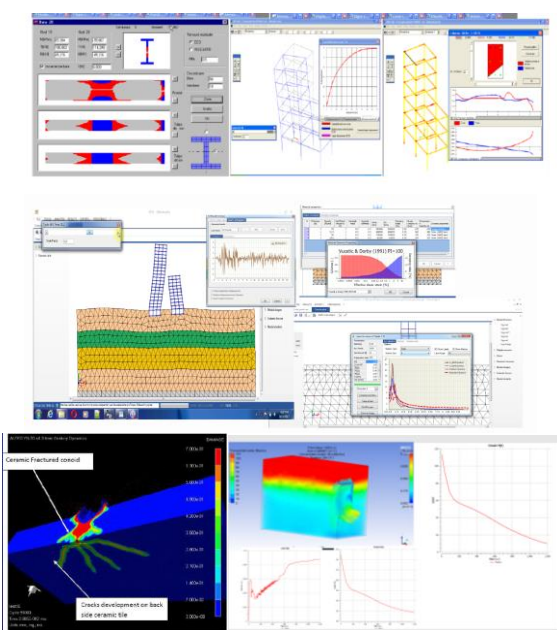



# COMPUTATIONAL MODELING AND ADVANCED SIMULATION IN STRUCTURAL AND GEOTECHNICAL ENGINEERING

## Contact details

Name	<b>Computational Modeling and Advanced Simulation in Structural and Geotechnical Engineering</b>	
Acronym	<b>CMASSGE</b>	
Logo		
Site	<a href="https://www.cosminchiorean.com/CMASSGE.pdf">https://www.cosminchiorean.com/CMASSGE.pdf</a>	
Address	15 C Daicoviciu Str., 400020, Cluj-Napoca, Romania ( <a href="http://constructii.utcluj.ro/departamentul_mecanica_constructiilor.php">http://constructii.utcluj.ro/departamentul_mecanica_constructiilor.php</a> )	
Faculty Department	<b>Faculty of Civil Engineering Structural Mechanics Department</b>	
Telephone	+40 264 401345	
Fax	+40 264 594967	
Director	Prof. Dr. Eng. Cosmin G Chiorean	
e-mail	<a href="mailto:cosmin.chiorean@mecon.utcluj.ro">cosmin.chiorean@mecon.utcluj.ro</a>	

## Areas of expertise

### Domain: Civil Engineering-Structural and Geotechnical Engineering

Computational and experimental techniques with emphasis on the development and application of *advanced nonlinear analysis of structural limit states, structural stability, progressive collapse analysis of structures, push-over analysis for seismic performance evaluation of structures, analysis of structures subjected to wind actions, finite element simulation of composite materials subjected to extreme loads such as ballistic impact and explosions, design and behavior of composite steel-concrete structures, and application of FEM for geotechnical problems and multiphysics problems.* Advanced Computational Fluid Dynamics (CFD) models to identify the mechanisms of radon accumulation and developing techniques for reducing radon accumulation in homes. The stability of thin-walled members by using the *Generalised Beam Theory*. The stiffness evaluation of the vertical and horizontal joints between precast RC walls. The structural health monitoring of bridges by *Machine Learning algorithms trained on experimental and FE numerical data.*

## Team (Key researchers)

The CMASSGE research structure coordinated by **Prof. Cosmin G Chiorean**, affiliates all the full members of the Structural Mechanics Department and encloses five research groups coordinated by the representative researchers from Structural Mechanics Department (MECON):

- Advanced Nonlinear Analysis Models for Structures & Soils (**Dr. Marius Buru**)
- Stability and Structural Health Monitoring of Structures (**Dr. Mihai Nedelcu**)
- Advanced Multiphysics FEM Modelling & Artificial Intelligence (**Dr. Marius Botos**)
- Advanced Testing and Experimental Procedures for Structures (**Dr. Ovidiu Prodan**)
- Advanced FEM Modeling of Structures (**Dr. Mircea Botez**)

## Representative projects

**Smart Systems for Public Safety through Control and Mitigation of Residential Radon linked with Energy Efficiency Optimization of Buildings in Romanian Major Urban Agglomerations** Code: SMART-RAD-EN:2017-2020-A1-A1; POC-A1-A1.1.4-E-2015 (<http://www.smartradon.ro/>)

**Integrated design, earthquake check and shelf structures offer**, Code: PN-III-P2-2.1-CI-2017-0113, [http://users.utcluj.ro/~mnedelcu/Proiect%20de%20cercetare\\_15CI.htm](http://users.utcluj.ro/~mnedelcu/Proiect%20de%20cercetare_15CI.htm)

**Technology for measuring forces in tensile cables**, Code: PN-III-P2-2.1-CI-2017-0116, [http://users.utcluj.ro/~mnedelcu/Proiect%20de%20cercetare\\_29CI.htm](http://users.utcluj.ro/~mnedelcu/Proiect%20de%20cercetare_29CI.htm)

**Design and seismic performance evaluation of 3D frame structures using advanced nonlinear static analysis method** (granted by **CNCSIS**, PNII-IDEI 193/2008)- <http://www.cosminchiorean.com/projects.html>

## Significant results

### The most representative (10) publications of the past 5 years:

1. Chiorean C.G., "Computational issues in biaxial bending capacity assessment of RC and composite cross-sections

exposed to fire”, *COMPUTERS & STRUCTURES* (ELSEVIER), 2024.

