The Institution of Structural Engineers

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2011/12 Undergraduate Research Grant Scheme – Executive Summary

Project title:
Mechanical characterisation of waste-tyre rubberised concrete

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Project summary:
A research program was undertaken to assess the feasibility of adopting rubberised concrete for structural members. Using previous literature from mechanical testing of the properties of rubberised concrete it was evident that the addition of rubber to concrete decreases the compressive and tensile strengths, critical for structural members.

From this, a methodology was created to limit these reductions by using crumb rubber as fine aggregate replacement as well as pre-treating the rubber with water. Experimental testing established that rubberised concrete increases its strength similarly to traditional concrete through longer curing periods. It also showed that rubberised concrete stops gaining strength after a certain period of curing, although further testing is recommended to verify this aspect.

The inclusion of rubber in concrete decreased the modulus of elasticity due to the replacement of sand with the flexible rubber particles. All these properties contributed to an overall reduction in loading carrying capability of the members in structural applications. Interestingly, however, full-scale experimental testing demonstrated the possible benefits of using rubberised concrete in structural elements, showing a more controllable mode of failure. Noticeably, rubberised concrete samples exhibited a ductile shear failure in place of the common brittle shear failure observed in stocky beams made of traditional concrete.

Although all the rubberised concrete samples experienced a reduction in the ultimate load, the rubberised samples with 20% replacement in the fine aggregate were able to carry up to 84% of the load taken by the normal concrete elements, while with 40% replacement the post-failure behaviour improved drastically, showing a gentle softening branch and a significant residual capacity (about 30% of the ultimate load). Initial observations on the use of rubberised concrete in structural elements are therefore promising, although further research is needed to confirm these initial findings.