SHEAR BEHAVIOUR OF ROCK JOINTS

A DISSERTATION
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DEGREE OF
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(GEOTECHNICAL ENGINEERING)

By
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UNDER THE GUIDANCE OF

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CERTIFICATE

This is to certify that the thesis work entitled "**SHEAR BEHAVIOUR OF ROCK JOINTS**" being submitted by me, is a bonafide record of my own work carried by me under the guidance and supervision of Associate Professor Dr. A.K. Shrivastava in partial fulfilment of requirements for the award of the Degree of Master of Technology (Geotechnical Engineering) in Civil Engineering.

The matter embodied in this project has not been submitted for the award of any other degree.

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This is to certify that the above statement made by the candidate is correct to the best of my knowledge.

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I Certify that

a. The work contained in this thesis is original and has been done by me under the guidance of my supervisor.
b. The work has not been submitted to any other Institute for any degree or diploma.
c. I have followed the guidelines provided by the University in preparing the thesis.
d. I have conformed to the norms and guidelines given in the Ethical Code of Conduct of the Institute.
e. Whenever I have used materials (data, theoretical analysis, figures, and text) from other sources, I have given due credit to them by citing them in the text of the thesis and giving their details in the references.

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ABSTRACT

Rocks in natural state always consist of joints and the presence of intact rock is very difficult because some weathering action is always taking place in nature .Compared to intact rocks the weathered rocks has very less crushing and shearing strength ,thus this requires the study of strength parameter of rock masses. In jointed rocks, the shear displacement is accompanied with vertical movement or dilation and it is one of the most important parameter which should be considered while designing any structure in jointed rocky strata. It is very difficult to take actual sample of rock from field because i) during the extraction of sample, sample get disturbed due to vibration therefore actual sample will not be found ii) it is not possible to take out sample from inside core because process employed is difficult & expensive, therefore for such purposes the artificial rocks are prepared with the help of different material. The material for construction of sample should be such that i) It should be easily available in the local market ii) It should be cheaply available in local market iii) Sample prepared with material should represent best model of actual field condition. There are the various material can be used for sample preparation example Mortar, POP and other adhesive material. But we have taken POP for testing because POP is best suited for testing gives good strength and can also be used for simulating behaviour of hard as well as soft rock.

The joints can be prepared at any angle but in this analysis the joints are taken unequal with asperity geometry of 15°-30° and 15°-45° and 45°-15° .The geometry of 15°-30° represent that the facing angle is 30°. The sample are prepared with POP at the moulding water content of 50% by weight and direct shear test is conducted at 14 days of air dried curing and test is done in conventional direct shear test machine. The direct shear test can be conducted in CNL or CNS condition. In CNL condition, the normal stress is kept constant but in actual the normal stress does not remain constant, in field CNS condition occurs. In CNS condition stiffness remains constant ,the result obtained from CNS condition gives higher value of shear stress but this condition of testing is not adopted because the equipment developed in the past for CNS boundary condition was either having difficulty in changing the boundary conditions or it was not useful for wide variety of rock joints. The orientation of rock during testing plays an important role in resisting shear stress.

Direct shear stress carrying capacity for 15°-45° asperity sample as compared with 15°-30° asperity sample will more and dilation will also more in case of 15°-45° asperity sample as compared with 15°-30° asperity sample.

In case of 15°-45° asperity sample and 15°-30° asperity sample, the peak shear displacement increases upto 0.4MPa but it drastically reduced at 0.5MPa because at this value the normal stress tries to prevent the horizontal displacement and finally the result obtained experimentally are compared with well known equation of Barton(1973), Bandis(1982) and Patton's(1966) and Shrivasta and Rao (2012) criteria.

NOTATIONS

1. $d_{s.peak}$ -Peak secant dilation angle
2. $d_{t.peak}$- Peak secant dilation angle
3. $d_{t.mobilized}$- Mobilized dilation angle
4. JCS- Joint Compressive Strength
5. JRC-Joint Roughness Coefficient
6. L- Length of rock block in shearing direction in meters
7. M- Damage coefficient
8. δ_h – Shear displacement
9. δ_{peak} – Peak shear displacement (at which shear stress is maximum)
10. δ_v – Dilation
11. $\delta_{v.peak}$ – Dilation at peak shear displacement
12. φ_b- Base friction angle
13. φ_r- Residual friction angle
14. σ_c- Uniaxial compressive strength in MPa
15. σ_n- Normal stress in MPa
16. τ_{peak}- Peak shear strength of rock joints in MPa

Dedication

I dedicate this thesis to my Papa and my Teachers for Supporting me all the way & inspiring me at all the moments during my M.Tech.