# Short Course in

# Structural Analysis and Design of Reinforced Concrete Structures

#### **Short Course Overview**

This three-day course has been specifically designed to provide the underpinning skills and knowledge necessary to be able to meet the design requirements for the analysis and design of reinforced concrete structures according to Australian Standards and includes:

- Key design considerations and present various methods of analysis suitable for different types of structural systems.
- Detailed demonstration of the application of the design requirements and corresponding methods for analysis of real-world structures using a structural design software package (SPACE GASS).
- Review the content of structural reports and explain how to utilise results obtained from *SPACE GASS* to produce structural reports and detailing requirements with clarity and conciseness.

This is an intermediate level course designed for civil and/or mechanical engineers who wish to broaden knowledge and skills on structural engineering analysis and modern design methods using *SPACE GASS*.

#### **Learning Outcomes**

On completion of this course, participants will be able to:

- Apply design procedures according to Australian standards.
- Complete the structural analysis and design of a reinforced concrete structure.
- Produce structural reports and detailing based on results obtained from a structural engineering software program (*SPACE GASS version 2021*).

#### **Duration**

The course will be delivered over three days. It runs for 6.25 hours per day, with tea and lunch breaks.

#### **Delivery Methods**

The School provides a high level of support with tuition by discipline experts and exposure to industry structural design software. The delivery mode of this short course consists of face-to-face lectures integrated with workshops.

#### **About the Presenter**

Dr Themelina Paraskeva holds a PhD degree and a MSc in Structural Engineering. Her teaching areas are design of structures, structural dynamics, and nonlinear analysis methods. She has worked as a Structural Engineer for more than ten years, in heavy civil engineering projects and smaller-scale works. Themelina is a Lecturer and Course Coordinator for Civil Engineering at the School of Engineering, Edith Cowan University.

#### **Course Details**

Date: Tuesday to Thursday, 26 - 28 April 2022 Time: 9:30 AM – 3:45 PM Venue: Building 23, School of Engineering, ECU Joondalup Campus Cost: \$2,900 plus GST \*This cost includes morning tea, lunch, and afternoon tea.

\*\*Discount available to ECU students, alumni, and group booking from same company.

#### **Bookings**

#### https://www.ecu.edu.au/short-courses/engineering Enquiries

Contact seadmin@ecu.edu.au







#### Appendix 1 – Short Course Program

Day 1	
Part A: Structural analysis and design requirements Presentation	
1.1	<b>Design procedures</b> This section provides a broad overview on (i) design for strength and serviceability; (ii) design for earthquake actions; (iii) design for robustness and structural integrity; (iv) design for durability and fire; (v) design for fatigue; (vi) material properties.
1.2	Actions and combinations of actions This section focuses on the actions and loads that must be considered in the structural analysis and design of a structure, as well as the combinations of those actions and loads. Further explanations on the calculation of the wind loads, as well as the consideration of earthquake loads and other dynamic loads are provided.
Part B: Application in SPACE GASS	
Practical component	
	In this part of the course, students develop a numerical model of a reinforced concrete structure in SPACE GASS, by applying the structural analysis and design requirements introduced in Part A.

#### Day 2

## Part A: Structural analysis methods

#### Presentation

#### 2.1 Dynamic Frequency (Modal) Analysis

This section introduces structural dynamics, and explains the significance of the dynamic frequency (modal) analysis of the structure before conducting any other method of analysis. It provides the basic concepts on the estimation of the dynamic characteristics and the natural vibration frequencies of a real-world structure. It focuses on understanding the natural modes of vibration and their contribution to the performance of the structure under various types of loads. Guidelines on how to identify possible simulation errors through the frequency analysis will also be provided.

#### 2.2 Structural analysis methods

This section presents the various methods of analysis, such as (i) static analysis, including both elastic and non-linear; (ii) dynamic response analysis; and (iii) dynamic time-history analysis. It explains the applicability of each method of structural analysis considering Australian Standards requirements.

### Part B: Application in SPACE GASS

#### **Practical component**

In this part of the course, students select and apply suitable methods for analysis and design of a real-world structure in SPACE GASS.

