Data-Centric Engineering (2025), 6: e25
doi:10.1017/dce.2025.16

CAMBRIDGE UNIVERSITY PRESS

RESEARCH ARTICLE

Influence of confining stress on different diameters of disc cutters in rock cutting

Mohammad Ali Torabi, Massoud Palassi and Ghazaleh Ali Mohammadi

School of Civil Engineering, College of Engineering, University of Tehran, 14155-6619, 16 Azar Ave, Tehran, Iran
Corresponding author: Massoud Palassi; Email: palassimassoud@gmail.com

Received: 21 February 2025; **Revised:** 15 March 2025; **Accepted:** 26 March 2025

Keywords: confining stress; disc cutter; rock cutting; TBM

Abstract

Tunnel boring machines (TBMs) are essential equipment for tunnel excavation. The main component of TBMs for breaking rock is the disc cutter. The effectiveness and productivity of TBM operations are directly impacted by the disc cutter design and performance. This study investigates the effects of confining stress on the breaking force of disc cutters with various diameters. Both saturated and dry rock, such as low-strength concrete, medium-strength marble, and high-strength granite, are used in the tests. It is found that disc cutters with larger diameter can reduce the influence of the confining stress. Moreover, this research indicates that the influence of confining stress is more notable in rocks with higher strengths, especially in dry condition as opposed to saturated condition. The failure load is related to the confining stress, cutter diameter, and compressive strength of the rock in a multivariate linear regression model, suggesting that the confining stress is more significant than the other variables. These results highlight the importance of considering in-situ stress conditions when excavating tunnels by TBMs.

Impact Statement

This research highlights the critical role of confining stress in the performance of tunnel boring machines (TBMs) during rock excavation, by demonstrating how larger disc cutters can effectively minimize the impact of confining stress. The study offers valuable insights for optimizing TBM operations in varying geological conditions. Policymakers in infrastructure development can leverage these findings to enhance the efficiency and safety of tunnel construction, ultimately leading to reduced project costs and improved resource management. Understanding the relationship between rock strength, cutter design, and confining stress can inform better engineering practices, promoting sustainable tunneling solutions that accommodate the complexities of subsurface environments.

1. Introduction

The main excavating tool used by hard rock tunnel boring machines (TBMs) is a disc cutter. Thus, an extensive understanding of the mechanics underlying rock failure during cutting is essential for effective TBM operation. During drilling, the thrust of the cutting head pushes the disc cutter into the rock. The key concept of disc cutter cutting force prediction must be understood to design and optimize TBM cutting heads. Gong and Zhao (2009) asserted that, because of rapid progress, minimal disturbance, and worker safety, underground constructions using TBMs have grown recently. The disc cutter is the most important cutting tool for TBMs. Chen and Labuz (2006) concluded that the mechanical characteristics of rock, the tool's geometric features, and the applied lateral confinement affected the ability of wedge-shaped tools to penetrate rock after laboratory testing. Kang et al. (2023) investigated the optimal design of twin discs by conducting experiments on sandstone. They reported that the crushing coefficient of the rock mass between two cutters decreased from 0.955 to 0.788 when the cutter spacing increased from 10 to 80 mm and concluded that rock-breaking efficiency was achieved when the cutting distance was 50 mm and the penetration depth was 10 mm. Farrokh (2021) investigated the optimal spacing of disc cutters, the corresponding tilt angles, and the normal forces for peripheral cutters. Pan et al. (2021) examined the behavior of disc cutters in large-scale linear cutting experiments. A new empirical model for predicting the cutting force of CCS disc cutters was proposed based on experimental results from a variety of rocks, ranging from relatively soft to extremely hard. The model input parameters were the disc cutter diameter, cutter spacing, cutter penetration depth, and rock uniaxial compressive strength. Abubaker et al. (2014) conducted a series of full-scale cutting tests to determine the impact of moisture content on rock behavior using a disc cutter. Compared with dry sandstone, saturated sandstone produced lower specific energy and higher penetration rates.