2. Le-Van Binh, Chiorean C.G., Kim S.E., Ngo-Huu C., Nonlinear Inelastic Analysis of Space Semi-Rigid Steel Frames Subjected to Static Load Using Plastic-Zone Method, *MECHANICS OF ADVANCED MATERIALS AND STRUCTURES*, (TAYLOR & FRANCIS), 2024.
3. Nedelcu, M., “New unified family of GBT deformation modes for the analysis of thin-walled cylinders”, *THIN-WALLED STRUCTURES* (ELSEVIER), Vol. 183, 2023.
4. Moga, R.A., Buru, S.M., Chiorean C.G., “Overall stress in periodontal ligament under orthodontic movement during a periodontal breakdown”, *AMERICAN JOURNAL of ORTHODONTICS and DENTOFACIAL ORTOPEDICS* (ELSEVIER), Vol. 161(2), 2022.
5. Dicu, T., Burghel, B.D., Botos, M., Cucos, A., et.al., “A new approach to random temporal correction factor based on active environmental monitoring devices”, *SCIENTIFIC REPORTS (NATURE)*, Vol. 11, 2021.
6. Burghel, B.D, Botos M. et al “Comprehensive survey on radon mitigation and indoor air quality in energy efficient buildings from, *SCIENCE OF THE TOTAL ENVIRONMENT* (ELSEVIER), 751, 141858, 2021.
7. Chiorean, C.G., D. Passera, R. Ferrari, E. Rizzi, “An implementation for 2<sup>nd</sup>-order M-N coupling and geometric stiffness adaptation in tapered beam-column elements”, *ENGINEERING STRUCTURES* (ELSEVIER), 225, 111241, 2020.
8. Bredean, L.A., M.D. Botez, “The influence of beams and the slabs effect on the progressive collapse resisting mechanisms developed for RC framed structures”, *ENGINEERING FAILURE ANALYSIS* (ELSEVIER), 91, 527-542, 2018.
9. Chiorean C.G., and S. M. Buru, "Practical nonlinear inelastic analysis method of composite steel-concrete beams with partial composite action" *ENGINEERING STRUCTURES* (ELSEVIER), 134, 74-106, 2017.
10. Chiorean C.G., and I. V. Marchis, "A second-order flexibility-based model for steel frames of tapered members," *JOURNAL OF CONSTRUCTIONAL STEEL RESEARCH* (ELSEVIER), 132, 43-71, 2017.

**Software developed**

**GFAS & RSL2D** – (A Finite Element System for Geotechnical Applications) a product developed for [Geostru Corporation \(www.geostru.com\)](http://www.geostru.com) is a finite element package that has been developed specifically for the analysis of deformation and stability analysis in geotechnical engineering problems and local seismic response. <http://www.geostru.com/EN/Geotechnical-and-F.E.M.-analysis-system.aspx>  
**NEFCAD & ASEP** – Advanced Nonlinear Inelastic Analysis System for Seismic Performance Evaluation of 3D Steel and Composite Steel-Concrete Frameworks (<http://www.cosminchiorean.com/software.html>)

**The offer addressed to the economic environment**

Research & development	<b>Development of advanced nonlinear analysis methods</b> able to describe the complex behaviour of 3D steel, RC and composite steel-concrete frame structures, <i>under normal and abnormal loads</i> . Ultimate strength analysis and design of composite-steel concrete cross-sections with arbitrary shapes subjected to biaxial bending and axial force at elevated temperatures; Computer automated optimal structural design in seismic zones based on structural performance criteria; Analysis of structures subjected to extreme actions. <b>Development of specialized software concerning application of nonlinear analysis to describe complex behaviour of frame structures. The stability of thin-walled members by using the Generalised Beam Theory.</b> The elastic buckling behaviour of rectangular plates with initial geometric imperfections by using energy methods and trigonometric series approximation of the displacements field. The elasto-plastic behaviour of the joints between the precast RC members. The optimisation of scaling for testing the RC walls under cyclic lateral loading. The stiffness evaluation of the vertical and horizontal joints between precast RC walls. <b>The structural health monitoring of bridges by Machine Learning algorithms trained on experimental and FE numerical data.</b> The effect of FRP strengthening on hollow-core slabs. <b>Application of FEM in geotechnical and multiphysics problems:</b> Development of general purpose and dedicated purpose finite element package (GFAS) specifically for the analysis of deformation and stability analysis in geotechnical engineering problems. <b>Advanced Computational Fluid Dynamics (CFD) models</b> to identify the mechanisms of radon accumulation and developing techniques for reducing radon accumulation in homes. <b>Numerical simulation of ballistic impact on composite laminated plates:</b> The ballistic performance of the lightweight armour systems can be examined to obtain an estimate for the V50 and the global damage of the composite plates.
Consulting	Application of nonlinear analysis methods for seismic performance evaluation of spatial structures; Application of FEM in structural and geotechnical engineering; Composite materials, Thin-walled structures, Experimental techniques.
Applied engineering services	Advanced analysis and Design of Structural Systems in Civil and Geotechnical Engineering. Software development for structural and geotechnical engineering.
Training	Advanced software applications such as: Abaqus, Ansys, GFAS, TrueGrid, MatLab; Extreme Loadings, Open Sees, etc. Application of nonlinear analysis for seismic performance evaluation of spatial structures; Application of FEM in Structural and Geotechnical Engineering and Multiphysics (CFD).