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Optimal design of prefabricated vertical drain-improved soft ground considering uncertainties of soil parameters

Key words: Robust geotechnical design; Consolidation; PVD arrangement; Ground improvement

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Highlights

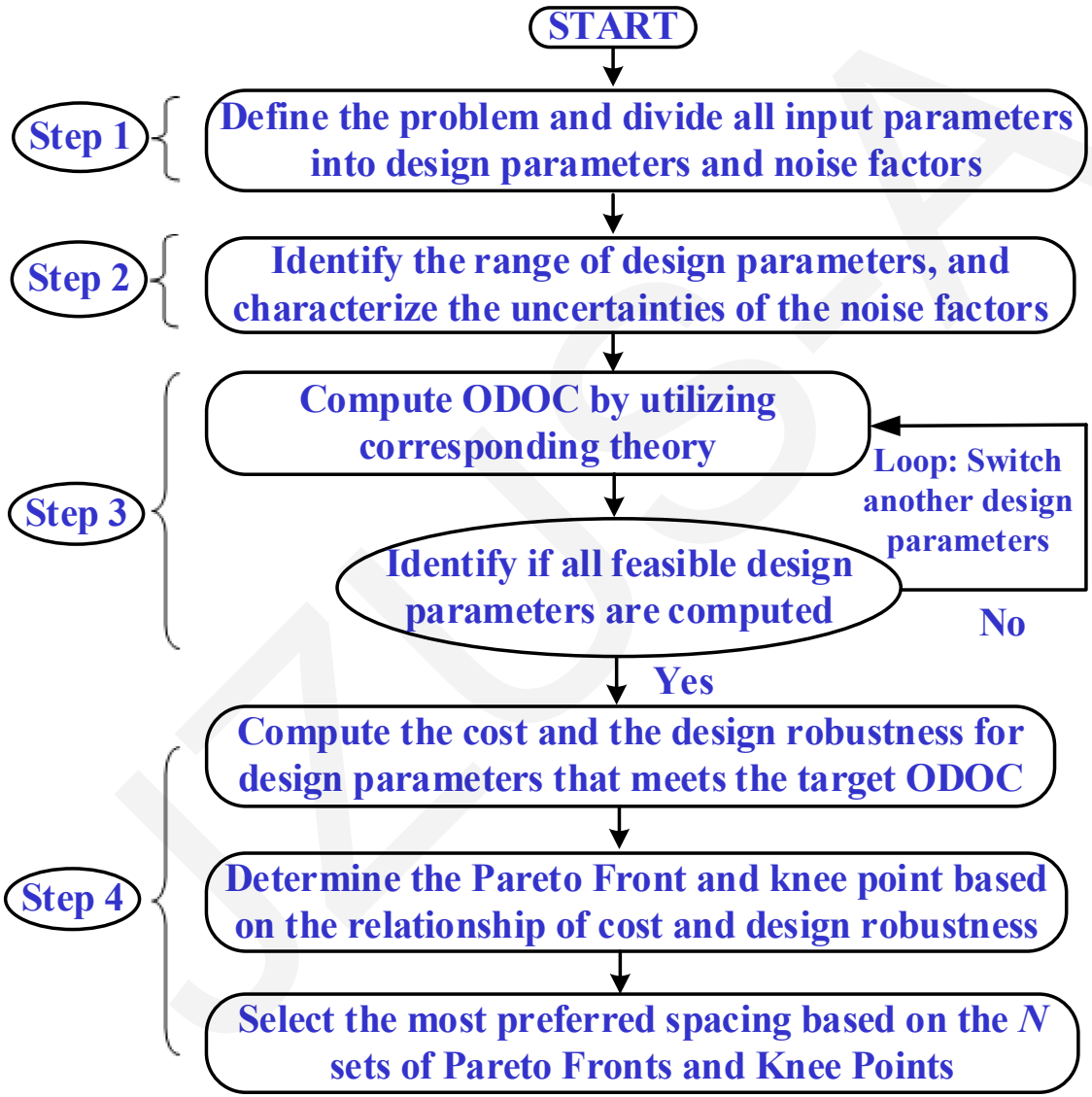
- The optimal design of PVDs is determined accounting for the uncertainties of soil parameters based on the concept of robust geotechnical design.

