

The Evolution of Shear Deformation and Its Implication to the Residual Behavior of the Granular Material by Means of Ring Shear Apparatus

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This research is concerned with the understanding of the behaviour of granular materials in undrained monotonic test under stress control by using ring shear apparatus. The advantages of the ring shear apparatus compared to the other devices for soil mechanics laboratory experiments is that the ring shear apparatus could be used for very long and almost un-limited of shear displacement such as for investigating the residual behaviour of the specific sample as many researchers interested in. But actually, the other greatest value for this apparatus is the capability for making the specimen within the shear box to become separated (split) each other, consequently, one part still moving whilst another part is relative stable by progressing the shear stress during the test. Furthermore, by considering this stage the mechanism of transition from slide to flow based on progressive failure concept could be examined. This is the goal of the research.

One of the progress reports on this topic is the shear zone generation process from the beginning to the residual state. This is one of the most important parts to make clear and understandable the evolution of shear deformation processes on granular material. By using a newly developed sample picker as an additional tool for ring shear apparatus in order to obtain the 'undisturbed' specimen after test to minimize the structural disturbance, as required for particular shear zone

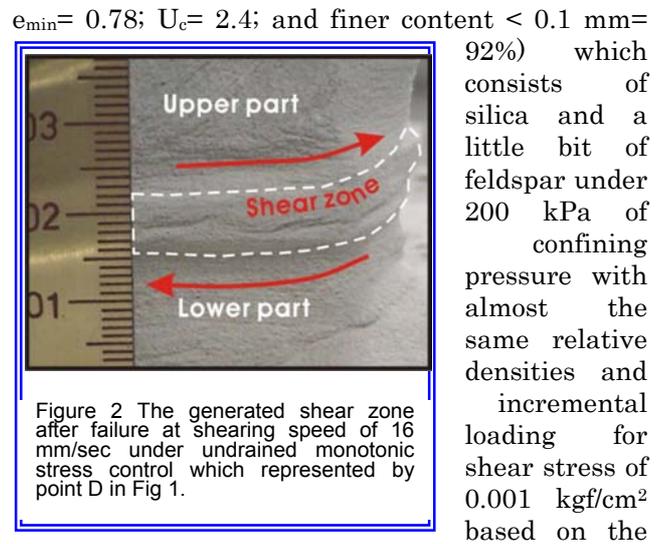


Figure 2 The generated shear zone after failure at shearing speed of 16 mm/sec under undrained monotonic stress control which represented by point D in Fig 1.

progression of stress path and the generating shearing speed is shown in Figure 1. First is that when the stress path just passed the phase transformation (2 tests, $D_r=76.5\%$ and 77.6% respectively). Second, just after failure has occurred at a particular value of the shearing speed of 5 mm/sec, 16 mm/sec, and 30 mm/sec (3 tests, D_r value of 75.6%, 81.3%, and 73.9% respectively). Third, when the continuous shearing speed (assumption for splitting state) of about 54 mm/sec has reached (1 test, $D_r=73.9\%$) and the last one is that when the specimen has been sheared for 10 m of shear displacement (1 test, $D_r=78.1\%$). After finishing each test the sample picker immediately used to obtain the sample within the shear box after the loading plate was lifted up. After that it must be immediately brought into the oven and let it stays for 24 hours to remove all water content. The investigation of shear zone then performed by using a paint brush to clean the sample in which the shear zone could be seen clearly (see Figure 2).

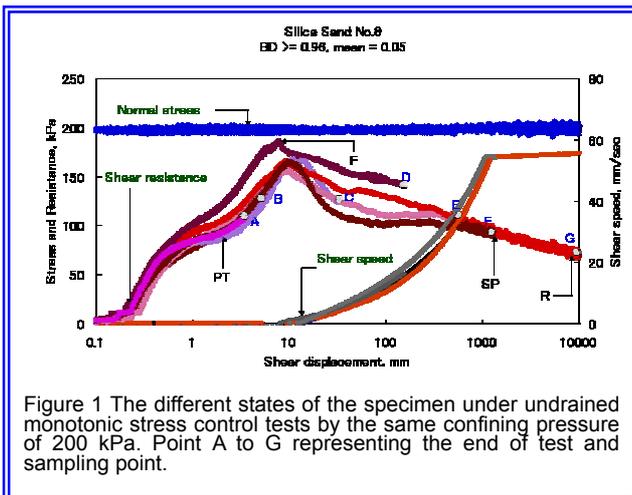


Figure 1 The different states of the specimen under undrained monotonic stress control tests by the same confining pressure of 200 kPa. Point A to G representing the end of test and sampling point.

investigation, the evolution of shear zone from the beginning to the residual state could be displayed clearly. Even though it was a simple sample picker but it was very useful for such purpose since it could be used to collect the samples for every desired state, stress path, shearing speed and shear displacement. In this paper 7 tests on Silica Sand No.8 ($G_s=2.65$; $D_{50}=0.05$ mm; $e_{maks}=1.52$;

Result

Based on these experiments on Silica Sand No.8 by using an additional sample picker for ring shear apparatus revealed that the clear evolution of generated shear zone after failure to the residual state (10 m of shear displacement) could be obtained. Within the generated shear zone after failure the micro-fold structure could be clearly recognized even without micro-structural analysis. The splitting state by means of ring shear test proposed in this research as the most important stage for understanding the mechanism of transition state from slide to flow for granular material is helpful for further progressive failure research.