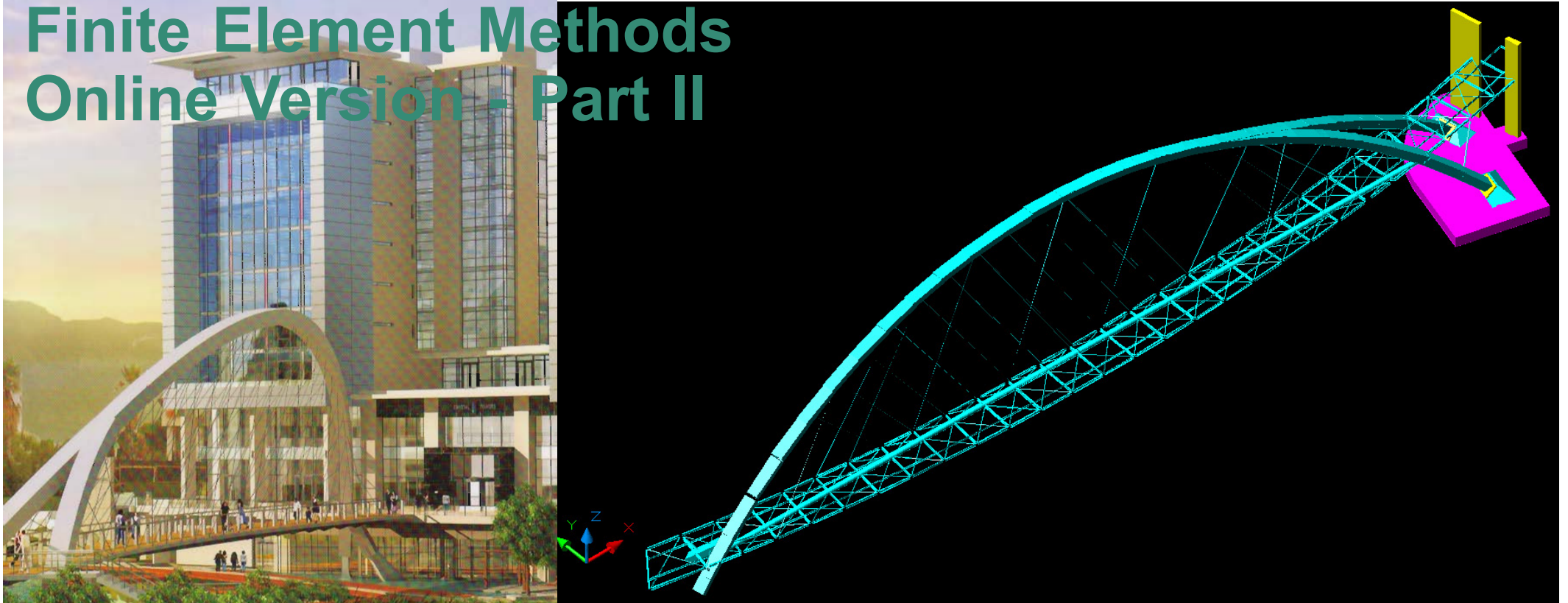




# Finite Element Methods Online Version - Part II



The Finite Element Method is a widely used numerical method for the solution of physical problems. The aim of this course is to present the theory underlying the finite element method (FEM) and the practical implications of using FEM software. Linear static structural analysis as well as basic techniques for non-linear structural analysis are covered.

Stellenbosch (Part II)  
Hosted online by the Department of Civil Engineering  
6-7 April 2022

**Part II - 2**    **R 5 400**  
CPD Credits    (VAT included)





## COURSE OBJECTIVES

Candidates that have successfully completed the Finite Element Methods (FEM) course Part II should be able to:

- have a basic knowledge of structural modelling and idealisation i.e. truss, beam, plate and solid structural models
- have a basic overview knowledge of the mathematical formulation of engineering problems in the form of differential equations, and the integral form of such equations, specifically for linear- and non-linear solid and structural mechanics
- have a basic understanding of numerical techniques for interpolation and integration
- have an understanding of the use of isoparametric plane and solid, beam, frame and plate finite elements
- be able to formulate and interpret the finite element (FE) system of equations
- have an understanding of methods for solving the FE system of equations, as well as the programming techniques used to implement these methods,
- apply FE techniques for basic linear and non-linear static structural problems and develop basic FEM computer code in Java, MATLAB or any other programming language.
- develop FEM models to solve structural analysis problems using commercially available FEM software packages
- interpret and critically evaluate FEM results, the graphical representation thereof and its use in engineering design

## COURSE FOCUS AREAS

*There are two distinct reasons for emphasising the theory underlying the FEM in this course.*

- Firstly, the course aims to expose practitioners in the field to the basic FEM theory necessary to support practical structural analysis activities in this field.
- Secondly, the course aims at providing the South African structural analysis and design industry with competent and responsible users of FEM software.

# COURSE PROGRAMME - Part II

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- Introduction – Objectives of and arrangements for the course
- Concise overview of finite element theory and system formulation
- Truss, beam and frame elements, isoparametric elements, plate elements, axi-symmetric elements, integration schemes
- Congruent transformations, rotation and assembly of models, sub-structuring and static condensation techniques
- Non-linear analysis techniques
- Non-linear geometry and non-linear material modelling
- Structural stability analysis of frame and truss structures
- Software use and numerical computation considerations

# COURSE FORMAT

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*This course will be presented in online (internet based) format using MS Teams.*

- The course outline and study material will be provided in digital format on the online course delivery platforms of the University (online.sun.ac.za for CPD candidates).
- Digital versions of the course notes and example files and data sets will be provided using the online delivery platform.
- Lectures will be in the form of live as well as recorded video presentations. The recordings will be made available on the online delivery platforms as soon as they are ready. Students can determine their own pace while working through the supplied course material.
- Participants will be required to complete an online quiz on the material presented to confirm course attendance per ECSA requirements. Satisfactory completion of the quiz will be deemed sufficient for attendance/CPD purposes.