- The design robustness is evaluated by the signal-to-noise ratio of the overall degree of consolidation.

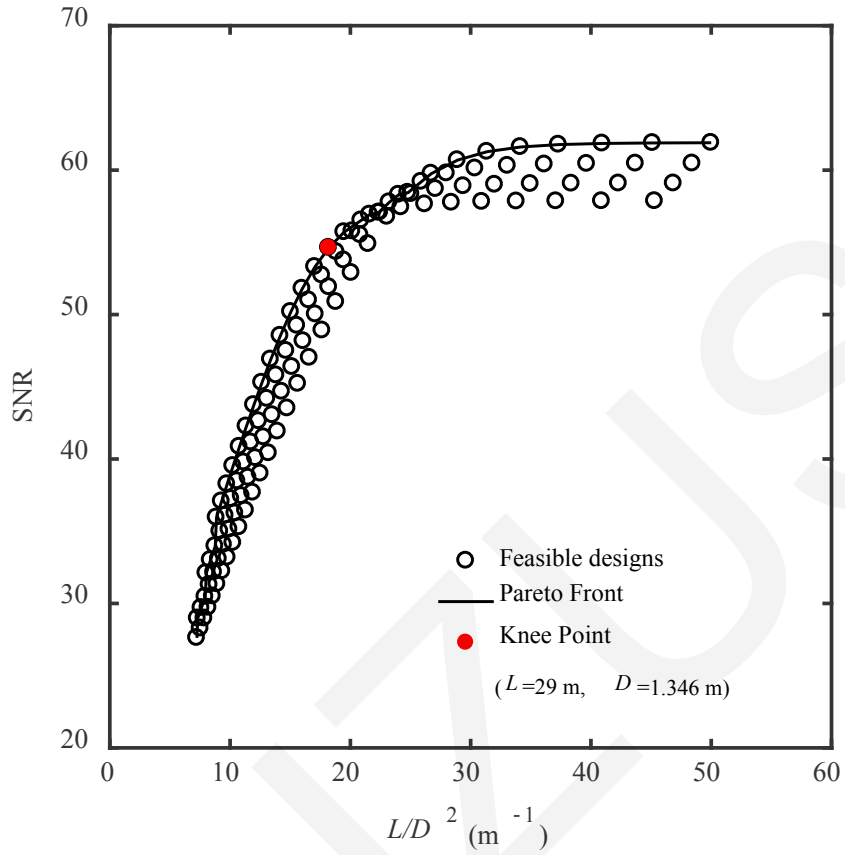
- The factors affecting the optimal PVD arrangement are discussed.

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Methods


START
Step 1
Define the problem and divide all input parameters into design parameters and noise factors
Step 2
Identify the range of design parameters, and characterize the uncertainties of the noise factors
Step 3
Compute ODOC by utilizing corresponding theory
Loop: Switch another design parameters
Identify if all feasible design parameters are computed
No
Yes
Step 4
Compute the cost and the design robustness for design parameters that meets the target ODOC
Determine the Pareto Front and knee point based on the relationship of cost and design robustness
Select the most preferred spacing based on the N sets of Pareto Fronts and Knee Points

Results



- The cost of the most preferred PVD design (L/D^2) in RGD is higher than that obtained using the deterministic method.
- More expense should be incurred to address the uncertainties of the soil parameters.

Fig. 1. The feasible designs, Pareto Front and Knee Point of the illustrative example

Conclusions

- A framework was established based on the optimal procedure and illustrated with an example.
- The target overall DOC, elapsed time, and PVD arrangement pattern affected the optimal PVD design when the cost was in a lower range. Higher costs can guarantee the design robustness of PVD-improved soft clay ground.
- If the COVs of certain noise factors are underestimated, the cost of the most preferred PVD design will be underestimated.

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