A sustainable new solution for ageing, corroding infrastructure

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New research at UC led by Structural Engineering Professor Alessandro Palermo (right) has highlighted the impact deterioration can have on the performance of structures. PhD student Cain Stratford (left) is investigating how GFRP bars may be used in reinforced-concrete bridge columns. Credit: University of Canterbury

Surrounded by ocean, most of New Zealand's reinforced-concrete infrastructure lies close to the coast, making it susceptible to corrosion. Could new glass-based reinforcing hold the answer?

New research at the University of Canterbury (UC) led by Structural Engineering Professor Alessandro Palermo has highlighted the impact deterioration can have on the performance of structures. This research is important, especially given recent deadly bridge failures, such as the Morandi bridge in Italy, which collapsed due to corrosion and structural weakness, killing 43 people in 2018.

Safety is key in bridge design, but what about ongoing costs associated with the repair and rehabilitation of aging infrastructure?

"The way we build our future infrastructure should be more sustainable and not only limited to the construction carbon footprint," Professor Palermo says.

"In the next 30 to 50 years, we will have more people, more bridges and probably less money to maintain our infrastructure. We need to look forward and opt for more durable materials. This will significantly reduce maintenance costs and increase structural life-cycles."

One alternative gaining international interest is the use of non-metallic reinforcing bars. Glass Fiber-Reinforced Polymer (GFRP) bars have proved to be a promising substitute for steel reinforcement in structures subject to harsh environments. Corrosion-free, they have higher tensile strength than steel with only a quarter of the weight.

University of Canterbury (UC) Ph.D. candidate Cain Stratford is investigating how GFRP bars may be used in reinforced-concrete bridge columns to achieve a superior design life for the bridge, while maintaining sufficient seismic performance.

"Construction of the columns was made noticeably easier by the lightweight nature of the GFRP bars. The experiment has been designed to simulate the loading that a bridge pier may be expected to withstand during a seismic event. Initial results from our tests have shown that a combination of GFRP bars with conventional steel can be an optimum choice to guarantee both excellent seismic performance and an increase in the usable life of the structure," Stratford says.

"I believe that the outcomes of this study will result in a major design shift in the field of bridge engineering, with structural application soon in New Zealand," Professor Palermo says.

Last year, the University of Miami (UM) published "Durability of GFRP Bars Extracted from Bridges with 15 to 20 Years of Service Life' showing that the GFRP rebars maintained over 97% of their original strength with no sign of corrosion. UM has been studying the extremely high durability of Mateenbar, manufactured by New Zealand company, Pultron Composites.

"It's great that UC's focus on seismic performance gives engineers more information about the use of GFRP rebar," says Pete Renshaw, Business Development Director at Pultron Composites.

Provided by University of Canterbury

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