Part A: Structural design reports           Presentation and Practical component           3.1         Developing efficient structural design reports           One of the major tasks of a Structural Ingineer, besides conducting a good analysis and design of the structural report must be as clear and simple as possible, in order for the reviewer to interpret and understand the important parts of the analysis and the design of the structure. The structural report is one of the primary requirements of a structural design submission.           This part of the course, aims to provide an overview of the sections that should be considered in a structural regort. Students will learn how to export the required results from the structural design software (SPACE GASS), and how to process the obtained data to include them into the structural report.           A structural report will be developed based on the results of the structural analysis and design of the structural model in SPACE GASS during the practical component of this session.           Part B: Detailing of reinforcement           Presentation and Practical component           3.2         Developing detailing of reinforcement           Detailing of the reinforcement involves the translation of a good structural design from the computer into the final structure. If the drawings are poor, the actual requirements according to Australian Standards. It also aims to guide professionals towards a uniform method of communicating the design principles for the detailing requirements according to Australian Standards. It also aims to guide professionals towards a uniform method of communicating the design ensure that there will be no confusion from misinterpretation of the drawings.	Day 3		
<ul> <li>3.1 Developing efficient structural design reports         <ul> <li>One of the major tasks of a Structural Engineer, besides conducting a good analysis and design of the structural report must be as clear and simple as possible, in order for the reviewer to interpret and understand the important parts of the analysis and the design of the structure. The structural report is one of the primary requirements of a structural design submission.</li> <li>This part of the course, aims to provide an overview of the sections that should be considered in a structural report. Students will learn how to export the required results from the structural design software (SPACE GASS), and how to process the obtained data to include them into the structural report.</li> <li>A structural report will be developed based on the results of the structural analysis and design of the structural model in SPACE GASS during the practical component of this session.</li> </ul> </li> <li>Part B: Detailing of reinforcement         <ul> <li>Presentation and Practical component</li> <li>3.2 Developing detailing of reinforcement</li> <li>Detailing of the reinforcement involves the translation of a good structural design from the computer into the final structure. If the drawings are poor, the actual reinforcing provided on site may not match the design principles for the detailing requirements according to Australian Standards. It also aims to guide professionals towards a uniform method of communicating the design requirements to the construction detailing of primary structural elements (columns, walls, beams, slabs, footings) according to AS3600-2018.</li> <li>Detailing of primary structural elements (columns, walls, beams, slabs, footings) according to AS3600-2018.</li> <li>Detailing of primary structural elements (columns, walls, beams, slabs, footings) according to AS3600-2018.</li> <li>Detailing for seismi</li></ul></li></ul>	Part A: Structural design reports Presentation and Practical component		
<ul> <li>One of the major tasks of a Structural Engineer, besides conducting a good analysis and design of the structural report nust be as clear and simple as possible, in order for the reviewer to interpret and understand the important parts of the analysis and the design of the structure. The structural report is one of the primary requirements of a structural design submission.</li> <li>This part of the course, aims to provide an overview of the sections that should be considered in a structural report. Students will learn how to export the required results from the structural design software (SPACE GASS), and how to process the obtained data to include them into the structural report.</li> <li>A structural report will be developed based on the results of the structural analysis and design of the structural model in SPACE GASS during the practical component of this session.</li> <li>Part B: Detailing of reinforcement</li> <li>Presentation and Practical component</li> <li>3.2 Developing detailing of reinforcement</li> <li>Detailing of the reinforcement involves the translation of a good structural design from the computer into the final structure. If the drawings are poor, the actual reinforcing provided on site may not match the design revietations. Poor quality drawings result in increased costs in the material supply and construction sectors and loss in valuable time. Detailing is also important for durability, as poor placement of reinforcement leads to insufficient cover and long term problems.</li> <li>The aim of this part of the course is to provide the guiding principles for the detailing requirements according to Astandards. It also aims to guide professionals towards a uniform method of communicating the design requirements to the construction team with clarity and consistences, to ensure that there will be no confusion from misinterpretation of the drawings.</li> <li>The focus will be on the following items:         <ul> <li>Detailing of reinforcemen</li></ul></li></ul>	3.1	Developing efficient structural design reports	
