Texas Department of Transportation

CENTER FOR TRANSPORTATION RESEARCH

PROJECT SUMMARY REPORT

0-7074: Increase the Allowable Content of Recycled Crushed Concrete Aggregate in Class P Concrete

Background

In a world with diminishing natural resources and an increasing emphasis on sustainability, it is becoming more and more important to recycle and reuse products ranging from water bottles to batteries to construction materials. As the world's most widely used construction material (besides water), portland cement concrete is an ideal candidate for implementing sustainability on a grand scale, especially with regard to recycling and reuse. It has been estimated that over 140 million tons of concrete are recycled each year in the United States. This includes concrete recovered and recycled from demolished pavements and structures, as well as concrete returned to ready-mix plants. Most commonly, recycled concrete is crushed and used as aggregate for fill, road base or new concrete. Typically for new concrete, recycled concrete aggregates are used as an alternative for natural coarse aggregates. There are fewer instances of the use of recycled concrete aggregate as a replacement for natural fine aggregates. This project focused specifically on recycled concrete fine aggregates (RCFA), with the goal of increasing the allowable replacement level of RCFA for natural sand above the current 20 percent limit specified by TxDOT.

What the Researchers Did

The research team reviewed and synthesized published literature related to the use of recycled concrete fine aggregates in concrete, in general, and concrete pavements, specifically. A review of state highway specifications across the county was performed to better understand how RCFA is used in paving applications. A comprehensive laboratory testing program was conducted to evaluate the performance of paving mixes containing RCFA (two sources), as well as some mixes containing recycled concrete coarse aggregates (RCCA). Applying the knowledge and experience gained in the laboratory evaluations, a field trial was performed to test the performance of recycled concrete aggregates in TxDOT Class P paving concrete mixtures. The field trial took place on September 12, 2022 and included a total trial section of about a half a mile of 9" thick, 14' wide continuously reinforced concrete pavement (CRCP) frontage road on I-10 in Sealy, TX. The performance of the test sections was tracked over time using vibrating wire gauges (for strain and temperature) and periodic visual surveys, including crack quantification.

What They Found

The overall findings from this study show that it is possible to increase the allowable RCFA content above the current 20 percent limit allowed by TxDOT. This conclusion is based on both a comprehensive laboratory evaluation, which also showed that RCCA can be used at very high replacement levels in Class P concrete, and a full-scale field trial on I-10 in Sealy, TX. Up to 70 percent RCFA was successfully used in the field trial, with performance similar to that of typical Class P concrete using virgin aggregates. More work is needed to demonstrate the long-term performance of Class P concrete containing high replacement levels of virgin aggregates for RCCA and/or

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Project Completed:
08-31-2023

RCFA. Particularly, it is recommended that much larger test sections be constructed to gain more insight into QC/QA issues that might arise in a full production mode. Such efforts are recommended in the form of large-scale implementation projects using RCCA and/or RCFA.

What This Means

This research confirmed that recycled concrete aggregates can effectively be used in Class P concrete mixtures at replacement levels significant above the current 20 percent limit set today by TxDOT. Increasing the allowable amount of RCFA allowed in TxDOT applications should increase the use of this recycled material, thereby preserving natural resources for future generations.

For More Information

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Keyword: Research

This research was sponsored by the Texas Department of Transportation and the Federal Highway Administration. The contents of this report reflect the views of the authors, who are responsible for the facts and accuracy of the data presented here. The contents do not necessarily reflect the official view or policies of FHWA or TxDOT. This report does not constitute a standard, specification, or regulation, nor is it intended for construction, bidding, or permit purposes. Trade names were used solely for information and not for product endorsement.