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Prediction of the static elastic modulus of limestone using downhole seismic test in Asmari formation

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Abstract

Determining the elastic modulus of rocks is one of the crucial parameters in civil and petroleum engineering. Asmari geological formation is widely outcropped in a significant part of the west and SW of Iran and NE of Iraq. Understanding the static elastic modulus of host rocks is crucial because of the design and construction of numerous geotechnical structures and the presence of large hydrocarbon reservoirs in this formation. To determine the elastic modulus of intact rocks, the uniaxial compressive strength test is typically used. However, in jointed rocks and deep areas, where obtaining samples may be challenging, costly, or even impossible, correlations between static–dynamic elastic modulus ($E_s - E_d$) is more frequently employed. Although some scholars have proposed correlations between $E_s - E_d$, they had determined dynamic modules based on the ultrasonic test. In the aforementioned test, intact samples are used and the effect of discontinuities would not be considered; hence, the results cannot be considered as rock mass representative. In this study, to consider field geotechnical conditions, the dynamic modules were determined based on the downhole seismic test (DS) in a tunnel in located the west of Iran. Then from the results of static elastic modulus, which were obtained from core samples, a linear correlation was proposed between $E_s - E_d$. The root-mean-square error and variance accounted showed that the predicted static elastic modulus by the proposed correlation is more accurate to a large extent. In addition, unlike the ultrasonic-based E_d , the results showed that the DS-based E_d is less than E_s .