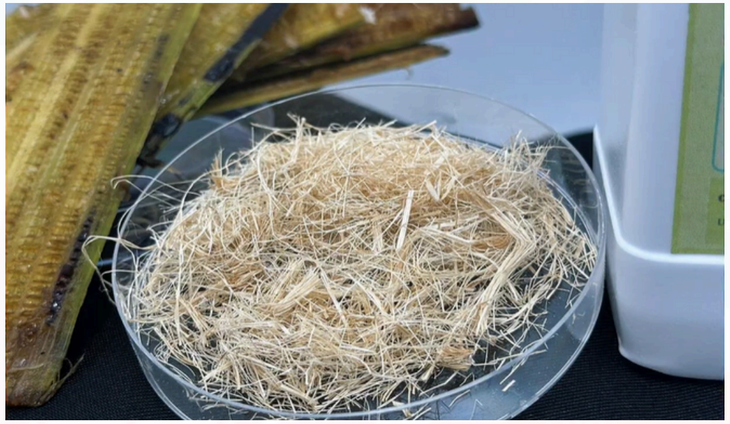
11 SUSTAINABLE CITIES AND COMMUNITIES

Engineered Smart Concrete Utilizing Indigenous Wastes for Durable and Intelligent Infrastructure

The Smart Concrete project addresses critical infrastructure challenges such as microcrack propagation in public structures like bridges and schools, which compromise safety and incur high maintenance costs. Funded by the DOST-PCIEERD, the project was implemented from August 2021 to January 2024 by the University of Mindanao.

Its core innovation lies in two complementary technologies: a self-healing additive that autonomously fills 70% of microcracks (0.4–0.6 mm) within 7 days, and a self-sensing additive that enables real-time structural monitoring through a portable health monitoring device. Both additives are introduced at just 1% cement replacement, resulting in up to 10% reduction in material costs and contributing to lower lifecycle maintenance expenditures.



Key activities included additive formulation using indigenous agricultural waste—such as banana pseudostem, coconut husk, durian rind, and papaya bast fibers—nanomaterial synthesis, laboratory testing, pilot concrete fabrication, and monitoring demonstrations By partially replacing cement with waste- derived materials, the project contributes to reducing CO2 emissions by approximately 0.09 kg per kg of cement replaced, helping lower the overall carbon footprint of construction. This aligns with global climate goals while promoting circular economy practices. The Smart Concrete project delivered significant technical, environmental, and institutional outcomes.

Laboratory and pilot evaluations confirmed that the self-healing additive could close up to 70% of surface microcracks (0.4–0.6 mm) within 7 days while enhancing compressive and flexural strength. The self-sensing additive reduced electrical resistivity by over 36%, enabling early damage detection through conductivity measurements. A portable structural health monitoring (SHM) device was developed and successfully tested demonstrating effective real-time tracking of strain and crack growth.

The project earned national and global recognition. It was featured at PhilConstruct 2023–2024 and selected as the sole Philippine entry to the Top 100 innovations at the Prototypes for Humanity 2024 Exhibition in Dubai, UAE—chosen from over 2,700 entries submitted by 800+ universities worldwide.