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Bureau of Research

Technical Brief



Recycled Concrete Aggregate in Portland Cement Concrete

Dwindling supplies of natural coarse aggregate in New Jersey and increased interest in using more sustainable methods and materials for construction led NJDOT to study the barriers and opportunities for using crushed concrete waste, known as recycled concrete aggregate (RCA), as an aggregate for new concrete. This report reviewed available published reports, the experiences of other states and the results of a laboratory and field testing program to determine the conditions under which RCA could be used in NJDOT projects.

Background

While using RCA as an aggregate for new hydraulic cement concrete can preserve supplies of natural aggregates and reduce landfilling of construction debris, the material has properties that are different from those of natural aggregates. These properties could potentially lead to poor durability in new concrete construction. Therefore it was important to understand how these properties differed and identify design methods that will minimize or eliminate inferior performance. The primary difference between natural and recycled aggregates is the presence of concrete mortar adhering to the surface of RCA. This mortar is less dense than stone and effects the properties of the new concrete. However, these effects can be mitigated through proper design.



Research Objectives and Approach

The objective of this work was to determine if RCA is suitable for use in NJDOT projects and if so, what limitations there are to its use. In order to answer these questions a review of previous published reports was performed along with a review of the experiences other state DOTs have with the material. This was followed by laboratory testing of RCA produced in New Jersey. This New Jersey produced RCA was then used as aggregate in concrete field trials. The trials included cast-in-place and precast applications.



Findings

Based on this study the following recommendations were made.

- The New Jersey Department of Transportation should allow the use of recycled concrete as coarse aggregate for concrete.
- Applications should be limited to non-structural or roadway concrete items, excluding surface and base courses. Precast roadway concrete items with SCC using RCA should also be permitted.
- Concerns with use of RCA in concrete are relatively easily mitigated.
- In cases of large pavement removal and replacement operations, reuse of the aggregates could be approved on a job basis with satisfactory test results of the recycled material.
- Many authors suggested the many problems associated with the use of RCA were alleviated by limiting the aggregate replacement rate to 30 percent or less. There is not a consensus on this and states are successfully allowing 100 percent replacement rates. It is suggested that no limit be placed on the replacement rate. Available supply of RCA will likely dictate whether contractors choose to use a blend of virgin aggregate and RCA or a 100 percent replacement. Precast facilities would likely use a blend.
- Because of the unknown history of material reaching Class B recyclers, specific mitigation methods are required for all mixes using RCA unless the source aggregate is known such as in the case of precast concrete operations.

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A final report is available online at: <http://www.state.nj.us/transportation/refdata/research/>.
If you would like a copy of the full report, send an e-mail to: Research.Bureau@dot.state.nj.us.

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