The Institution of Structural Engineers

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Project title: Influence of shredded waste plastic on flexural performance of reinforced concrete beams

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Aims of research:
There exist large amounts of waste plastic that are generated by various industry. Of particular interest is the waste plastic generated from old electric wires where plastic is used for insulation. The metal is extracted and recycled as there is demand for it, while there is not much outlets for the shredded waste plastic generated. The overall aim of this project is to investigate the structural characteristics of reinforced concrete beams containing shredded waste plastic. While the use of waste plastic in high grade applications (e.g. structural) is advantageous, it is hoped that the shredded plastic will improve the tensile properties of the concrete which will have an impact on load/deflection characteristics and the limitation of crack width.

Description of method:
Four different concrete mixes will be used for this investigation. Natural sand will be replaced with 0%, 25%, 50% and 100% of shredded plastic (by volume). Reinforced concrete beams will be cast with two different areas of tensile reinforcement. For each mix, 6 reinforced concrete beams will be cast, 2 beams without reinforcement, 2 beams with two 8mm diameter bar and 2 beams with three 8mm diameter bars. Also cubes will be cast for compressive strength for each of the mixes.

After 28 days of curing, the reinforced concrete beams will be tested in flexure under 4 point loading. The load will be applied in 2KN increment. At each load increment, the central deflection will be measured and also the strains at various locations along the cross section of the beam in the central region, two locations will be towards the top of the beam (approximately 20mm and 40mm from the top surface) where the compressive stresses are and two will be towards the bottom (one is at the reinforcement level) where the beam will be subjected to tension. Steel discs (demec) will be mounted on the beam to determine the strain. The load at which the first crack appears will be noted. Also continuous observation of crack patterns and location will be conducted until total failure of the beam occurs.

Load versus central deflection will be plotted for the various beams with the same area of tensile reinforcement to look at the effect of shredded plastic on the final load, the maximum load and the load at which the first crack appears. The initial slope as well as the elastic region of the curve will be determined. The ductility expressed as the amount of deformation before failure will be observed when shredded plastic is incorporated with various amounts into the concrete mix.

Benefits to structural engineering:
Structural Engineers will benefit from the results of the proposed projects in that there may be the opportunity to specify waste material (which would normally end up as landfill) in structural concrete applications. Concrete may have a better tensile and ductility properties which may improve the structural properties of flexural members. It may also have an impact on the design of reinforced concrete beams. In addition using waste materials in high-grade application will contribute towards the sustainability of our environment with regards to efficient utilisation of resources, reduction in virgin and raw materials used in construction. This will undoubtedly have a positive impact on carbon dioxide emission, in that less materials will be quarried, processed and transported..

Proposed finish date: May 13