

Driving innovation in the construction industry

HOW THE DEVASTATING IRPINIA EARTHQUAKE SPARKED AN INNOVATIVE NEW WAY TO BUILD IN HIGH-SEISMIC ZONES



An interview with

**MARCO CITRO
(BIOBUILDINGBLOCK)**



On 23 November 1980, the Irpinia earthquake claimed almost 3,000 lives, injured more than 7,000 people, and left over 250,000 homeless across southern Italy. It was – and still is – the most devastating natural disaster in Italy since the Avezzano earthquake in 1915. For Marco Citro, surviving this life-changing event ignited his desire to transform the construction industry and help build a better future.

Marco realised that traditional building materials like brick and mortar are more susceptible to collapsing during natural disasters such as earthquakes due to their low ductility, while the heavy weight of these materials also leads to more serious damage if the building collapses. Thus, Marco developed the BioBuildingBlock – an innovative lightweight, sustainable and environmentally-friendly building alternative made from natural materials. We spoke to Marco to find out more.

What is a bio-brick and how can it be used?

BioBuildingBlock is an innovative wooden and steel rod bio-brick that can accommodate natural materials such as cork chips or other plant fibres and sheep's wool, offering thermal and acoustic insulation properties. Now it is possible to incorporate a new insulating material with enhanced acoustic and thermal insulation properties, as well as fire resistance, made from plant fibres and proteins produced according to the newly approved patent. By using bio-bricks, it is possible to construct eco-friendly buildings, ranging from small

houses to large villas and even commercial properties. With its mechanical properties, multi-storey buildings can be realised. Additionally, due to its seismic resistance properties, construction in high-seismic zones is also feasible. BioBuildingBlock enables a fast and high-quality construction process, making it ideal for smart buildings, as well as recreational spaces, tourist villages or luxury resorts, and medical facilities.

What projects have utilised bio-bricks?

The BioBuildingBlock system has been utilised for constructing simple structures such as bungalows. These eco-friendly buildings showcase the versatility and sustainability of bio-bricks in smaller-scale projects. The BioBuildingBlock system has also been employed in the construction of NZEBs (Near Zero Emission Buildings). These projects focus on achieving highly energy-efficient structures with minimal environmental impact. BioBricks contribute to the overall sustainability of these buildings. There has been a growing demand for the implementation of bio-bricks in the construction of small and large



eco-villages. These sustainable communities emphasise environmentally-friendly practices and benefit from the thermal and acoustic insulation properties of bio-bricks. One of the goals of BioBuildingBlock is to construct larger buildings with increased structural complexity. By harnessing the potential of the innovative BioBuildingBlock construction system, it becomes possible to create impressive structures that adhere to eco-friendly principles.

What ignited your passion to change the patterns and future of construction?

The passion to change the patterns and future of construction was ignited by a personal experience – the survival of the Irpinia earthquake in 1980. Having gone through such a terrible event at a young age, it fostered a deep-seated desire to search for a different and improved approach to building structures that prioritise safety and sustainability. Witnessing the devastating effects of earthquakes and their impact on lives and the environment fuelled the motivation to find a better way.

The idea of developing the first reinforced wood wall through the mechanical joining of BioBuildingBlock bricks took shape after the earthquake in Amatrice in 2016. The aim was to combine this innovative concept with the fundamental principles of sustainability. Consequently, all the materials used to produce BioBuildingBlock were required to be natural, aligning with the goal of creating innovative products that challenge the prevailing use of less sustainable and energy-intensive concrete materials in construction.

By striving for change in construction practices, the intention is to create a paradigm shift towards safer, more environmentally-friendly, and sustainable methods of building. The goal is to prevent loss of life and minimise damage to the environment, inspired by a personal journey and a vision for a better future.

What are the benefits to performance from using reinforced wood rather than clay, concrete or any other form of brick?

Walls made of concrete and traditional bricks are susceptible to damage and collapse during earthquakes, potentially causing significant harm. In contrast, the BioBuildingBlock system utilises reinforced wood walls with a metal mesh, providing high resistance and load-bearing capabilities. The low mass of the BioBuildingBlock system, compared to concrete and brick structures of the same size, helps reduce the inertia effect caused by seismic waves. This allows for better dissipation of seismic energy, enhancing the building's ability to withstand earthquakes.

The BioBuildingBlock system is relatively lightweight compared to traditional construction materials such as concrete and brick, making it easier and more cost-effective to transport and assemble quickly. The reinforced wood walls of the BioBuildingBlock system are designed to withstand high lateral pressures, making them resilient to strong winds and extreme weather conditions. Unlike conventional timber-frame buildings that may be vulnerable to hurricane forces, the BioBuildingBlock system demonstrates the ability to withstand wind speeds exceeding 250 km/h, providing increased safety and protection during severe storms.

Are there any additional benefits from an environmental perspective?

Absolutely! The BioBuildingBlock system offers significant environmental benefits. The wood used in the BioBuildingBlock system is sourced from controlled and certified tree cuts in accordance with the Forest Stewardship Council (FSC) and the Programme for the Endorsement of Forest Certification (PEFC). This ensures responsible forestry practices and promotes the conservation of forest ecosystems.