However, there is a significant issue with respect to rock stress caused by overburden and anisotropic stresses because of the development and use of TBMs in tunnel and mining industries. Tunnel excavation by a TBM can be improved by examining the failure force in restricted settings, which are similar to actual subterranean conditions. The impact of confining stress on disc cutters remains unclear, despite various theories of rock failure (Tumac and Balci, 2015; Li et al., 2018). These mechanisms sometimes contradict one another. Tarkoy and Marconi (1992) demonstrated the detrimental effect of high confining pressure on the drillability of rock via field data from Star mine tunnels, which were excavated with an overburden of 1200–2000 m. The penetration energy increases steadily with increasing confining pressure, as reported by Chen and Song's (2018) regarding the impact of confining stresses on penetration energy. According to Liu et al. (2018), a series of two-dimensional wedge indentation tests showed that a 120° wedge indenter is more effective for cutting medium-strong rock because of its greater damage zone. Ma et al. (2016) investigated the effect of confining force on the normal and rolling forces acting on a 432-mm disc cutter by performing full-scale cutting tests on large, intact granite samples. They reported that increasing the confining force increased the normal force but decreased the rolling force. Research has indicated that in restricted rock, the axial force provides approximately 90% of its breaking force. According to Wang et al. (2021), who studied the impact of critical confining stress, as the confining stress increases, the value of the maximum thrust force and penetration energy increases until a certain point is reached, beyond which it decreases as the confining force increases. The cutters used in the indentation tests were shaped as a portion of the 450-mm diameter TBM cutter rings. For the V-shaped cutter, the included edge angle was 80°. Zou et al. (2022) studied the effect of triaxial stress on the crushing of granite rock using a type of inserted cutter. They were able to provide a model for predicting compressive forces by investigating the effects of triaxial stress and the cutting rate of granite rock through indentation tests using a newly designed triaxial testing device. In the rock-cutting process, the applied thrust from the TBM cutting heads allows the disc cutters to penetrate the rock.

While previous studies have examined various factors affecting disc cutter performance, the combined effect of confining stress and cutter diameter on different rock types, considering both dry and saturated conditions, remains underexplored. This study examines the normal breaking force of disc cutter diameters under the influence of confining stresses, excluding the rolling force, since approximately 90% of the rock-breaking force in excavations occurs through the normal force of the disc cutter. Three types of weak to hard materials have also been used to investigate this effect on rocks with varying compressive strengths, in accordance with the ISRM compressive strength classification system (ISRM Commission on the Classification of Rocks and Rock Masses, 1981). To further investigate the behavior of the rocks, we also studied them under saturated conditions. This method can help anticipate and optimize TBM drilling operations.

2. Test method

In this study, to exert confining stress on the sample, a metal frame was fabricated, and the stress was applied using a hydraulic jack. Confining rock fragmentation under a disc cutter depends on the thrust force. Thus, the cutter-rock interaction can be treated as an indentation process using a loading system. This study adopted the indentation methodology to conduct the laboratory tests.

2.1. Test equipment

2.1.1. Cutters

Disc cutters with different diameters are used in practice. Two cutters with relatively large diameter differences from one another were used to study the influence of the diameter. The choice of 14-inch and 20-inch cutters was justified based on their representation of commonly used sizes in practice. A small portion of the disc that mimics the real diameter of the disc cutter was made of MO40 steel, and a Rockwell hardness of 55 was considered. The disc cutters with 14- and 20-inch diameters and 8-mm edge radii are shown in Figures 1 and 2.

2.1.2. Confining box

The hydraulic jack and frame comprise the confining-pressure device. SVS150 alloy steel with a tensile strength of 1300 MPa was used to construct the metal frame. The two plates can be length-adjusted and fastened together with four steel rods and bolts. A five-ton manual hydraulic jack that provides variable confining stresses during loading by using a consistent load application approach. The sample was

Figure 1. *Fabricated cutters.*

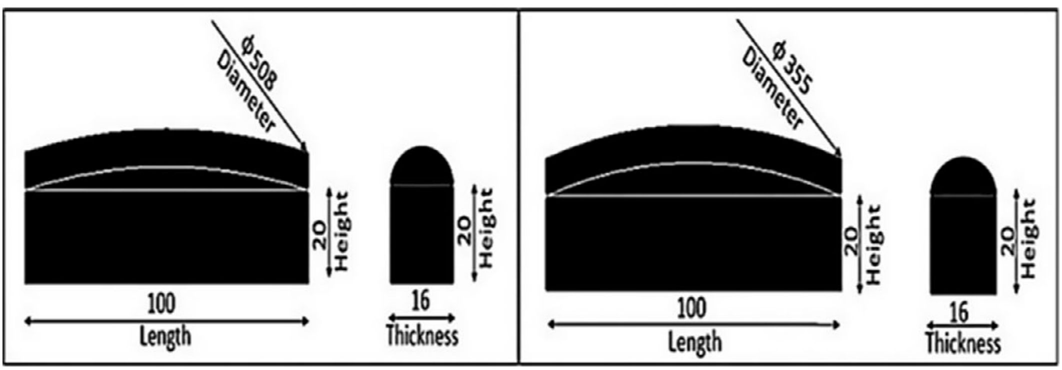

Figure 2. *Drawings of the designed cutters with diameters: of (a) 20 in and (b) 14 in.*

https://doi.org/10.1017/dce.2025.16 Published online by Cambridge University Press

Figure 3. *Hydraulic jack and metal frame for confining pressure applications.*

positioned within a metal frame and compressed from one side by a piston. Two 100 × 100 mm steel plates were positioned on either side of the samples to provide confining stress on the entire sample face, as depicted in Figure 3. These initiatives reflect a well-structured approach to simulating real-world conditions by replicating the stresses encountered in subterranean environments.

