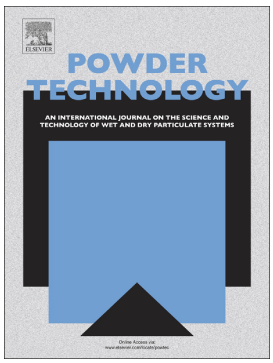

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An Experimental Investigation on Stable Arch Formation in Cohesionless Granular Materials Using Developed Trapdoor Test

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ABSTRACT

Arching in granular materials is a general phenomenon that exists in different domains of engineering such as design of silos and hoppers as well as geotechnical engineering problems. Due to the interaction among particles that are flowing through an opening, an arch-like structure comes into existence that causes the particles to be in a stationary state. Few researches have explored the formation of stable arches. In this study, the characteristics of statically stable arches generated in purely cohesionless granular materials are investigated experimentally. A developed form of the so-called trapdoor test was implemented in which, the opening width can be increased incrementally. The test box can also be inclined with respect to the horizontal direction in order to consider the gravity effect on the arch formation. Investigations on the self-supported arches indicate that the arch height increases as the arch width increases. However, there is fall in the height of the critical arch, which is the arch with the biggest possible width. The results also indicate that the frictional parameters of granular materials have major influence on the arch formation. The dimensions of stable arches are a function of the peak friction angle, while the critical state friction angle dominates the height of the critical arch. Furthermore, the results show that the unit weight of the granular materials has minor effect on the critical arch formation rather than frictional parameters.

Keywords: Arching; Granular materials; stable arch; trapdoor test; gravity; arch characteristics

1. Introduction