In addition the BioBuildingBlock system incorporates natural materials as insulators, such as wood shavings, cellulose flakes, sheep's wool, straw, or hemp. These materials are obtained through recycling processes, reducing waste and promoting the efficient use of resources. By utilising these natural insulators, the system reduces reliance on energy-intensive synthetic insulation materials, thus minimising environmental impact. The integration of recycled and natural materials within the BioBuildingBlock system fosters a circular economy approach promoting the sustainable utilisation of resources. BioBuildingBlock has a negative carbon footprint. For each brick used in construction, approximately 10 kg of CO2 is sequestered from the environment.

Why is the need for sustainability and modality becoming increasingly prevalent in the current market of construction?

The construction industry is a significant contributor to gas emissions, energy consumption, and resource depletion. Sustainable construction methods help minimise the industry's environmental footprint, preserve natural resources, and combat climate change.



Nowadays, stricter regulations and building codes prioritise sustainability, including energy efficiency requirements, waste management guidelines, and standards for environmentally friendly materials. Compliance with these regulations is essential for construction companies to operate legally and meet the expectations of regulators and society.

There is a rising demand from consumers, businesses, and investors for sustainable buildings. Sustainable buildings offer benefits such as improved indoor air quality, energy efficiency, reduced operating costs, and a smaller carbon footprint.

Sustainable construction practices can lead to long-term cost savings. Energy efficient buildings, for example, reduce energy consumption and lower utility bills over time. Additionally, the use of renewable energy systems, recycled materials, and efficient construction techniques can decrease operational costs and enhance the lifespan of buildings.

At a time where construction majorly contributes to environmental degradation, how are bio-bricks paving the way for sustainable construction processes?

BioBuildingBlocks contribute to sustainable construction by the use of natural wood and renewable materials such as agricultural waste or natural fibres, instead of traditional non-renewable materials like concrete and mortar. By stopping reliance on non-renewable resources, they help conserve natural resources and decrease the environmental impact of construction.

The natural wood and fibres used in BioBuildingBlocks can store carbon dioxide captured from the atmosphere during their growth, making them carbon-negative. Recycled fibres provide a sustainable solution for waste management and guarantee better thermal insulation properties compared to traditional materials. They reduce the need for heating and cooling and lead to lower energy consumption.

BioBuildingBlocks have natural properties that contribute to improve indoor air quality. They have no VOC (volatile organic compound) emissions, avoiding the release of harmful chemicals into the indoor environment. This enhances the health and wellbeing of occupants. BioBuildingBlocks have the potential to be biodegradable or compostable, providing a sustainable end-of-life solution to the environment without leaving long-lasting waste or pollution.

What measures are taken for continuous improvement and innovation of bio-bricks' characteristics and performances?

Our pillar values are innovation and sustainability and the first aim is to guarantee innovative products that can perform the best structural characteristics for the safety of inhabitants. To reach this purpose we continuously struggle to find best technical solutions to outperform structural requirements for better buildings. All new ideas can be tested experimentally as new solutions in terms of structural requirements as well as of thermal and acoustic insulation or fire resistance. We also try to combine natural recycled materials to find new mixture that can be used as insulation materials with better insulation characteristics housed in BioBuildingBlocks. We strongly believe in research to innovate and all the experiments



are provided by the best renowned Italian research centres and laboratories such as Strength Department of Salerno University, ITC-CNR and IUAV.



How do you ensure the creation of solid building structures is preserved with this cost-effective and efficient alternative?

BioBuildingBlocks are designed with a simple yet effective mechanism that ensures the structural integrity of the building. The neighbouring bio-bricks are tightened using steel bars and special bolts, creating reinforced bearing walls. This mechanical joining system eliminates the need for adhesives or cement mortar, which preserves the total cost and makes them an economical alternative to other building systems of constructions. The use of steel reinforcement enhances the strength and stability of the building, ensuring its durability.

BioBuildingBlock system requires less time of construction than other systems of construction. For example, in one day,

it is possible to build a 100sqm villa. Every construction company is aware of cost incidence for a construction site and the necessity to reduce construction times to save money – BioBuildingBlocks can be the best economical solution for them!

Are there any other exciting developments in the pipeline for BioBuildingBlock?

Our innovative start up, BBB, is focused on creating new innovative solutions in green technology. After the approval of two patents respectively for the bio-brick and for our digital platform, we have recently received approval for a patent related to a system that uses innovative technology to provide an energy efficient and sustainable method

for heating water, reducing reliance on traditional heating systems and minimising energy consumption.

Another patent approval we have received is for an innovative mixture of vegetal fibres and proteins. This mixture is used to produce high-performance insulating panels with exceptional acoustic and thermal properties, as well as enhanced fire resistance. These panels offer sustainable and effective solutions for insulation in buildings.

With a strong focus on invention, research, and development, we have plans for future patents and advancements in the BioBuildingBlock system. Our dedication to learning and staying at the forefront of green technology drives us to continually seek new solutions and applications to further improve the performance, sustainability, and versatility of BioBuildingBlocks.

Find out more about the innovative BioBuildingBlock and how it can be used to build your own environmentally-friendly and cost-effective property by visiting www.biobuildingblock.com.