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# Analysis of The Rock Fracture on Uniaxial Compressive Strength Test

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**Abstract**
The compressive strength test is one of the technical properties or compressive strength tests that are commonly used in rock mechanics to determine the collapse point or the elasticity of rock against maximum pressure. The rock collapse point is a measure of the strength of the rock itself when the rock is no longer able to maintain its elastic properties. The purpose of this test is to find out how long the rock maintains its strength or elasticity properties when pressure is applied, and to find out the difference between the strength of compact rock and rock that has fractures when pressure is applied. Rocks that have fractures will break more easily or quickly when pressure is applied compared to compact rocks. This analysis is carried out by comparing the rock strength of each sample, both those that have fractures and compact rocks. To find out these differences, laboratory testing was carried out. The test results show the value (compressive strength test 57.76 MPa), (elastic modulus 5250.000MPa), (Poisson ratio 0.05) and the average value of rock mechanical properties test (axial 0.91), (lateral-0.279), and (volumetric 0.252) . Based on the test results above, it shows that rocks that have fractures will break more easily when pressure is applied, compared to compact rocks that have a long time in the uniaxial compressive strength test.

## 1. Introduction

Fracture is one of the most influential factors on rock strength. Rocks will easily lose their elasticity if the fractured rock is subjected to maximum pressure. However, it is different from compact or fresh rock, which when under pressure, the rock will not easily lose its elastic properties due to its dense nature. The results of this rock fracture test are in the form of a curve that shows the fluid pressure in the direction against time, where from the curve the fracture compressive value or maximum compressive value will be obtained. In the mining industry, rock strength is also very influential or very important in rock engineering. Especially in underground mines that require rock engineering.

Rock mechanics is the study of rocks and other aspects contained in them. Therefore, it is necessary to know the hardness of each rock, so that in excavation design, rock slope stability, and tunnel design can run efficiently. Fractures greatly affect the strength of the rock because when pressure is applied, the rock will crack or break more easily. In this case the test is carried out by providing a constant or constant strength.

The uniaxial compressive strength test is a uniaxial compressive test carried out on reduced rock samples in the form of blocks, which is the most commonly used mechanical property test. Uniaxial compressive strength test was conducted to determine the rock compressive strength (σt ), Young's modulus (E), Poison ratio (v). ), and the stress-strain curve. Examples of rocks in the form of blocks are pressed or loaded until they collapse. The comparison between height and size used in this test is the equation L = 2 X D with an average loading surface area parallel to the axis of the rock sample. From the test results will be obtained some data. Uniaxial compressive strength test resulted in seven types of failure, namely:

- Cataclysm
- Axial separation
- Crushing cone
- Shear shear (homogeneous shear)
- Corner to corner shear (homogeneous shear angle to corner)
- Combination of axial and local shear
- Splintery union-leaves and bends.

## 2. Methodology

In this practical field work activity in geological mapping, survey methods are used in the form of surface geological mapping which includes several aspects including aspects of Lithology, Geomorphology, Sedimentology, Stratigraphy, Structural Geology, Historical Geology and excavation materials found in the research area. At the field research stage, a trajectory map is made, observations of rock outcrops, morphology of the research area, structural measurements, and observations of geological resources and disaster sources in the surrounding area are carried out. Meanwhile, in the laboratory research phase, petrographic analysis and fossil analysis were carried out.

The methods of data collection are: (1) surface data collection is carried out directly in the field using tools, (2) data collection with or without using tools, (3) data collection includes primary and secondary data collection.

The object of this research is fieldwork practice on geological mapping, covering several aspects including aspects of lithology, geomorphology, sedimentology, stratigraphy, structural geology, historical geology as well as excavation materials found in the research area.

## 3. Results

Fractures in the support have a direct effect on the uniaxial compressive strength test. The following are the results obtained are as follows:

**Table 1.** Uniaxial Compressive Strength Test Results on samples with an area of 2601.00mm => 260.1mm2 and a load of 11016.50 Kg

| No. | Description | Uniaxial Compressive Strength Test Results |
|---|---|---|
| 1 | Uniaxial Compressive Strength | 42.35MPa |
| 2 | Poisson Ratio | 0.62 |
| 3 | Modulus of Elasticity | 6754.386Mpa |