2.1.3. Loading system

A 200-ton indentation test device was used for testing in this study. The device includes two steel loading plates; the upper plate is fixed. The sample is loaded by moving the bottom plate, which stops automatically when the sample breaks. The force exerted during the test is displayed on the digital force measurement system's display screen, as shown in Figure 4. The confining device is positioned with the sample on the lower plate, and the disc cutters created are fitted in place of the upper plate.

Figure 4. *Test apparatus.*

https://doi.org/10.1017/dce.2025.16 Published online by Cambridge University Press

Figure 5. *The cube samples from right to left: granite, marble, and concrete.*

2.2. Sample preparation

Based on ISRM classification, three different material types with varying strengths were selected for this study, each with dimensions of 100 mm × 100 mm × 100 mm. Figure 5 illustrates Isfahan black granite as a typical high-strength rock, Isfahan Lashotor marble as a medium-strength rock, and low-strength concrete samples. Firuzkoh sand (type 131) was used to make the concrete samples, which were cured in water for 3 days to achieve lower strength, using a water-to-cement ratio of 0.5 and a sand-to-cement ratio of 2.5. The mechanical and physical properties of the materials are listed in Table 1. The unconfined uniaxial strength test was conducted using the recommended ISRM methodology. The tests were carried out on three types of materials. At least 5 samples were tested for each rock type, and the average value was taken as the unconfined compressive strength of the rock type.

2.2.1. Dry and saturated conditions

The samples used for the dry tests were stored in a dry environment for 2 weeks. For saturated tests, the marble and granite samples were placed in a container of de-aired water once they had been in the oven and reached a consistent weight. The weight of each wet sample was subsequently measured every hour, after which the wet sample was returned to the water. The weight increase was used to calculate the water content of the sample at various times as calculated by Eq. (1):

$$\omega = \frac{m_s - m_d}{m_d} \times 100\% \tag{1}$$

where m_s (g) and m_d (g) are the wet and dry masses of the sample, respectively, and ω (%) is the water content. Because the weights of the samples were fixed, we determined that the sample was saturated, and the test was performed immediately. The samples were stored for 21 days in a container filled with water. In the marble samples, the average water absorbed was 0.14%, whereas that in the granite samples was 0.03%. The concrete samples were subjected to saturation tests after the curing period had passed.

Table 1. *Physical and mechanical properties of the materials*

Material	Compressive strength (UCS, MPa)	Density (q, g/cm3)	Young's modulus (E, GP)	Poisson's ratio (t)
Granite	152.7	2.8	46.2	0.18
Marble	42.23	2.61	16.71	0.28
Concrete	9.93	2.05	2.05	0.18

https://doi.org/10.1017/dce.2025.16 Published online by Cambridge University Press

