

Dynamic and Static Behavior of Calcareous Sands

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ABSTRACT

The behavior of reefoidal calcareous sediments from a variety of locations was examined by testing with a cyclic simple shear device. The results were compared to common quartz sands to determine if there are any differences. Static shear tests indicate that calcareous sands tend to dilate more and therefore have higher friction angles than the quartz sands. Their failure envelopes are also more curved. Their cyclic resistance appears to be larger than that of the quartz sand used as a reference, probably due to contrasts in gradation, grain shape and fabric.

KEY WORDS: Calcareous, carbonate, sand, quartz, liquefaction, strength, cyclic testing

INTRODUCTION

The 2006 earthquake on the Island of Hawaii resulted in extensive liquefaction at the commercial Kawaihae Harbor and the adjacent public marina (Figure 1). As a result there has been renewed interest in assessing the dynamic properties of calcareous sands in Hawaii and in understanding if such behavior may be different in any way from the more commonly studied quartz sands. It is known that the effects of crushing and cementation can be more pronounced in calcareous sands and that these types of materials can exhibit differences in terms of frictional strength and volume change behavior (Brandes and Johnson, 2003; Ong et al., 1998; Jewell, 1993; Datta et al., 1979). A distinction is made between general carbonate sands and the more specific calcareous sands that are the focus of this study. The latter ones represent detrital material from the breakdown of calcareous reefs and skeletal remains of organisms that inhabit shallow waters in tropical and sub-tropical regions. A wide range of grain types, grain shapes, and fabric arrangements are possible and it is conceivable that the static and dynamic behavior of these soils may vary accordingly. In this investigation we have focused our attention on the two most common types of calcareous sediments found in Hawaii and contrast their behavior to other calcareous sediments from elsewhere and to common quartz sands.



Figure 1. Sand boils and lateral spreading due to liquefaction at Kawaihae Harbor during the 2006 Hawaii earthquake.