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Estimation of Elastic Modulus of Soil Surrounding Buried Pipeline Using Multi-Response Surface Methodology

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Abstract : The stress on the buried pipeline under pavement is significantly affected by vehicle loads and elastic modulus of the soil surrounding the pipeline. The correct elastic modulus of soil has to be applied to the finite element model to investigate the effect of the vehicle loads on the buried pipeline using finite element analysis. The purpose of this study is to establish the approach to calculating the correct elastic modulus of soil using the optimization process. The optimal elastic modulus of soil, which minimizes the difference between the strain measured from vehicle driving test at the velocity of 35km/h and the strain calculated from finite element analyses, was calculated through the optimization process using multi-response surface methodology. Three elastic moduli of soil (road layer, original soil, dense sand) surrounding the pipeline were defined as the variables for the optimization. Further analyses with the optimal elastic modulus at the velocities of 4.27km/h, 15.47km/h, 24.18km/h were performed and compared to the test results to verify the applicability of multi-response surface methodology. The results indicated that the strain of the buried pipeline was mostly affected by the elastic modulus of original soil, followed by the dense sand and the load layer, as well as the results of further analyses with optimal elastic modulus of soil show good agreement with the test.

Keywords : pipeline, optimization, elastic modulus of soil, response surface methodology
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