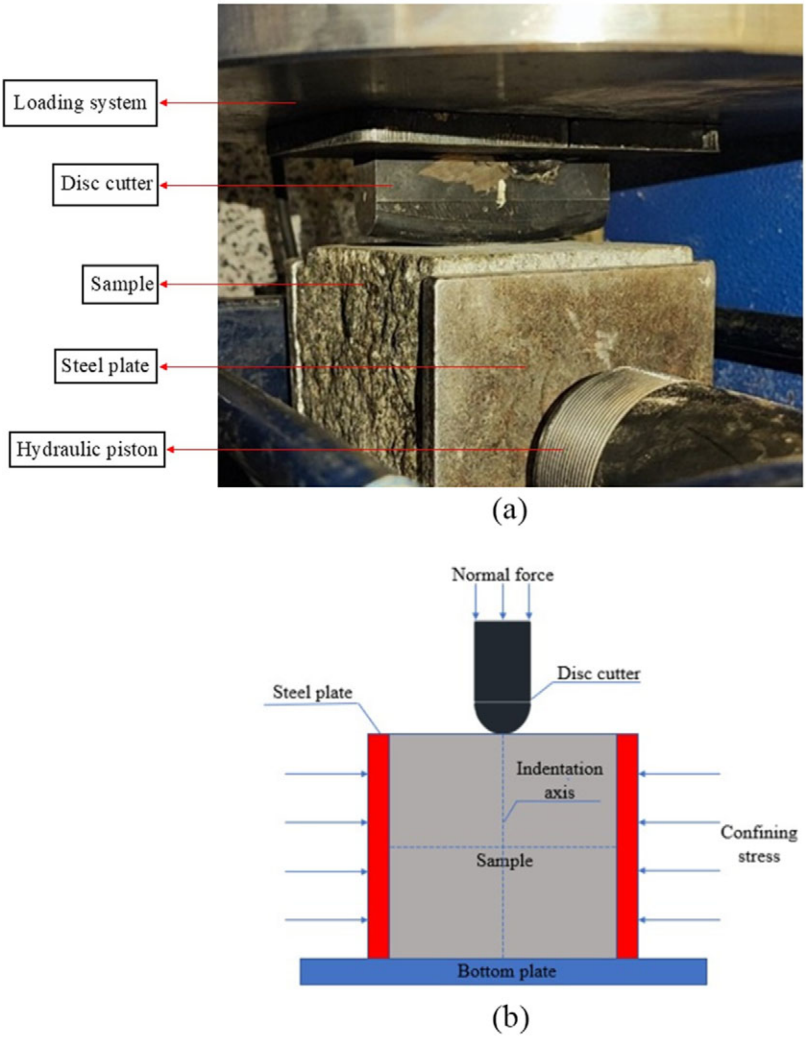

Figure 6. *Test system: (a) Details of testing setup (b) Indentation test schematic.*

3. Testing design and procedures

3.1. Test design

Under three different confining stresses of 0, 2.5, and 5 MPa, all dry and saturated granite, marble, and concrete samples were broken with 14-inch and 20-inch disc cutters. The sample was placed inside a confining box, and steel plates were placed on both sides. The confining stress was applied using a hydraulic jack, and the sample was broken by a disc cutter by applying a vertical force at the center of the sample, as depicted in Figure 6.

Each material type was tested with a minimum of three samples, and the failure load was determined by averaging the results.

3.2. Test procedure

There are six steps to perform the test, and the testing procedure is as follows:

(i) Finding the sample midpoint.

https://doi.org/10.1017/dce.2025.16 Published online by Cambridge University Press

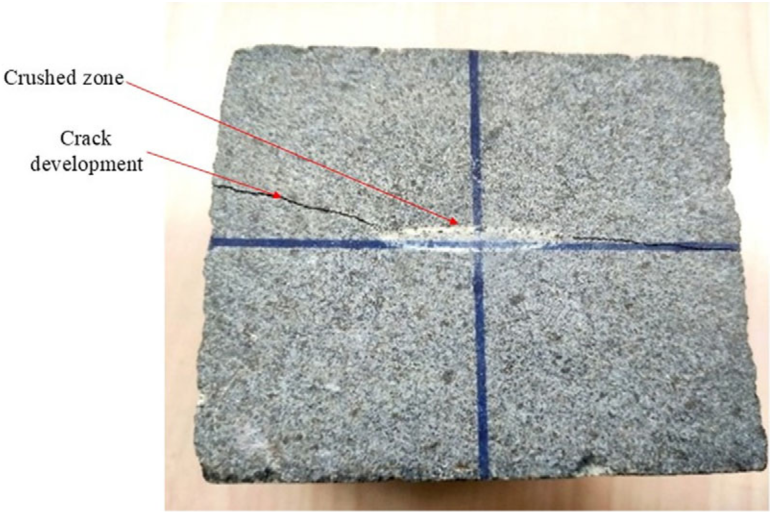

Figure 7. *Broken granite sample.*

(ii) The device nuts were tightened after inserting the sample into the confining box and covering it with metal plates on both sides.
(iii) Place the confining box inside the loading system.
(iv) The designated disc cutters were placed at the center of the sample.
(v) The confining stress was applied using a hydraulic jack.
(vi) The machine was switched to loading mode, and force was applied until the sample failed. The failure load was recorded at that point.
(vii) After the test was completed and the machine was unloaded, the hydraulic jack was removed, and the specimen was removed from the machine.

A dry granite sample fractured using a 14-inch disc cutter at a confining pressure of 5 MPa is depicted in Figure 7.

4. Discussion of results

Over 120 experiments were conducted. The experimental results illustrate the influence of the confining stress on the failure load of disc cutters with two different diameters. To investigate this effect, three types of materials, granite, marble, and concrete, were used to study the effect of the compressive strength of weak to hard rocks under dry and saturated conditions. The average, standard deviation (SD), and coefficient of variation (CV) of the failure load values for all rock types are shown in Tables 2–4.

