate the design of doubly reinforced (simple) beams. 2.5 Analyse the design of continuous beams.
3. Design reinforced concrete slabs.	3.1 Comprehend the construction of various kinds of slabs. 3.2 Support in designing one-way slabs. 3.3 Competently design two-way slabs.
4. Design reinforced concrete columns.	4.1 Supply knowledge of the effective length of columns. 4.2 Assess the design of an isolated column. 4.3 Provide a design for columns in multi-storey structures.

Text Book

1. Mosley, B., Bungey, J. and Hulse, R. (2012) *Reinforced Concrete Design to Eurocode 2.* 7th ed. Palgrave Macmillan.

Recommended Reading

1. Arya, C. (2009) *Design of Structural Elements.* 3rd ed. Spon Press.
2. Bhatt, P., MacGinley, T.J. and Choo, B.S. (2014) *Reinforced Concrete Design to Eurocodes: Design Theory and Examples.* 4th ed. CRC Press.

SE503: Structural Design of Steel

Learning outcomes: The learner will	Assessment criteria: The learner can
1. Understand and have knowledge of structural metals in the construction industry.	1.1 Explain the standardisation of steel and structural shapes. 1.2 Explain design and analysis methods for structural steel. 1.3 Review BS EN 1991.
2. Be able to design steel beams.	2.1 Comprehend BS EN 1992 2.2 Provide section classifications. 2.3 Assess design for Ultimate Limit state. 2.4 Determine the best design for Serviceability Limit state.
3. Be able to design steel columns.	3.1 Record effective length of compression members. 3.2 Design slender and stocky compression members. 3.3 Provide a column base plate design.
4. Understand features of combined stress members of symmetrical members.	4.1 Monitor combined flexure and axial load.
5. Be able to design simple bolted and welded connections.	5.1 Analyse bolt types and types of connections. 5.2 Assess bolt holes. 5.3 Identify types of welds. 5.4 Monitor weld strength. 5.5 Determine plate girders proportioning limits.

Text Book

1. Arya, C. (2009) *Design of Structural Elements.* Spon Press.

Recommended Reading

1. McKenzie, W.M.C. (2013) *Design of Structural Elements to Eurocode.* Palgrave Macmillian
2. Davidson, B. and Owen, G. (2013) *Steel Designers' Manual.* 7th ed. Wiley Blackwell, UK.

SE504: Advanced Structural Design

Learning outcomes: The learner will	Assessment criteria: The learner can
1. Develop conceptual design solutions for building structures.	1.1 Identify various stake holders and their roles in concept development. 1.2 Determine factors that influence of site conditions. 1.3 Monitor building form, façade and envelope design. 1.4 Assess sustainability considerations: BREEAM and LEED.
2. Design reinforced concrete slabs commonly used in multi-storey frames.	2.1 Maintain temporary works and the state of the art in concreting. 2.2 Record interrelationships between frame elements. 2.3 Design flat slabs. 2.4 Case studies.
3. Design reinforced concrete columns with complex loading arrangements.	3.1 Review of column design and analysis. 3.2 Design reinforced concrete columns with bi-axial bending. 3.3 Assess the design of slender columns.
4. Gain deeper understanding of prestressed concrete construction.	4.1 Comprehend the evolution of prestressed concrete. 4.2 Determine the principles and methods of prestressing. 4.3 Analyse and design of prestressed concrete elements.

Text Book

1. Mosley, B., Bungey, J. and Hulse, R. (2012) *Reinforced Concrete Design to Eurocode 2.* 7th ed. Palgrave Macmillan.

Recommended Reading

1. Arya, C. (2009) *Design of Structural Elements.* 3rd ed. Spon Press.
2. Bhatt, P., MacGinley, T.J. and Choo, B.S. (2014) *Reinforced Concrete Design to Eurocodes: Design Theory and Examples.* 4th ed. CRC Press.

SE505: Design and Computing

Learning outcomes: The learner will	Assessment criteria: The learner can
1. Recognise strategies for decomposing a (mathematical) model of an engineering system or process into smaller task that may be solved sequentially.	1.1 Comprehend the design process and design context. 1.2 Observe and analyse an engineering situation, and interpret it into a computer model. 1.3 Monitor material behaviours, structural connections and structural failures.
2. Recognise techniques by which a computer program (BENTLEY and ANSYS) can be built up using the appropriate algorithm. Basic techniques for the solution of linear equations, linear and non-linear regression, root finding and numerical differentiation and integration.	2.1 Apply general programming skills such as; executing basic modelling to solve and analysis of a mathematical equation or simple structural elements and frames, and writing and executing algorithms to demonstrate the linear and non-linear analysis (ANSYS). 2.2 Apply numerical methods skills such as; writing and executing functions to solve linear and non-linear equations, iterative solutions, integration and graphical plots (ANSYS). 2.3 Enhance computer modelling skills such as; structural modelling, analysis and design of the structures according to Euro Code and BS to solve linear and non-linear solutions, structural report preparation, integration and graphical plots (BENTLEY STAAD Pro.).
3. Understand the steps necessary to solve practical problems in engineering using an appropriate algorithm to solve the problem. Use verification techniques to confirm the viability of simple structural designs.	3.1 Analyse a real-world engineering problem, find a methodological solution for the problem and verify the results according to the scientific techniques and standards.

Recommended Reading

1. Knuth, D.E. (2011) *The Art of Computer Programming.* Addison-Wesley Professional.
2. Palm, W. (2010) *Introduction to MATLAB for Engineers.* 3rd ed. McGraw-Hill Education.

SE506: Structural Engineering Design Report

Learning outcomes: The learner will	Assessment criteria: The learner can
1. Demonstrate understanding of client and project requirements.	1.1 Engage with the project brief and seek clarifications where appropriate. 1.2 Produce preliminary sketches for consultation with the client. 1.3 Develop resource-based project estimates.
2. Develop detailed conceptual designs.	2.1 Work in multi-disciplinary teams to collectively produce multiple, viable conceptual designs. 2.2 Refine concept design based on client feedback.
3. Plan and deliver work to industry standards.	3.1 Plan and develop detailed programmes of work. 3.2 Maintain regular correspondence with the project team in a professional manner. 3.3 Demonstrate good team work. 3.4 Take health and safety considerations into account within the design concepts.
4. Display effective communication and interpersonal skills.	4.1 Show effective written and oral communication skills by contributing towards drawings/sketches, technical reports and presentations.

Recommended Reading

1. Arya, C. (2009) *Design of Structural Elements.* 3rd ed. Spon Press.
2. Bhatt, P., MacGinley, T.J. and Choo, B.S. (2014) *Reinforced Concrete Design to Eurocodes: Design Theory and Examples.* 4th ed. CRC Press.
3. Davidson, B. and Owen, G. (2013) *Steel Designers' Manual.* 7th ed. Wiley Blackwell, UK.
4. Westbrook, R. and Walker, D. (1997) *Structural Engineering Design in Practice.* 3rd ed. Pearson.