

Discontinuum-Based Analysis of Unreinforced Masonry Structures via Discrete Element Method (DEM): Theory and Applications

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Computational modelling of masonry structures can be grouped under the continuum and discontinuum-based analysis. The former approach represents masonry composite as a continuous medium with no distinction between masonry constituents, while the latter explicitly considers masonry units and their interaction within the adopted discrete-block modelling framework. The course covers discontinuum-based analysis of masonry structures based on the discrete element method (DEM) and comprehensively discusses the essential features/concepts of DEM. The emphasis is given to the explicit solution scheme of DEM, rigid-body dynamics, mechanical interactions in multi-block discontinuous systems, and contact mechanics. Furthermore, a fundamental background related to numerical methods will be presented. An experiential learning environment will be offered through the implementation of hands-on DEM applications. Structural analysis of unreinforced masonry arches, walls, and large-scale buildings will be performed by employing a step-by-step approach to discussing selected problems. The proposed course aims to provide a solid background in DEM and discontinuum-based analysis of URM structures, containing state-of-the-art applications and course materials.

Programme (*2 hours, +3 hours)

Subjects

Part I*	Overview of Finite Difference Method, Discretization, and Explicit Solution Scheme
	Dynamic Relaxation and Cundall's Local Damping
Part II*	Fundamentals of Discrete Element Method (DEM) and Computational Procedure of DEM
	Computational Procedure of DEM and Applications (A). A#1 : Two-Block Analysis, A#2 : Structural Analysis of an Unreinforced Masonry Arch
Part III⁺	Contact Mechanics: A Detailed Look (Brittle, Elasto-plastic and Elasto-softening contact constitutive models), Local Mechanisms in Tension, Shear and Compression
	A#3 : Simulation of Couplet and Triplet Tests of URM Masonry, A#4 : Structural Analysis of URM Arches (Non-proportional Loading)
Part III⁺	Pushover Analysis of URM Buildings and Masonry Structures. A#5 : In-Plane (IP) Analysis of A URM Wall Subjected to Different Vertical Pressures
	URM Walls Subjected to out-of-plane (OOP) Loading via Discontinuum-Based Analysis A#6 : Analysis of A Large-Scale URM Building Subjected to IP and OOP Loading