4.1. Effect of confining stress on disc cutter failure load

The results of the 14- and 20-inch disc cutter fracture tests conducted under confined conditions on dry and saturated granite are presented in Table 2. In these experiments, the lowest breaking load was 121.3 kN, and the highest was 180.5 kN. In studies of fractures in both dry and saturated granites, the CVs ranged from 0.09% to 2.8%. The relationships between the granite breaking load (kN) and confining stress (MPa) at failure when a 14-inch (Eq. 2) or 20-inch (Eq. 3) disc is used are depicted in Figure 8.

$$F_n = 8.193\sigma + 118.41 \tag{2}$$

$$F_n = 7.72\sigma + 138.58 \tag{3}$$

https://doi.org/10.1017/dce.2025.16 Published online by Cambridge University Press

Table 2. *Results of the granite failure load tests*

Test code	Condition	Disc diameter (in)	Confining stress (MPa)	Average failure load (kN)	SD	CV
1	Dry	14	0	124.9	1.74	0.014
2	Dry	14	2.5	131.7	0.11	0.0009
3	Dry	14	5	165.3	0.62	0.003
4	Saturated	14	0	121.3	2.54	0.021
5	Saturated	14	2.5	127.3	1.43	0.011
6	Saturated	14	5	162.8	4.49	0.028
7	Dry	20	0	140.9	1.31	0.009
8	Dry	20	2.5	162.1	0.92	0.005
9	Dry	20	5	180.5	1.89	0.01
10	Saturated	20	0	135.3	1.24	0.009
11	Saturated	20	2.5	155.6	1.31	0.008
12	Saturated	20	5	172.9	1.43	0.008

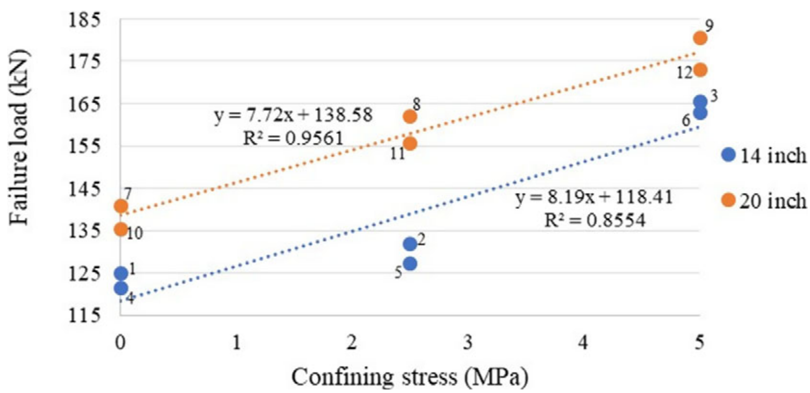

Figure 8. *Relationship between the confining stress and failure load of granite.*

When a 14-inch cutter was used, the coefficient of determination for failure was 0.85; when a 20-inch cutter was used, it was 0.95. Using a larger-diameter disc cutter reduces the influence of the confining stress on the breaking load when cutting granite, as shown in Eqs. (2) and (3). In novel ways, the confining stress effect on the rock-breaking load can be minimized, and drilling operations can be conducted more effectively by increasing the cutter disc diameter.

Table 3 presents the results of the marble saturation and dry breakage tests. Additionally, these tests were run under 0, 2.5, and 5 MPa stresses using 14 and 20-inch discs. Owing to the differences in the physical properties of granite and marble, the overall failure load was lower than that of granite. The failure load ranged from 55.71 kN at minimum to 94.35 kN at maximum. The CV ranged from 0.2% to 4.2%. The relationships between the dry and saturated marble fracture loads (kN) and the confined stress (MPa) when a 14-inch disc (Eq. (4)) or a 20-inch disc (Eq. (5)) is used are depicted in Figure 9.

$$F_n = 4.832\sigma + 58.952 \tag{4}$$

$$F_n = 6.103\sigma + 60.249 \tag{5}$$

https://doi.org/10.1017/dce.2025.16 Published online by Cambridge University Press

Table 3. *Results of the marble failure load tests*

Test code	Condition	Disc diameter (in)	Confining stress (MPa)	Average failure load (kN)	SD	CV
1	Dry	14	0	58.15	0.11	0.002
2	Dry	14	2.5	77.01	0.88	0.011
3	Dry	14	5	82.9	1.73	0.021
4	Saturated	14	0	55.71	0.23	0.004
5	Saturated	14	2.5	73.14	1.02	0.014
6	Saturated	14	5	79.28	1.47	0.018
7	Dry	20	0	60.17	1.32	0.022
8	Dry	20	2.5	81.89	0.31	0.003
9	dry	20	5	94.35	2.04	0.021
10	Saturated	20	0	56.64	0.11	0.002
11	Saturated	20	2.5	76.5	3.18	0.042
12	Saturated	20	5	83.49	2.01	0.024

