Kansas Department of Transportation

TECHNICAL SUMMARY

Air Void Clustering

Report Number: K-TRAN: KSU-13-6 ▪ Publication Date: June 2015

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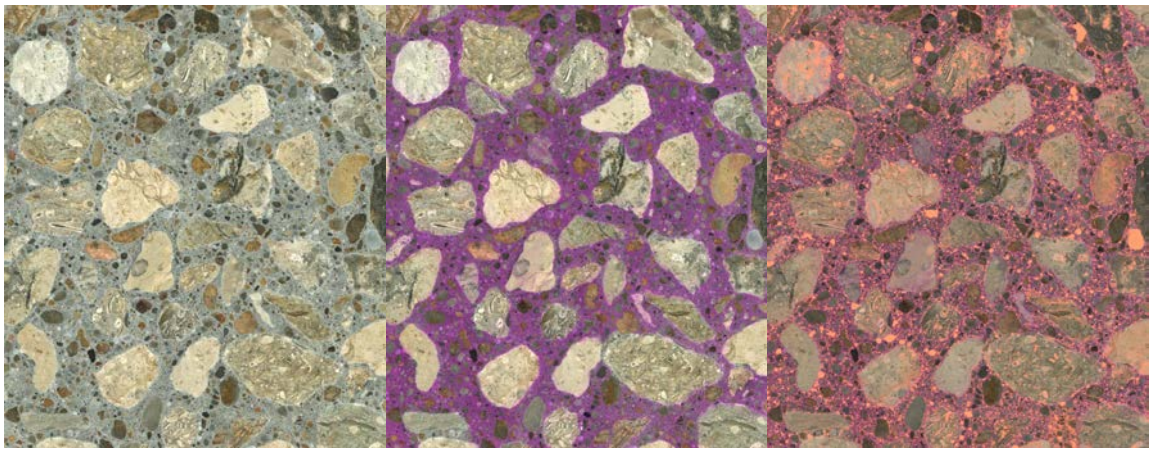
Introduction

Air void clustering around coarse aggregate in concrete has been identified as a potential source of low strengths in concrete mixes by several Departments of Transportation around the country. Research was carried out to (1) develop a quantitative measure of air void clustering around aggregates; (2) investigate whether air void clustering can be reproduced in a laboratory environment; (3) determine if air void clustering contributes to lower compressive strengths in concrete mixes; and (4) identify potential factors that may cause clustering.



Scanned Images Used for Air Void Analysis of Hardened Concrete

Project Description

Five types of coarse aggregate and five different air entraining agents were included in the laboratory study to determine if aggregate type or chemical composition of the air entraining agent directly relates to air void clustering. A total of 65 mixes were made, implementing the frequently used technique of retempering that has been previously associated with air void clustering around aggregates. Cylinders for compressive strength testing as well as samples for total air void analysis in the hardened concrete were made. Compressive strength at 7 and 28 days was determined, and automated testing for total air void analysis (including a new method of clustering evaluation) was performed on all mixes.

Project Results

This study found that it is possible to reproduce air void clustering in laboratory conditions. However, the results have shown that retempering does not always cause air void clustering. It was also observed that air void clustering is not responsible for a decrease in compressive strength of retempered concrete, as neither aggregate type nor chemical composition of the air entraining agent had a significant impact on severity of void clustering around coarse aggregate particles. It was found that the total air content and an inhomogeneous microstructure of the cement paste, not air void clustering, were responsible for lower strengths.

Project Information

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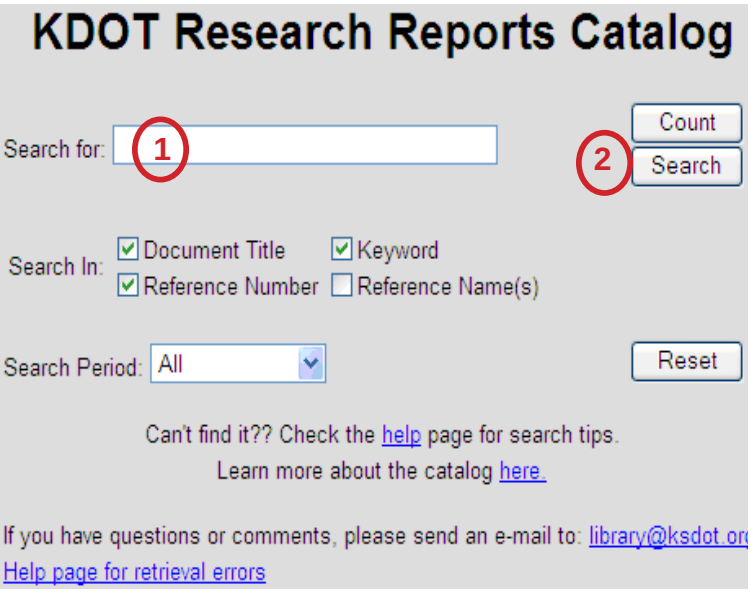

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