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Extended Abstract

Self-Healing and Highly-Damped Concrete for Applications as Railway Sleepers and Track Slabs †

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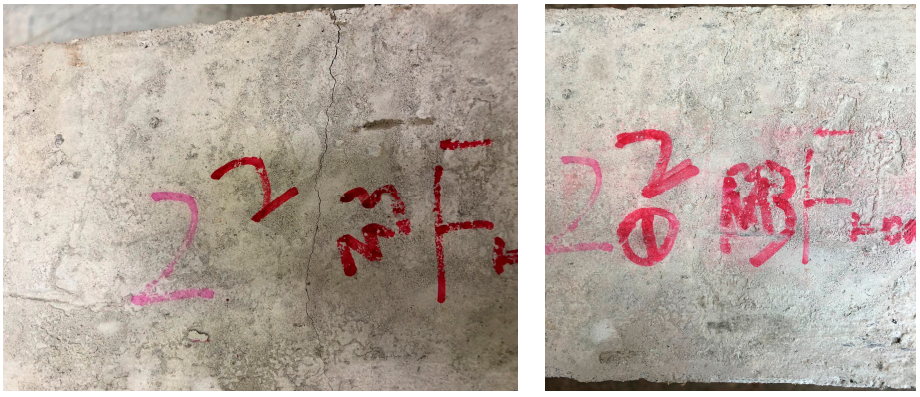
The demand of concrete material is increasing for applications in railway construction such as railway concrete sleepers, concrete track slabs, viaducts, etc. especially for the expansions of metro, light-rail and urban railway systems, due to their improved multi-functional performance as well as the reduced lifetime cost and carbon footprint compared to the timber or other materials. However, the premature deterioration of concrete sleepers and track slabs (e.g., shear key) under high impact loading and excessive vibration is the major issue that jeopardizes the safety and durability; and then increases the lifecycle cost of concrete sleepers and track slabs [1–12].

This study is the word first to establish and demonstrate a novel self-healing concrete that is practical and useful for urban railway and metro systems. The root cause of crack tends to be due to infrequent but high-intensity impact loading. This implies that the crack would not be frequently repetitive and the self-healing solution to cracks can still be effective in practice. This project builds on the study of crumb rubber to enhance dynamic damping of concrete sleepers [13–17]. Additional use of micro fibres has been adopted to also control the crack width. Eight concrete mixes have been evaluated for autogenous self-healing capability and effectiveness. Artificial and man-made cracks have been developed in the laboratory environment. The depths of crack paths at each location have been investigated in details. The crack healing is monitored using modal impact excitation, ultrasonic pulse velocity, and visual inspection. As shown in Figure 1, the highly-damped concrete shows effective self-healing capability. Based on the study it is found that modal impact excitation shows the lest effective method to monitor cracks, especially when the cracks are rather small (<20% of crack depth over the total depth).



(**a**) (**b**)

Figure 1. Self-healing of crack (**a**) initial crack; (**b**) healed crack after 4 weeks.

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