DOI: https://doi.org/10.30836/igs.iies.2024.36

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EXPLORING LIQUEFACTION POTENTIAL THROUGH NUMERICAL MODELING

Liquefaction is a critical concern in seismic-prone regions, where the transformation of soil from a solid to a liquefied state can lead to catastrophic damage to infrastructure and loss of life. In this study, we investigate the liquefaction potential of a site located in a seismic region of Algeria, which has previously experienced two earthquakes of magnitude 6.5 (the 1856 Djidjili earthquake, 21 and 22 August 1856). The analysis is based on standard penetration test (SPT) data, and the numerical modeling is carried out using the Plaxis 2D [1, 2, 3].

We employed the UBCSand constitutive model within the Plaxis 2D software, which incorporates the effects of soil plasticity and liquefaction. The model parameters are obtained from correlations with Standard Penetration Test (SPT) data collected at the site [3, 4, 5].

The study area is located in Northeast Algeria, in the Skikda Province, with coordinates (36°49'20.40"N, 5°55'9.16"E). The terrain comprises a sequence of loosely consolidated Pleistocene sand deposits, exhibiting a reddish coloration, with varying degrees of relative density, ranging from 28% to 55%. The piezometric level is observed at a depth of 6 m (Fig.1).

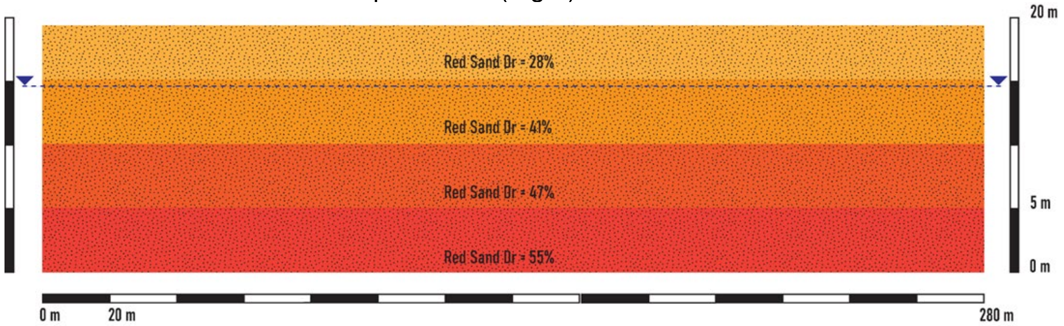

Fig. 1. Depth profile of relative soil densities within the study area

In the static analysis stages, the default model boundary conditions were used. Displacements were fixed in both directions at the base boundary (Ux=0 and Uy=0), while displacements were allowed in the y direction but not in the x direction at the vertical boundaries (Ux=0 and Uy≠0).

For the dynamic analyses, tied boundary conditions were applied on the vertical boundaries and the "none" option was used in the horizontal direction. Tied boundary conditions allow points located at the same elevation to move with the same displacements, reflecting the behavior of the laminar box more realistically. A prescribed displacement of 0.05 m in the S direction was applied to the model base to provide the earthquake input motion.

Since seismic signal data for the 1856 Djidjili earthquake is not available in the literature, we chose to use ground motion data from the 1952 Kern County earthquake. This earthquake occurred on July 21 in the southern San Joaquin Valley and had a moment magnitude of 7.3. The seismic signal data was obtained from the PEER Ground Motion Database.To ensure accuracy and reliability in our seismic simulations, we calibrated and corrected the data using the SeismoSignal 2024 software tool (Fig. 2) [6, 7, 8].

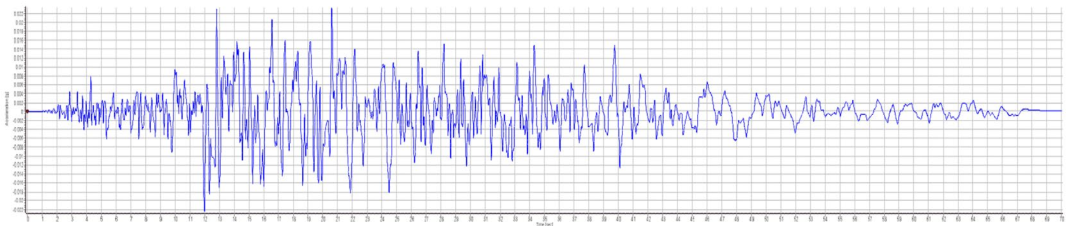

Fig. 2. Input signal

Excess pore water pressure (EPWP) is a critical parameter in assessing liquefaction potential. In this study, EPWP was calculated at three depths: 12 m (P2), 6 m (P5), and 3 m (P8). The results were compared to the effective stress at each depth to determine the liquefaction potential (Fig.3).

The results show that the EPWP at P8 and P5 exceeds the effective stress at those depths, indicating that liquefaction is likely to occur at these locations. At P2, the EPWP is lower than the effective stress, suggesting that liquefaction is less likely at this depth.

These findings are consistent with the observed liquefaction during the 1856 Djidjili earthquake. Liquefaction was reported to have occurred in areas with sandy soils and shallow groundwater, which are conditions that favor the development of high EPWP.

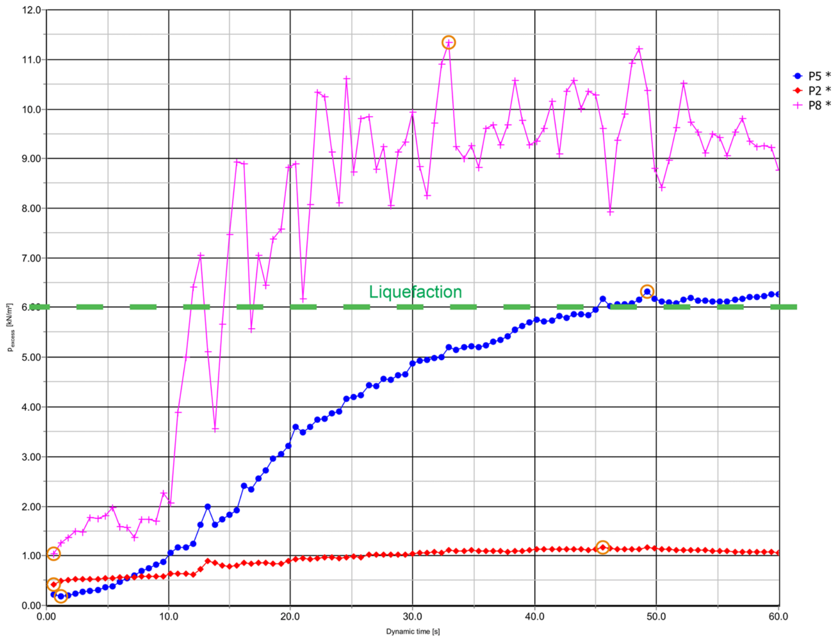

Fig. 3. Results

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