Results based on laboratory tests, the rock has a compressive strength of 42.35 MPa. With the following calculations:

$$\sigma_c = \frac{P}{A}$$

$$\sigma_c = \frac{11016.50 \text{ kg}}{260.1 \text{ mm}^2}$$

$$\sigma = 42.35 \text{ MPa}$$

**Table 2.** Uniaxial Compressive Strength Test Results on samples with an area of 2601.00mm => 260.1mm2 and a load of 11016.50 Kg

| No. | Description | Uniaxial Compressive Strength Test Results |
|---|---|---|
| 1 | Uniaxial Compressive Strength | 42.35MPa |
| 2 | Poisson Ratio | 0.31 |
| 3 | Modulus of Elasticity | 7833.333 MPa |

Based on the results of laboratory tests, the rock has a compressive strength of 42.35 MPa. By calculating the uniaxial compressive strength as follows:

$$\sigma_c = \frac{P}{A}$$

$$\sigma_c = \frac{11016.50\ \text{kg}}{260.1\ \text{mm}^2}$$

$$\sigma = 42.35\ \text{MPa}$$

The sample results above are almost the same as the previous samples, which have the same strength but have different Elasticity Modulus and Poisson's Ratio.

**Table 3**. Uniaxial Compressive Strength Test Results on samples with an area of 2601.00mm => 260.1mm2 and a load of 11016.50 Kg

| No. | Description | Uniaxial Compressive Strength Test Results |
|---|---|---|
| 1 | Uniaxial Compressive Strength | 42.35MPa |
| 2 | Poisson Ratio | 0.12 |
| 3 | Modulus of Elasticity | 7700.00MPa |

Based on the results of laboratory tests, the rock has a compressive strength of 42.35 MPa. By calculating the uniaxial compressive strength as follows:

$$\sigma_c = \frac{P}{A}$$

$$\sigma_c = \frac{11016.50\ \text{kg}}{260.1\ \text{mm}^2}$$

$$\sigma = 42.35\ \text{MPa}$$

The results of the sample above are almost the same as the results of the previous sample, which has the same compressive strength but has a different modulus of elasticity and Poisson's ratio. it can be seen from the test that the three samples have the same compressive strength.

**Table 4.** Uniaxial Compressive Strength Test Results on samples with an area of 2601.00mm => 260.1mm2 and a load of 11016.50 Kg

| No. | Description | Uniaxial Compressive Strength Test Results |
|---|---|---|
| 1 | Uniaxial Compressive Strength | 57.76MPa |
| 2 | Poisson Ratio | 0.05 |
| 3 | Modulus of Elasticity | 5250.00MPa |

Based on the results of laboratory tests above, the rock has a compressive strength of 57.76 MPa. By calculating the uniaxial compressive strength as follows:

$$\sigma_c = \frac{P}{A}$$

$$\sigma_c = \frac{15022.50\ \text{kg}}{260.1\ \text{mm}^2}$$

$$\sigma = 57.77\ \text{MPa}$$

**Table 5.** Uniaxial Compressive Strength Test on a sample with an area of 2601.00mm2 and a load of 15022.50kg

| No. | Description | Uniaxial Compressive Strength Test Results |
|---|---|---|
| 1 | Uniaxial Compressive Strength | 46.21MPa |
| 2 | Poisson Ratio | 0.33 |
| 3 | Modulus of Elasticity | 10628.571MPa |

Based on the results of laboratory tests above, the rock has a compressive strength of 46.21 MPa. By calculating the uniaxial compressive strength as follows:

$$\sigma_c = \frac{P}{A}$$

$$\sigma = \frac{16024.00\ kg}{260.1\ mm^2}$$

$$\sigma = 57.77\ \text{MPa}$$

Based on the uniaxial compressive strength test that has been carried out on each rock sample, the compressive strength value of each rock is 42.35 MPa three times, then 57.77 MPa and 46.21 MPa. Based on the literature review and also the results of the study of rocks that have fractures that affect the strength of the rock when pressure is applied or the uniaxial compressive strength test is applied. The pictures of samples that have good fractures before size reduction (Corring) and vice versa.

## 4. Conclusion

The conclusions from the results of the research above that have been carried out are as follows:

- There is an effect of rock fracture on the uniaxial compressive strength test where the rock has low Elasticity. Meanwhile, compact rock has high elasticity when it is subjected to pressure.
- The test results show the value (compressive strength test 57.76 MPa), (Modulus of elasticity 5250.000MPa), (Poisson ratio 0.05) and the average value of rock mechanical properties test (axial 0.91), (lateral-0.279), and (volumetric 0.252).
- The compressive strength test is carried out to determine the strength of the rock, so that the more fractures in the rock, the lower the elasticity, and vice versa, the strength of the rock or not having the strength of elasticity is higher.

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