

Presentation of 2023 Awards

The BEST of 2023

Presented by

Dr. Giri Venkiteela

Research Scientist, Bureau of Research

New Jersey Department of Transportation



BUREAU OF RESEARCH

2023

Outstanding University Student in Transportation Research Award



Alissa Persad

Rutgers University

2023

Research Implementation Award



Dr. Hao Wang

Rutgers University

Energy Harvesting on New Jersey
Roadways Project

2023

Best Poster Award

Properties of Cementitious Materials with Reclaimed Cement
Alyssa Sunga, Shahrir Abubakr, Gibon Lomboy, and Islam Mantawy

Rowan University
CENTER FOR RESEARCH & COLLABORATION IN
ADVANCED TRANSPORTATION INFRASTRUCTURE

RESEARCH FRAMEWORK

BACKGROUND

- Concrete, as the second most widely used material globally, forms the backbone of infrastructure development, particularly in transportation sector.
- Concrete roads offer a service life of 30 to 50 years without the need for repeated resurfacing, repairs, or patching.
- The production of Ordinary Portland cement (OPC) is an energy-intensive process, contributing to over 500,000 tons of harmful emissions annually.
- The growing demand for supplementary cementitious materials (SCMs) such as fly ash and slag is expected to outstrip supply by 50%, while the availability of slag cement is diminishing due to reduced blast furnace operations.
- The demolition of concrete structures, whether due to structural failure or the end of their service life, often results in their disposal in landfills, creating more environmental concerns.

OBJECTIVES

- Produce concrete blocks and subsequently crush them (simulating demolished concrete) to obtain recycled concrete.
- Determine the chemical composition of reclaimed cement.
- Partially replace OPC with reclaimed cement (RC) in cement paste and mortar.
- Determine fresh and hardened properties of cement paste and mortar such as flowability, initial setting time, heat of hydration, and compressive strength.

MATERIALS AND METHODS

- Concrete cubes with an average compressive strength of 5000 psi were produced and then crushed to generate recycled concrete aggregate (RCAs).
- Two-year old RCAs were crushed to obtain RC.
- Cement paste and mortar specimens were prepared with OPC type I, incorporating varying proportions of RC (percentage by weight of binder).

Mx	Cement Paste			Mortar		
	OPC (%)	RC (%)	water/binder	OPC (%)	RC (%)	water/binder
Control	100	0	0.45	100	0	0.45
RC5	95	5	0.35	95	5	0.405
RC10	90	10	0.35	90	10	0.405
RC15	85	15	0.35	85	15	0.405
RC20	80	20	0.35	80	20	0.405

Chemical Composition (%)

	SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	CaO	MgO	SO ₃	Na ₂ O	K ₂ O
OPC	21.7	4.2	2.1	63.9	2.0	1.30	0.09	1.00
RC	34.3	7.9	7.4	43.8	1.8	1.0	0.7	2.89

RESULTS

FLOW MEASUREMENT
The results of flow test show no significant effect on replacing cement with RC.

Mix No.	Cement Paste	Mortar
Control	184	184
RC5	176	181
RC10	181	184
RC15	199	187
RC20	182	194

HEAT OF HYDRATION
Data from the total heat of hydration for cement paste specimens shows that replacing cement with RC lower the total heat generated during the first 8 days of curing. A similar trend is also observed when fly ash is used, however; the effect here is much less significant.

COMPRESSIVE STRENGTH
The compressive strength of specimens with RC is comparable to control specimens. Cement paste specimens containing up to 20% RC exhibit a 4% reduction in compressive strength after 90 days. In contrast, mortar specimens with RC surpass the strength of control specimens at 28 days.

SETTING TIME
Partially replacing cement with up to 20% RC has an insignificant effect on the initial setting time of cement paste, showing a difference of only a few minutes.

PRACTICAL IMPLICATIONS

- Supply Shortage Mitigation: Demolished concrete, readily available globally, presents a solution for addressing the supply shortage of SCMs, particularly in cost-competitive regions.
- Sustainable Transportation Infrastructure: Utilizing RC in transportation infrastructure not only reduces costs but also conserves resources and lowers the environmental impact.
- Continuous Improvement: The development of more stringent control and precise mix proportioning for cement paste, mortar, and concrete is essential before widespread application.

CONCLUSION

Cement paste and mortar incorporating up to 20% RC exhibit performance similar to control specimens using OPC only, suggesting their suitability for infrastructure applications, including concrete pavements.

FUTURE WORK

Concrete, UHPC, 3D-Printing

25th Annual NJDOT Research Showcase, October 25, 2023, New Jersey

Alyssa Yvette Sunga Rowan University

Properties of Cementitious Materials with Reclaimed Cement



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2023

Research Champion Excellence Award

Thomas Bushar

New Jersey Department of Transportation



In recognition of your partnership and dedication while acting as the Technical Advisory Panel member on the **Evaluation of Different Paint Systems for Over-Coating Existing Structural Steel** research project. Your commitment has greatly contributed to the success and implementation of this research project.



CELEBRATING
25th
ANNIVERSARY

BUREAU OF RESEARCH

2023

Build a Better Mousetrap Award



Gerald Oliveto

National BABM “Bold Steps” Winner

New Jersey Department of Transportation

Innovation Solution:

Route 71 Over Shark River Road Diet



BUREAU OF RESEARCH

UP NEXT

- **Lunch**
- **Poster exhibits –
in Rooms 116 and 117**
- **Concurrent breakout sessions –
beginning at 1:00pm**



BUREAU OF RESEARCH



New Jersey Department of Transportation

25th Annual NJDOT Research Showcase

Commitment to Safety