# Abstract

The point load index (PLI) test is one of the most frequently applied indirect methods in predicting the uniaxial compressive strength (UCS). Depending on the rock sample shape, the PLI test is performed in four procedures: axial, diametrical, block, and irregular lump tests. The present research aims to conduct a comparative study on the accuracy of these four procedures in predicting the UCS and evaluate the effect of density (ρ) and porosity (n) on the correlation between UCS and PLI. For this purpose, 15 different sandstone samples were collected from north Khorramabad, west of Iran. Some sandstone specimens were prepared for ρ, n, UCS, and PLI tests. Results indicated that PLI procedures have different accuracies in predicting the UCS, such that axial and irregular lump tests have the highest (R2 = 0.85) and the lowest (R2 = 0.70) accuracies, respectively. Moreover, the results of multivariate regression analysis revealed that ρ compared to n have a more important effect on the correlation between UCS and PLI (R2 = 0.87 and 0.92, respectively).

**Keywords:** Density, Point load index; Porosity, Sandstone; Uniaxial compressive strength

# 1. Introduction

Rock strength is among the fundamental properties to evaluate the site suitability of geotechnical projects such as dams, tunnels, mining, and slope stability. In this regard, uniaxial compressive strength (UCS) is the most important strength property of rocks used in the design of geotechnical projects. Lack of accurate measurement of this property can lead to design errors, damaging the geotechnical project (Heidari et al., 2012). According to standards such as the International Society for Rock Mechanics (ISRM 1981) and the American Society for Testing and Materials (ASTM 1986), performing the UCS test requires having rock samples with appropriate dimensions. However, in many cases, such as layered sedimentary rocks, metamorphic rocks with schistosity, and highly weathered rocks, it is impossible to obtain standard-sized rock samples for UCS testing (Jamshidi et al., 2016). Hence, indirect methods such as PLI, Brazilian tensile strength (BTS), and ultrasonic wave velocity (Vp) are used for predicting the UCS. Certainly, these methods are for the initial assessment of UCS in geotechnical projects. Therefore, obtaining reliable results for a specific site needs to carry out a series of UCS tests to calibrate the indirect methods.

The PLI test is one of the most common indirect methods for predicting the UCS. This test is very popular among rock and geotechnical engineers owing to its simplicity and quickness (Azimian and Ajalloeian 2015). Regarding the portability of the PLI test device, it can be used in both laboratory and field conditions.

So far, several studies have been conducted on correlations between UCS and PLI. Some of these correlations are presented in Table 1. In this table, the determination coefficients (R2) and the correlation form are different between UCS and PLI. This difference is a function of rock type, rock sample conditions (natural, dry, or saturated), number of tests, and the procedure of UCS and PLI tests.

In PLI test, rock samples can be in the form of either core (the axial and diametrical tests), cut blocks (the block test), or irregular lumps (the irregular lump test). One of the issues that have not been considered in previous research is the accuracy of the PLI test procedures in predicting the UCS. Accordingly, in the present study, the accuracy of procedures proposed for four PLI tests (i.e., axial, diametrical, block, and irregular lump tests) in predicting the UCS for 15 different sandstone samples is investigated. This study also aims to evaluate the effect of ρ and n on the correlation between UCS and PLI.

**Table 1**

2. Materials and Methods















To achieve the research objectives, we visited sandstone outcrops in the north of Khorramabad, Lorestan province. During the visit, 15 samples of different sandstone blocks almost shape-cubic with dimensions 20 × 20 × 30 to 30 × 30 × 40 cm3 were collected. Fig. 1 illustrates the geological map and sampling location of the study area. These sandstones are widely used in Ghasem Abad and Sarab Talkh regions, north of Khorramabad, as construction materials to construct retaining walls and bridge piers (Fig. 1). After transferring the block samples to the Laboratory of Geology Engineering and Rock Mechanics at Lorestan University, the specimens were prepared for different tests using a core drill and saw machine (Fig. 2). Then, ρ, n, UCS, and PLI tests were performed on the specimens. Finally, achieved data were analyzed with two aims: 1) investigating the accuracy of the PLI test procedures in predicting the UCS and 2) Evaluating the effect of ρ and n on the correlation between UCS and PLI.