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Case-Based Reasoning Application to Predict Geological Features at Site C Dam Construction Project

Authors : Shahnam Behnam Malekzadeh, Ian Kerr, Tyson Kaempffer, Teague Harper, Andrew Watson

Abstract : The Site C Hydroelectric dam is currently being constructed in north-eastern British Columbia on sub-horizontal sedimentary strata that dip approximately 15 meters from one bank of the Peace River to the other. More than 615 pressure sensors (Vibrating Wire Piezometers) have been installed on bedding planes (BPs) since construction began, with over 80 more planned before project completion. These pressure measurements are essential to monitor the stability of the rock foundation during and after construction and for dam safety purposes. BPs are identified by their clay gouge infilling, which varies in thickness from less than 1 to 20 mm and can be challenging to identify as the core drilling process often disturbs or washes away the gouge material. Without the use of depth predictions from nearby boreholes, stratigraphic markers, and downhole geophysical data, it is difficult to confidently identify BP targets for the sensors. In this paper, a Case-Based Reasoning (CBR) method was used to develop an empirical model called the Bedding Plane Elevation Prediction (BPEP) to help geologists and geotechnical engineers to predict geological features and bedding planes at new locations in a fast and accurate manner. To develop CBR, a database was developed based on 64 pressure sensors already installed on key bedding planes BP25, BP28, and BP31 on the Right Bank, including bedding plane elevations and coordinates. Thirteen (20%) of the most recent cases were selected to validate and evaluate the accuracy of the developed model, while the similarity was defined as the distance between previous cases and recent cases to predict the depth of significant BPs. The average difference between actual BP elevations and predicted elevations for above BPs was ±55cm, while the actual results showed that 69% of predicted elevations were within ±79 cm of actual BP elevations while 100% of predicted elevations for new cases were within ±99cm range. Eventually, the actual results will be used to develop the database and improve BPEP to perform as a learning machine to predict more accurate BP elevations for future sensor installations.

Keywords : case-based reasoning, geological feature, geology, piezometer, pressure sensor, core logging, dam construction
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