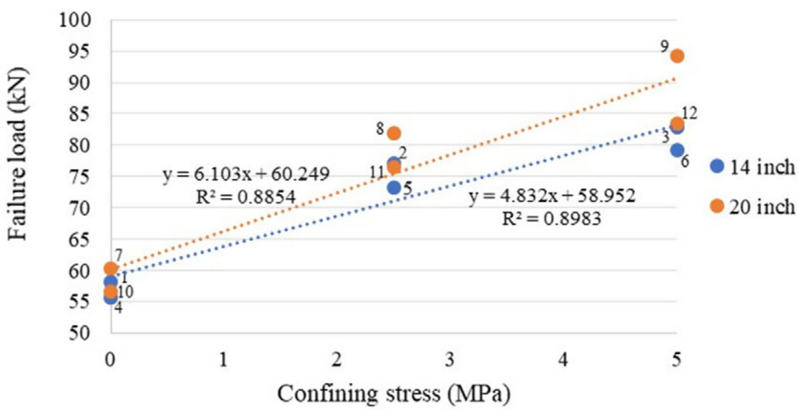

Figure 9. *Relationship between the confining stress and failure load of marble.*

For the 14-inch and 20-inch cutters, the coefficients of determination for the breaking load were 0.89 and 0.88, respectively. A comparison of Eqs. (4) and (5) clearly reveals that the smaller disc cutter minimizes the impact of confinement stress during marble rock fracture.

The results of the fracture tests on the confining concrete samples cut with 14- and 20-inch cutters are shown in Table 4. The samples were subjected to both saturated and dry conditions. When a 14-inch cutter was used under saturated conditions, the minimum breaking load for the concrete samples was 22.95 kN, whereas when a 20-inch cutter was used under dry conditions, the maximum breaking load was 38.07 kN. Additionally, the CV of the samples increased from 1.1% to 6.3%. The relationship between the confined stress (MPa) and failure load (kN) of the concrete sample is shown in Figure 10, where a 14-inch disc (Eq. (6)) and a 20-inch disc (Eq. (7)) are used.

$$F_n = 1.966\sigma + 25.005 \tag{6}$$

$$F_n = 1.804\sigma + 28.673 \tag{7}$$

For the 14-inch cutter, the coefficient of determination was 0.77, and that for the 20-inch cutter was 0.84. Compared with those in granite and marble, the relationships between the confining stress and breaking load in concrete are more linear. These relationships demonstrate that employing a larger cutter diameter

https://doi.org/10.1017/dce.2025.16 Published online by Cambridge University Press

Table 4. *Results of the concrete failure load tests*

Test code	Condition	Disc diameter (in)	Confining stress (MPa)	Average failure load (kN)	SD	CV
1	Dry	14	0	24.92	0.51	0.021
2	Dry	14	2.5	33.67	1.43	0.043
3	Dry	14	5	35.7	0.62	0.017
4	Saturated	14	0	22.95	1.42	0.063
5	Saturated	14	2.5	30.45	0.95	0.032
6	Saturated	14	5	31.83	0.58	0.018
7	Dry	20	0	29.44	0.4	0.014
8	Dry	20	2.5	36.04	0.4	0.011
9	Dry	20	5	38.07	1.22	0.032
10	Saturated	20	0	26.94	0.82	0.031
11	Saturated	20	2.5	32.26	1.22	0.038
12	Saturated	20	5	36.35	0.73	0.02

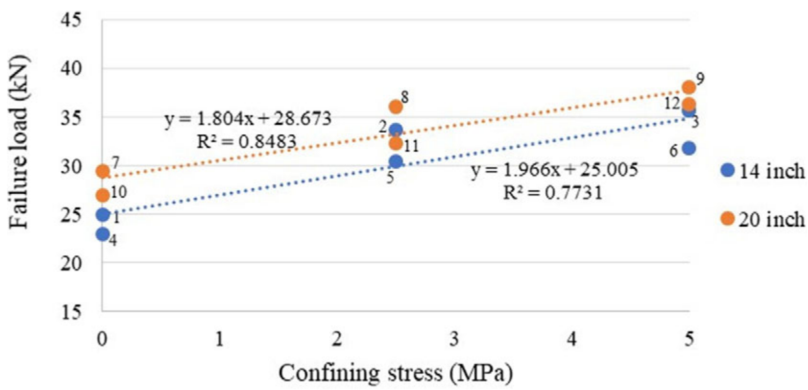

Figure 10. *Relationship between the confining stress and failure load of concrete.*

in concrete samples can decrease the impact of confining stress. While the linear equations provide a useful approximation within the tested stress range, it is important to acknowledge that the relationship between confining stress and failure load may become non-linear at higher stress levels. This could be due to the onset of non-linear elastic behavior or the development of micro-cracking within the rock samples. Future studies should investigate the behavior at higher confining stresses to determine the limits of the linear approximation.

