

UNIVERSITI TEKNOLOGI MARA

**INVESTIGATING THE SHEAR
STRENGTH OF GRAVELS
AFFECTED BY PARTICLE
BREAKAGE UNDER SATURATED
AND UNSATURATED CONDITIONS**

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PhD

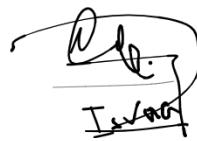
June 2020

AUTHOR'S DECLARATION

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by Particle Breakage Under Saturated and
Unsaturated Conditions



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ABSTRACT

One of the essential factors affecting the shear strength and volume change behaviour of the granular materials is the phenomenon of breakage undergone on the gravel particles after subjecting to stresses exceed the particle's strength. The potential of particle breakage increases as the gravel particles subjected to pure rain and acid rain. Particle breakage produces fine particles and small fragments when the neighbouring particles are sheared under specific stresses. However, under unsaturated conditions, the effect of the produced fines due to particle breakage becomes significant due to the development of suction stresses. In this research, two phases of triaxial tests were conducted on limestone gravels; the first phase is the initial shearing, which conducted to produce crushed material which named as the pre-sheared gravels. In this phase, limestone gravels prepared at different conditions; (fresh gravels, water soaked and acid soaked; all tested under fully saturation conditions and fresh gravels tested under fully dry conditions) are subjected to triaxial tests under confining pressure of 1000 kPa. The second phase involves the re-shearing of the pre-sheared gravels at four different suctions using non-axis translation technique and at fully saturated conditions under low confining pressure. According to the test results, it was found that the maximum deviator stress value decreases as the breakage rate increases. Also, great influence of acidic solution and water on the amount of particle breakage which reduces the strength of the particle. Furthermore, the effect of particle breakage on the mechanical behaviour of limestone under saturated and unsaturated condition was found that the pre-sheared gravels gain additional strength at unsaturated conditions resulted from the development of suction stresses. A model for predicting the deviator stress after the occurrence of particle breakage was developed, and the effect of matric suction was incorporated in the model. The proposed model was validated by using experimental data from different types of gravels.

ACKNOWLEDGEMENT

Firstly, I wish to thank God for giving me the opportunity to embark on my PhD and for completing this long and challenging journey successfully. My gratitude and thanks go to my supervisor Assoc. Prof. Dr. Mohd Jamaludin Md Noor.

My appreciation goes to the staff members of Centre of Postgraduate Studies in Faculty of Civil Engineering-UiTM for continuous support. Special thanks to my colleagues and friends for helping me with this project.

Finally, I would like to express my love and gratitude to my beloved family for their encouragement and understanding throughout my study. Alhamdulilah.

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