Postdoc position at IMSIA (CNRS)

Development of numerical *models to account for subsoil variability in soil-structure interaction analysis*

Where : *IMSIA (Institute of Mechanical Science and Industrial Applications) UMR CNRS-EDF-CEA-ESTA, EDF R&D AMA*

Duration : *12 month (to start between september 2015 and january 2016)*

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General context

Owing to the complexity of its intrinsic structure, geomaterials exhibit large coefficients of variation of design parameters and natural spatial variability of soil properties is important and cannot be neglected (Fenton 1999). It is now recognized that soil properties vary in space even within homogeneous layers. This local spatial variability depends on soil type, method of soil deposition and geological formation. Concurrently, recent studies revealed that subsoil characteristics such as material properties, number and nature of layers have a major impact on ground motion variability. It has been shown in the past that the spatial variability may have a major impact on extended and multi-supported structures are considered. The spatial variability may also play a major role in the accurate computation of Soil-Foundation-Structure Interaction (SFSI) problems with complex boundary conditions, such as it is generally the case for embedded structures (excavation, backfill) or when seismic isolation is considered.

The accurate modelling of soil properties and soil-structure interaction (SSI) are an important issue for the seismic margin and safety assessment of industrial plants and critical infrastructures. In this framework, SSI and soil uncertainties are accounted for, but the probabilistic models remain often very simple. In particular, in the US, a simplified approach, where the soil variability is introduced by a coherency function (Abrahamson 2006) has been adopted. Such an approach is also available with Code_Aster.

It is well known that the spatial variability of ground motion has a positive impact on high frequency response of structures (reduced response spectra) but might induce supplementary excitation due to rocking and torsion.

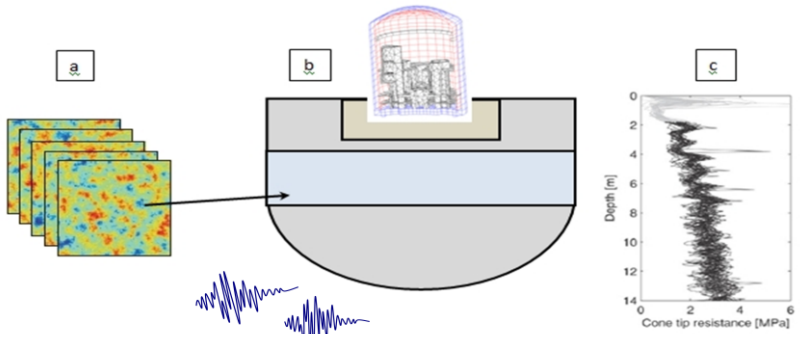

Figure 1: Schematic view of horizontal spatial variability (a), vertical spatial variability (c) and SSI problem with stratification (b).

Work program

- Participate in the development of numerical tools in *Code_Aster*; in particular the improvement of the operator DYNA_ISS_VARI (to account for spatial variability of seismic load via a coherency function), implement random soil profile models
- Perform numerical SSI analysis with *Code_Aster* including spatial variability, compare FULL-FEM approach to simplified analysis with soil springs and FEM-BEM methodology where ground motion variability is introduced via a coherency functions, perform sensitivity analysis and evaluate impact on safety factors

Framework

This postdoc position is part of the European Project NUGENIA+ LOSSVAR. There will be technical meetings and collaborations with the LOSSVAR project partners.
It is the aim of the project to properly model local subsoil variability by means of random fields and to investigate the impact on structural response and surface ground motion spatial variability. LOSSVAR will implement probabilistic numerical SSI models and evaluate the impact on the expected seismic margin and safety factors in probabilistic risk assessment. The proper distinction of random spatial soil variability and epistemic uncertainty is one of the keys to reduce uncertainty. Moreover, the project will implement a V&V procedure including small-scale laboratory tests, benchmarking and sensitivity analysis.
The project partners are: Institute of Mechanical Science and Industrial Applications (IMSIA – UMR CNRS-EDF-CEA-ENSTA), Electricité de France (EDF) R&D, Stangenberg und Partner Ingenieur GmbH, University of Brighton.

Qualifications

The candidate has to have a strong background in the field of Soil-structure interaction, numerical FEM analysis, and programming (Python). Ideally, he/she should have a first experience in the development of Code_Aster. Knowledge in stochastic dynamics, uncertainty propagation and sensitivity analysis would be a plus.