Steel-fiber reinforced concrete for conventional construction work as well

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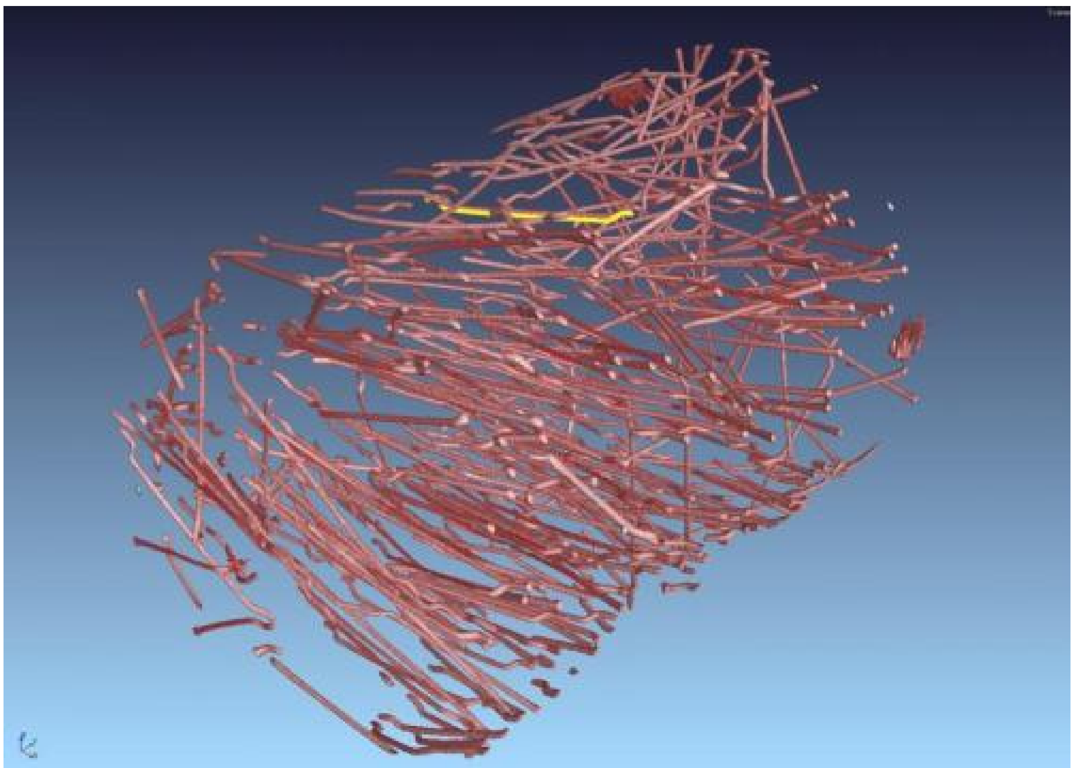

This is the three-dimensional expression of the distribution of the steel fibers. Credit: UPV/EHU

Reinforcing concrete with steel bars is a very common practice in construction. The industrial engineer and researcher Aimar Orbe-Mateo (UPV/EHU-University of the Basque Country) has studied the possible use of a material that is normally used for other applications for these tasks: concrete reinforced with steel fibres.What the study shows is that this material has certain advantages over conventional reinforced concrete; among others, it is less prone to cracking, and it can be used for purposes like the manufacture of cylindrical holding tanks.

According to Aimar Orbe-Mateo, an engineer at the Faculty of Engineering in Bilbao, right from the start of the study it was clear that "it had to be something that had a practical application, not just any piece of research". Sothe team produced a material for research purposes and which had the potential for being used in construction: steel fibre reinforced self-compacting concrete (SFRSCC).

These are materials that are already being used in building but "they have other applications. Self-compacting concrete, for example, is used in prefabricated buildings. If this concrete is used in conventional building tasks, it is difficult to measure it out because it is very fluid, very runny. Yet its texture allows one to do away with the procedures that are used with conventional concrete (vibration, shovelling, etc.), because it moves and becomes compact on its own," pointed out Orbe.

Steel fibres are also used to reinforce glass, "but more than anything else, to manufacture secondary elements: paving of industrial estates, tunnels, sewage pipelines and such things," he added. These fibres are small, both in terms of length (50 mm) and diameter (1mm), with dimensions similar to those of an unbent paper clip."

These are trials and tests using the samples extracted from the wall built. Credit: UPV/EHU

From the lab to reality

Alongside the laboratory tests, the team also tested the use to which the material could in fact be put.For this purpose, a wall three metres high and six metres long was built and divided into 380 samples on which various tests were carried out, destructive as well as non-destructive ones, "to determine the structural capabilities of the steel fibres and, in general, the toughness of the wall," highlighted Orbe.

Since the toughness of the structure depends on the orientation and distribution of the fibres within the concrete (impossible to see with the naked eye), the research team resorted to a magnetic system.Firstly, a magnetic field was created inside the samples; then the changes that had taken place in the field were analysed.Two aspects were clarified: the axis towards which the fibres tended to orientate themselves, and how much fibre there was in each sample.According to this study, "the fibres orientated themselves in the direction we were interested in, thanks to the fluid nature of the self-compacting concrete," pointed out the researcher.Apart from these tests, the team carried out computer simulations on fluid dynamics."These simulations showed us that the orientation that the fibres are going to take can be predicted.That way we can detect the weak points and unsuitable concreting processes in advance," pointed out the researcher.

Other tests in the research showed that when compared with conventional concrete reinforcing barsthe steel fibres canmore effectivelycontrol the cracks that may open up when the concrete dries. "There are thousands of fibres distributed throughout the mortar that compact it continually," asserted the engineer.

Orbe believes that with these pieces of research, the material "has reached a level of maturity" and that it can contribute towards making certain construction work easier.Specifically, he is proposing that it be used for manufacturing cylindrical holding tanks for collecting water.Bearing in mind the capacity of the SFRSCC to control cracks better and the results of other studies undertaken by this research team,"the conclusion is thatit is more economical and more sustainable than the conventional structural design," asserted Orbe.

But using it (for the purposes put forward by the research team and for other ones) requires "building contractors to be aware of the advantages of this material".And it is difficult to persuade building contractors not to fit the traditional steel rods, that everything needs to have been mixed into the concrete, because that way it reinforces the, etc.At the same time, one reason for mistrust is the fact that when the concrete dries, it is not possible to see where the fibres are, whether they have been properly distributed or are facing in the right direction. Besides, stresses Orbe, "there are few examples of building work carried out using this system."

Provided by Elhuyar Fundazioa

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