<ul> <li>This part of the course, aims to provide an overview of the sections that should be considered in a structural report. Students will learn how to export the required results from the structural design software (SPACE GASS), and how to process the obtained data to include them into the structural report.</li> <li>A structural report will be developed based on the results of the structural analysis and design of the structural model in SPACE GASS during the practical component of this session.</li> <li>Part B: Detailing of reinforcement</li> <li>Presentation and Practical component</li> <li>3.2 Developing detailing of reinforcement</li> <li>Detailing of the reinforcement involves the translation of a good structural design from the computer into the final structure. If the drawings are poor, the actual reinforcing provided on site may not match the designer's expectations. Poor quality drawings result in increased costs in the material supply and construction sectors and loss in valuable time. Detailing is also important for durability, as poor placement of reinforcement leads to insufficient cover and long term problems.</li> <li>The aim of this part of the course is to provide the guiding principles for the detailing requirements according to Australian Standards. It also aims to guide professionals towards a uniform method of communicating the design requirements to the construction team with clarity and conciseness, to ensure that there will be no confusion from misinterpretation of the drawings.</li> <li>Detailing of primary structural elements (columns, walls, beams, slabs, footings) according to As3600-2018.</li> <li>Detailing issues that affect the safety and ductility of concrete structure under extreme seismic events.</li> <li>Examples of good detailing will be developed based on the results and drawings obtained by the numerical analysis of the structural model in SPACE GASS during the practical component of this session.</li> </ul>		One of the major tasks of a Structural Engineer, besides conducting a good analysis and design of the structural model, is how to interpret the design in the form of a structural report. The structural report must be as clear and simple as possible, in order for the reviewer to interpret and understand the important parts of the analysis and the design of the structure. The structural report is one of the primary requirements of a structural design submission.	
A structural report will be developed based on the results of the structural analysis and design of the structural model in SPACE GASS during the practical component of this session. Part B: Detailing of reinforcement Presentation and Practical component 3.2 Developing detailing of reinforcement Detailing of the reinforcement involves the translation of a good structural design from the computer into the final structure. If the drawings are poor, the actual reinforcing provided on site may not match the designer's expectations. Poor quality drawings result in increased costs in the material supply and construction sectors and loss in valuable time. Detailing is also important for durability, as poor placement of reinforcement leads to insufficient cover and long term problems. The aim of this part of the course is to provide the guiding principles for the detailing requirements according to Australian Standards. It also aims to guide professionals towards a uniform method of communicating the design requirements to the construction team with clarity and conciseness, to ensure that there will be no confusion from misinterpretation of the drawings. The focus will be on the following items: • Detailing of primary structural elements (columns, walls, beams, slabs, footings) according to AS3600-2018. • Detailing for seismic response based on AS1170.4 including discussion on detailing issues that affect the safety and ductility of concrete structure under extreme seismic events. Examples of good detailing will be developed based on the results and drawings obtained by the numerical analysis of the structural model in SPACE GASS during the practical component of this session.		This part of the course, aims to provide an overview of the sections that should be considered in a structural report. Students will learn how to export the required results from the structural design software (SPACE GASS), and how to process the obtained data to include them into the structural report.	
Part B: Detailing of reinforcement         Presentation and Practical component         3.2       Developing detailing of reinforcement         Detailing of the reinforcement involves the translation of a good structural design from the computer into the final structure. If the drawings are poor, the actual reinforcing provided on site may not match the designer's expectations. Poor quality drawings result in increased costs in the material supply and construction sectors and loss in valuable time. Detailing is also important for durability, as poor placement of reinforcement leads to insufficient cover and long term problems.         The aim of this part of the course is to provide the guiding principles for the detailing requirements according to Australian Standards. It also aims to guide professionals towards a uniform method of communicating the design requirements to the construction team with clarity and conciseness, to ensure that there will be no confusion from misinterpretation of the drawings.         The focus will be on the following items: <ul> <li>Detailing for seismic response based on AS1170.4 including discussion on detailing issues that affect the safety and ductility of concrete structure under extreme seismic events.</li> <li>Examples of good detailing will be developed based on the results and drawings obtained by the numerical analysis of the structural model in SPACE GASS during the practical component of this session.</li> </ul>		A structural report will be developed based on the results of the structural analysis and design of the structural model in SPACE GASS during the practical component of this session.	
Presentation and Practical component         3.2       Developing detailing of reinforcement Detailing of the reinforcement involves the translation of a good structural design from the computer into the final structure. If the drawings are poor, the actual reinforcing provided on site may not match the designer's expectations. Poor quality drawings result in increased costs in the material supply and construction sectors and loss in valuable time. Detailing is also important for durability, as poor placement of reinforcement leads to insufficient cover and long term problems.         The aim of this part of the course is to provide the guiding principles for the detailing requirements according to Australian Standards. It also aims to guide professionals towards a uniform method of communicating the design requirements to the construction team with clarity and conciseness, to ensure that there will be no confusion from misinterpretation of the drawings.         The focus will be on the following items:       • Detailing of primary structural elements (columns, walls, beams, slabs, footings) according to AS3600-2018.         • Detailing for seismic response based on AS1170.4 including discussion on detailing issues that affect the safety and ductility of concrete structure under extreme seismic events.         Examples of good detailing will be developed based on the results and drawings obtained by the numerical analysis of the structural model in SPACE GASS during the practical component of this session.	Part B: Detailing of reinforcement		
