CHAPTER VII
DISCUSSIONS, CONCLUSIONS AND RECOMMENDATIONS FOR FUTURE STUDIES

7.1 Discussions

The CAI values decrease as a result of both Jn and e. This reduction is attributed to the stylus tip entering the joint apertures during the test, which led to a smaller abrasion of the stylus. The stylus tip did not maintain contact with the entire rock surface over the 10 mm distance, resulting in a reduction of abrasion.

Sandstone and basalt show higher CAI values than limestone. This is because of the dependence of CAI on rock strength, as indicated by previous studies elsewhere Thanadkha and Fuenkajorn, (2022) and Kathancharoen and Fuenkajorn, (2023). They report strengths of 81.43 MPa for sandstone, 79.17 for basalt and 54.61 for limestone. Hard rock gives greater CAI values and shows large effect of joint characteristics than the softer ones.

The force measured during scratching increases with Jn and e. Higher numbers of joints and larger apertures require higher force to scratch the rock surface. This is due to the stylus encountering the gaps created by larger apertures, causing additional resistance. When the stylus passes through a large gap, it drops and requires more force to step up to continue scratching. The larger gap (aperture) results in a higher scratching force. This implies that an excavating tool may show less wear if it cuts through fractured rocks as compared to the intact ones. Larger scratch volumes are obtained when the number of joints is increased. This effect is more pronounced in strong rock (basalt), as compared to the softer rock, and hence resulting in a higher CAI value. The roles of joint apertures are, however, opposite. Lager apertures lead to a reduction of scratching volume. This is because as the aperture increases the intact

portions of the rock surface reduce as the total scratching distance is maintained constant at 10 mm as specified by the ASTM standard practice.

Regardless of joint number and aperture the CERCHAR specific energy (CSE) increases with CAI. This observation is similar to those of intact rocks performed elsewhere. The CSE-CAI relations show small effect of Jn and e for softer rocks (limestone and sandstone). The Jn and e effects are significant for the CSE-CAI relation of strong rock (basalt). This implies that for strong rock under the same CAI value the increases of Jn and e can notably reduce the energy to cut their surfaces.

The results obtained here are limited to the condition at which the scratching direction is normal to the joint traces with one joint set. The effect of the angles between scratching direction and joint line has not been investigated. In addition, the dip angle of the simulated joints is limited to 90°. The effect of dip angle has not been investigated.

7.2 Conclusions

The results of testing and analyses obtained here can be concluded as follows.

1) Number of joint and aperture can decrease the wear of stylus pin (CAI) while increasing the scratching force and groove volume.

2) The effects of joint aperture and joint number on CAI and ploughing force pronounce more in strong rock (basalt) than in soft rock (limestone). This results in a reduction of lower cutting energy.

3) The groove volume increases more rapidly for larger numbers of joints, as compared to smaller number of joints.

4) The effect of joint aperture on groove volume is more significant in soft rock than in the stronger one.

5) Soft rocks show less effect on CSE-CAI relation than does the stronger ones.

7.3 Recommendations for future studies

Scope and limitations of the test variables in the study lead to

recommendations for future studies as follows.

1) A variety of rocks with a wide range of compressive strengths should be tested to confirm the conclusion drawn in this study.

2) The effect of joint orientations and dip angles in relation to the scratching abrasives should be investigated.

3) This study is limited to testing on smooth rock and joint surfaces. The effect of roughness of rock surface and joint wall should be investigated. Effect of pore pressure in joint should be incorporated into the future study.