4.2. Effect of confining stress on the failure load of different rocks

The graphs in Figures 8–10 clearly shows the impact of restricting pressure. For all three materials, the failure loads increased as the confining pressure increased from 0 to 5 MPa, suggesting that greater confinement resulted in greater load-bearing capacities. This conclusion is consistent with the results of the indentation tests provided by Chen and Labuz (2006) and Yin et al. (2014). By comparing Eqs (2)–(7) for the breaking tests using 14-inch and 20-inch cutters, the relationship between the breaking load and confining stress for all three material samples with varying compressive strengths is shown. The effect of confining stress on the failure load increased with increasing sample compressive strength; in other words,

https://doi.org/10.1017/dce.2025.16 Published online by Cambridge University Press

samples with greater compressive strength (e.g., granite) experienced a greater increase in the failure load due to the confining stress with different disc cutters. Additionally, according to the presented data, the confining stress effect on the failure of dry samples was greater than that on the failure of saturated samples. For example, in the fracture of a marble sample with a 14-inch disk cutter, when the confining stress changes from 0 to 2.5 MPa, the failure load changes by 32.4%, whereas in the saturated state with the same amount of increase in confining stress, the failure load changes by 31.2%. This suggests that confining stress has a more pronounced impact on the failure of high strength, dry rock materials than low strength or saturated rock samples.

4.3. Regression analysis

Numerous prediction models for TBM performance have been generated over time. Depending on the basis on which each model was built, each model was developed with some assumptions and restrictions. The experimental data were used to calculate the regression equation. The form of a multivariate linear regression model can be a useful starting point for understanding the relationship between failure load, confining stress, disc diameter, and compressive strength. A multivariate linear regression model was initially chosen for its simplicity and ease of interpretation. However, it is recognized that non-linear models may provide a better fit to the data, particularly if there are complex interactions between the variables. The coefficients of the equation were determined by calculating the best fit of the data with three independent variables: the confining stress (σ), cutter disc diameter (d), and rock compressive strength (σ_C). The failure load (F_n) is the dependent variable.

$$F_n = -5.63 + 5.1\sigma + 1.4d + 0.79\sigma_C \quad (8)$$

Eq. (8) expresses σ in terms of MPa, d in terms of inch, and σ_C in terms of MPa. For the linear regression relationship, 0.96 is the coefficient of determination. In rock cutting, the coefficients of the confining stress, disc cutter diameter, and compressive strength of the rock indicate that when various types of rock are broken, the confining stress plays a more significant and useful role than other factors in the multivariate linear regression relationship.

These findings underscore the importance of confining stress, cutter dimensions, and compressive strength for optimizing the cutting performance of geological materials.

5. Conclusions

This study revealed that the confining stress affected the normal breaking force of disc cutters of different diameters when different kinds of rock were cut, such as low-strength concrete, medium-strength marble, and high-strength granite. This result emphasizes the importance of considering in-situ stress conditions when operating (TBMs) to maximize their effectiveness under different geological conditions. The main conclusions can be drawn as follows:

1. Regardless of the type of rock or diameter of the disc cutter, the failure load of the rock samples increased with increasing confining stress.
2. A comparison of the relationships between the confining stress and failure load for the 14-inch and 20-inch disc cutters revealed that the confining stress effect on the failure load was more pronounced for cutters with smaller diameters. These results suggest that mostly using a larger disc cutter can minimize the impact of confining stress and improve cutting efficiency in high-stress environments. This finding highlights the importance of selecting appropriate cutter diameters and designs based on the compressive strength of the rock.
3. The influence of the confining stress on the failure load is more significant in higher-strength rock, such as granite, than in lower-strength rock, such as concrete, and this effect is greater in the breaking load of dry samples than in saturated samples. This highlights the importance of considering rock compressive strength when optimizing cutting performance.

4. This study presents a multivariate linear regression model that relates the failure load to the confining stress, disc cutter diameter, and compressive strength of the rock. This indicates that the confining stress plays a more important role than the other factors in the rock breaking. The proposed model can serve as a useful tool for predicting the cutting performance of TBM operations under various geological conditions.