<ul> <li>3.2 Developing detailing of reinforcement Detailing of the reinforcement involves the translation of a good structural design from the computer into the final structure. If the drawings are poor, the actual reinforcing provided on site may not match the designer's expectations. Poor quality drawings result in increased costs in the material supply and construction sectors and loss in valuable time. Detailing is also important for durability, as poor placement of reinforcement leads to insufficient cover and long term problems. The aim of this part of the course is to provide the guiding principles for the detailing requirements according to Australian Standards. It also aims to guide professionals towards a uniform method of communicating the design requirements to the construction team with clarity and conciseness, to ensure that there will be no confusion from misinterpretation of the drawings. The focus will be on the following items: <ul> <li>Detailing of primary structural elements (columns, walls, beams, slabs, footings) according to AS3600-2018.</li> <li>Detailing issues that affect the safety and ductility of concrete structure under extreme seismic events. </li> </ul> Examples of good detailing will be developed based on the results and drawings obtained by the numerical analysis of the structural model in SPACE GASS during the practical component of this session.</li></ul>	Presentation and Practical component		
<ul> <li>Detailing of the reinforcement involves the translation of a good structural design from the computer into the final structure. If the drawings are poor, the actual reinforcing provided on site may not match the designer's expectations. Poor quality drawings result in increased costs in the material supply and construction sectors and loss in valuable time. Detailing is also important for durability, as poor placement of reinforcement leads to insufficient cover and long term problems.</li> <li>The aim of this part of the course is to provide the guiding principles for the detailing requirements according to Australian Standards. It also aims to guide professionals towards a uniform method of communicating the design requirements to the construction team with clarity and conciseness, to ensure that there will be no confusion from misinterpretation of the drawings.</li> <li>The focus will be on the following items:</li> <li>Detailing of primary structural elements (columns, walls, beams, slabs, footings) according to AS3600-2018.</li> <li>Detailing for seismic response based on AS1170.4 including discussion on detailing issues that affect the safety and ductility of concrete structure under extreme seismic events.</li> </ul>	3.2	Developing detailing of reinforcement	
<ul> <li>The aim of this part of the course is to provide the guiding principles for the detailing requirements according to Australian Standards. It also aims to guide professionals towards a uniform method of communicating the design requirements to the construction team with clarity and conciseness, to ensure that there will be no confusion from misinterpretation of the drawings.</li> <li>The focus will be on the following items: <ul> <li>Detailing of primary structural elements (columns, walls, beams, slabs, footings) according to AS3600-2018.</li> <li>Detailing for seismic response based on AS1170.4 including discussion on detailing issues that affect the safety and ductility of concrete structure under extreme seismic events.</li> </ul> </li> <li>Examples of good detailing will be developed based on the results and drawings obtained by the numerical analysis of the structural model in SPACE GASS during the practical component of this session.</li> </ul>		Detailing of the reinforcement involves the translation of a good structural design from the computer into the final structure. If the drawings are poor, the actual reinforcing provided on site may not match the designer's expectations. Poor quality drawings result in increased costs in the material supply and construction sectors and loss in valuable time. Detailing is also important for durability, as poor placement of reinforcement leads to insufficient cover and long term problems.	
<ul> <li>The focus will be on the following items:</li> <li>Detailing of primary structural elements (columns, walls, beams, slabs, footings) according to AS3600-2018.</li> <li>Detailing for seismic response based on AS1170.4 including discussion on detailing issues that affect the safety and ductility of concrete structure under extreme seismic events.</li> <li>Examples of good detailing will be developed based on the results and drawings obtained by the numerical analysis of the structural model in SPACE GASS during the practical component of this session.</li> </ul>		The aim of this part of the course is to provide the guiding principles for the detailing requirements according to Australian Standards. It also aims to guide professionals towards a uniform method of communicating the design requirements to the construction team with clarity and conciseness, to ensure that there will be no confusion from misinterpretation of the drawings.	
Examples of good detailing will be developed based on the results and drawings obtained by the numerical analysis of the structural model in SPACE GASS during the practical component of this session.		<ul> <li>The focus will be on the following items:</li> <li>Detailing of primary structural elements (columns, walls, beams, slabs, footings) according to AS3600-2018.</li> <li>Detailing for seismic response based on AS1170.4 including discussion on detailing issues that affect the safety and ductility of concrete structure under extreme seismic events.</li> </ul>	
		Examples of good detailing will be developed based on the results and drawings obtained by the numerical analysis of the structural model in SPACE GASS during the practical component of this session.	