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STRONG DISCONTINUITY METHOD APPLIED TO SOIL/STRUCTURE INTERACTION IN EARTHQUAKE ENGINEERING

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The recent events occurred in Japan have once again shown the importance to account for the seismic risk in early-design stage of a structure. When considering nuclear facilities, this risk is taken into account carefully and accurate assessment methodologies are used to predict the effects of an earthquake. Under a seismic loading, the dynamic response of the structure may be dependent on the soil. This phenomenon in particularly preponderant when considering deep foundations. Making a structural assessment of the structure requires, of course, a satisfactory quantification of the seismic forces transferred from the soil to it and therefore, requires to capture the main dissipative phenomena related to the soil structure interaction such as plasticity or soil/foundation uplift. In this contribution, one is focused to this latter phenomenon namely the soil/foundation uplift. Several approaches have been developed to account for this phenomenon. Among the most used ones, one can distinguish the Winkler's methodologies which lie in considering a spatial distribution of springs or beam elements under the foundation [1, 2]. An alternative is to consider macroelements [3, 4] enhanced with complex constitutive law to deal with dissipative mechanisms. Although these approaches lead to satisfactory results, their main drawbacks are (i) the way of identifying their material parameters, (ii) numerical robustness issues when dealing with unilateral conditions due to velocity corrections that should be made and last, but not least, (iii) the quantification of the uplift is not straightforward due to the fact that no displacement discontinuity is introduced at the soil/foundation interface.

In this paper, the effect of soil/structure interaction is investigated. Within the framework of the Discrete Strong Discontinuity Method (SDM)[5, 6] a numerical model has been developed in order to capture in a natural way the displacement field discontinuity that appears when foundation uplift is activated. In addition, due to the cyclic nature of the seismic loading, a foundation can be successively uplifted and then, back in its initial position. This phenomenon leads to variations of the velocity field that should be corrected and controlled by specific techniques. This aspect is also studied in this contribution. The efficiency of the proposed strategy to deal with uplift is assessed through a structural case study.

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