Author contribution. Conceptualization: M.A. Torabi and M. Palassi; Data curation: G. Ali Mohammadi; Formal analysis: M. Palassi and G. Ali Mohammadi; Investigation: M.A. Torabi and M. Palassi; Methodology: M.A. Torabi, M. Palassi and G. Ali Mohammadi; Software: M.A. Torabi; Supervision: M. Palassi and G. Ali Mohammadi; Visualization: G. Ali Mohammadi; Writing—original draft: M.A. Torabi and M. Palassi; Writing, review and editing: M.A. Torabi, M. Palassi and G. Ali Mohammadi; all authors approved the final submitted draft.

Competing interest. The authors have no relevant financial or non-financial interests to disclose

Data availability statement. The data used in this study are available upon request from the corresponding author (Massoud Palassi, mpalas@ut.ac.ir). The data are not publicly available due to privacy and ethical restrictions.

Ethics statement. The data reported in this article were collected and analyzed honestly and objectively. The authors declare that they did not engage in any falsification, fabrication, or misrepresentation of the results.

Funding statement. The authors declare that no funds, grants, or other support were received during the preparation of this manuscript.

References

Abu Bakar MZ, Gertsch LS and Rostami J (2014) Evaluation of fragments from disc cutting of dry and saturated sandstone. *Rock Mechanics and Rock Engineering 47*, 1891–1903.
Chen L and Labuz J (2006) Indentation of rock by wedge-shaped tools. *International Journal of Rock Mechanics and Mining Sciences 43*(7), 1023–1033.
Chen Y and Song C (2018) Rock fragmentation characteristics by TBM cutting and efficiency under Bi-lateral confinement. *Applied Sciences 8*(4), 498.
Farrokh E (2021) Optimum design of the peripheral cutters' specification on the head profile for hard-rock TBMs. *Tunnelling and Underground Space Technology 107*, 103668.
Gong Q and Zhao J (2009) Development of a rock mass characteristics model for TBM penetration rate prediction. *International Journal of Rock Mechanics and Mining Sciences 46*(1), 8–18.
ISRM Commission on the Classification of Rocks and Rock Masses (1981) Basic geotechnical description of rock masses. *International Journal of Rock Mechanics and Mining Sciences & Geomechanics Abstracts 18*,85–1.
Kang Y, *et al.* (2023) Theoretical and numerical studies of rock breaking mechanism by double disc cutters. *International Journal of Mining Science and Technology 33*(7), 815–828.
Li J *et al.* (2018) Experiment and analysis of the rock breaking characteristics of disc cutter ring with small edge angle in high abrasive grounds. *Journal of the Brazilian Society of Mechanical Sciences and Engineering 40*, 1–12.
Liu Q, *et al.* (2018) Experimental study on rock indentation using infrared thermography and acoustic emission techniques. *Journal of Geophysics and Engineering 15*(5), 1864–1877.
Ma H, *et al.* (2016) Study on the influence of confining stress on TBM performance in granite rock by linear cutting test. *Tunnelling and Underground Space Technology 57*, 145–150.
Pan Y-c, *et al.* (2021) Investigation on disc cutter behaviors in cutting rocks of different strengths and reverse estimation of rock strengths from experimental cutting forces. *European Journal of Environmental and Civil Engineering 25*(1), 1–27.
Tarkoy PJ and Marconi M (1992) "Difficult rock comminution and associated geological conditions," *International Journal of Rock Mechanics and Mining Sciences and Geomechanics Abstracts*, *29*(4), 195–207.
Tumac D and Balci C (2015) Investigations into the cutting characteristics of CCS type disc cutters and the comparison between experimental, theoretical and empirical force estimations. *Tunnelling and Underground Space Technology 45*, 84–98.
Wang G, *et al.* (2021) The influence of confining stresses on rock fragmentation, thrust force, and penetration energy in sandstone indentation tests using disc cutters. *Advances in Civil Engineering 2021*, 1–13.
Yin L, *et al.* (2014) Use of indentation tests to study the influence of confining stress on rock fragmentation by a TBM cutter. *International Journal of Rock Mechanics and Mining Sciences 72*, 261–276.
Zou J, *et al.* (2022) Experimental investigation on hard rock fragmentation of inserted tooth cutter using a newly designed indentation testing apparatus. *International Journal of Mining Science and Technology 32*(3), 459–470.

Cite this article: Torabi MA, Palassi M and Ali Mohammadi G (2025). Influence of confining stress on different diameters of disc cutters in rock cutting. *Data-Centric Engineering*, 6, e25. doi:10.1017/dce.2025.16