## COURSE MATERIAL SUPPLIED

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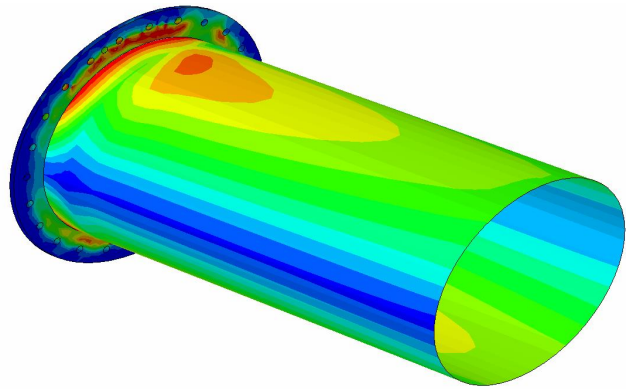
- Digital version of notes as well as example files
- Selected video recordings of presentations as well as pre-recorded videos explaining and highlighting applicable FEM theory and techniques

## USE OF APPLICATION SOFTWARE

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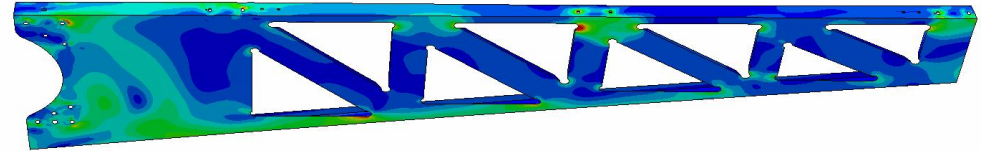
- Problem solution scripts in MATLAB will be made available
- Sample application programs in Java will also be supplied
- CPD candidates need to have access to commercial software of their choice to set up example FEM models for completing assignments

# PRESENTERS



**Dr GC (Gert) van Rooyen** retired as a Senior Lecturer in Structural Engineering at Stellenbosch University in 2019. Presently he is supporting the Department of Civil Engineering with undergraduate and post graduate course development and presentation on a contract basis. He obtained a BSc degree at the University of the Free State and studied Civil Engineering at Pretoria (B.Eng). He later specialised in Structural Engineering (M.Eng) and Civil Engineering Informatics (PhD) at Stellenbosch University and the Technical University of Berlin.

He spent four years in construction and then joined the Institute for Structural Engineering in Stellenbosch, performing finite element analyses and design of industrial structures, where he worked for eight years. Gert joined the academic staff of the Department of Civil Engineering of Stellenbosch University in 1992, where he spent the remainder of his career. He lectured Mechanics, Structural Analysis and Design and later focussed on Civil Engineering Informatics. He strongly believed that computational modelling and methods, like the Finite Element Method, should be included as core components of the undergraduate Civil Engineering curriculum and developed courses to make it possible. He supervised a significant number of Master and Doctoral studies, with diverse topics ranging from Structural Engineering to the optimisation of Sewer networks and Project scheduling. However, the research was always rooted in computational modelling, with a specific focus on meta-heuristic optimisation techniques.



**Dr JAvB (Breda) Strasheim** retired as a Senior Lecturer in Structural Engineering at Stellenbosch University in 2018. Presently he is supporting the Department of Civil Engineering with post graduate course development and presentation on a contract basis. He graduated in civil engineering in 1974 at Pretoria and subsequently obtained a BSc in Computer Science, an M Eng, a MBA and a PhD. His professional engineering career included a period with the Department of Water Affairs working on dam design and monitoring as well as being involved in dam, canal and pipeline construction on the Usutu-Vaal scheme for water supply to Sasol 2. He spent a decade in the consulting engineering practice of Geustyn Forsyth & Joubert Inc. doing municipal infrastructure design, construction and management projects as well as business system projects. He has been involved in a wide range of structural analysis, design and appraisal projects ranging from road and pedestrian bridges, arch dams, high rise buildings, lattice towers and guyed towers, mining ore crusher buildings and conveyor systems, reservoirs, dock structures, offshore pipelines, turbine support structures, irrigation installations, as well as mechanical engineering structures, specialised vehicles and piezo-electric equipment and structures for solar power plants. He also lectures on engineering management and is involved in organising and presenting course work for the Construction Management Programme (CMP).

# CPD CREDITS



The course is accredited for 2 Continued Professional Development credits with the Engineering Council of South Africa (ECSA).

# REGISTRATION



To register, please provide your details on the registration template provided at <https://shortcourses.sun.ac.za/application-form.html?offeringid=5714468d-e95b-ec11-8127-0050568033a6>.

Our system will generate an invoice for your records.

# PAYMENT - Part II - Online Course



**Price: R 5 200 (VAT included)**

Payment must be received by 24 April 2020

## PAYMENT INSTRUCTIONS:

On registering for this course you will receive an automated email stating the bank details for payment. If you are paying your own registration and do not require an invoice, please use this method. If however your company is making payment on your behalf and requires an official tax invoice, please indicate this on the registration form and wait until receiving the invoice before making payment.

## PLEASE EMAIL PROOF OF PAYMENT TO:

Ms. Tsholofelo Seroalo  
Stellenbosch University, Department of Civil Engineering  
Email: [civilcourses@sun.ac.za](mailto:civilcourses@sun.ac.za)  
Enquiries: 021 808 4131

**WE ARE LOOKING FORWARD TO INTERACTING ONLINE WITH YOU FOR THIS COURSE**

