New Lego-like beams could revolutionize construction

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Researchers from the Polytechnic University of Valencia (UPV) have come up with and patented a new system for manufacturing beams that aims to revolutionize the architecture, construction and civil engineering sectors. They are manufactured with 3-D-printed plastic pieces that can be assembled as if they were pieces of Lego adding a high-performance layer of concrete in the most compressed area.

Its advantages, according to its creators, are several: they weigh up to 80% less than concrete or metallic beams, which means that no heavy cranes or lorries are needed to carry and install them; they save time and money on labor and materials; and they can be printed and assembled in situ, which facilitates their installation anywhere, regardless of how difficult it is to reach. In addition to all of this, it uses recycled plastics as the raw material, giving a new life to this product and thus helping move towards more sustainable construction.

The development of these innovative beams is the result of almost three years of research. "Our goal was to propose an alternative to the current reinforced concrete beams. These are made using profiles built for the length of the piece, which requires expensive installation and are hard to transport," says José Ramón Albiol, lecturer at the Higher Technical School of Construction Engineering (ETSIE) of the Polytechnic University of Valencia. Following numerous hours of tests and trials, the combination of 3-D printing, plastics and concrete provided optimum results. And last October they patented the system.

Its main novelty resides in the polymeric profile of the beam, comprised by multiple longitudinal segments that can be assembled and concreted where you wish to install the structure. The beam is reinforced with elements that ensure the structure's rigidity and which have no metallic component. "This prevents corrosion, decreases the weight and simplifies the work time required," adds Xavier Mas, from the Institute for Heritage Restoration (IRP) of the Polytechnic University of Valencia.

The system also removes the need for costly formwork and bending, which makes it possible to work without having to stop traffic at the infrastructure that is being worked on. "Furthermore, this solution makes it possible to decrease the required labor and auxiliary means, which entails cost and time savings," adds José Luis Bonet, from the University Institute of Concrete Science and Technology (ICITECH) of the Polytechnic University of Valencia.

concludes Miguel Sánchez, from the Department of Systems and Computer Science (DISCA) of the UPV.

Provided by Asociacion RUVID

Credit: Asociacion RUVID

A "human" structure

Another novelty of the system is the internal structure of the polymeric profiles. "It is an alveolar structure, which makes it possible to decrease the amount of plastic used—and therefore its weight—while maintaining structural rigidity," says Albiol.

This alveolar structure was inspired by human bones around the epiphysis, where there is a layer of cancellous bone with a trabecular disposition—the alveolar structure—and a thicker external layer of compact bone. "This is what we have transferred to these revolutionary beams, specifically to their profiles. It is a very intelligent natural system and its reproduction in these beams awards them, with the low structural weight, very high mechanical capabilities," adds José Ramón Albiol.

Customized pieces anywhere

3-D printing makes it possible to manufacture customized pieces very near the area of implementation, which also simplifies transportation, saves costs and facilitates customisation. "To be able to customize the beams in situ makes it possible to adapt the characteristics of each of them to the structural needs at each point of construction. The possibility to recycle polymeric materials to produce the beams significantly decreases their carbon footprint,"

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