Reinventing the way in which the world builds

By Bongani Dladla

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Innovative technology is reinventing the way in which the world builds. Construction has always been a dynamic economic sector and recent breakthroughs in chemistry, biotechnology and material sciences are accelerating progress.

Bongani Dladla, CEO of the Construction Industry Development Board (CIDB)

Concepts such as self-healing concrete – once considered to be in the realm of science fiction – are now part of mainstream research, while new building materials, technology and processes are further changing the face of construction.

These new innovations are making their way from laboratories and computer screens to real-life building sites and may soon also become part of the South African construction and engineering landscape.

Changing the way the industry produces and consumes

The need for a sustainable construction sector is the driving force behind most of these innovations. Last year's global climate change conference – COP27 – again highlighted the reality that building and construction are responsible for almost 40% of the world's energy-related carbon emissions. Almost a third of such emissions come from building operations – lighting, heating and cooling – and another 10% is 'embodied carbon', released during the construction process itself.

Only 55% of these emissions can be tackled with renewables and through energy efficiency. The rest must be changed by changing the way in which the industry produces and consumes.

It is quite clear that there is an urgent need to produce construction materials differently or to replace them with alternative solutions that have a lower carbon footprint.

Making construction materials more sustainable

After water, concrete is the most widely used substance on Earth. It is often described as the 'cornerstone of life' because of its prevalence in all physical structures we observe - from skyscrapers, to homes, to bridges, to roads. It is, thus, obvious that so much research attention is directed towards efforts to make such construction materials more sustainable, while keeping them versatile and affordable.

Because concrete has a poor tensile strength compared to other building materials, it often develops cracks on the surface. This reduces the durability of the structure because it releases the flow of liquids and gases which might contain harmful compounds.

Should the microcracks grow, the concrete itself, as well as the reinforcement steel bars will be weakened. It is, thus, important to contain the width of the cracks and repair them as soon as possible.

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Self-healing materials

Self-healing concrete refers to material that can regain strength and seal itself after it has been cracked. It imitates the automatic rejuvenation taking place in our own bodies where material is secreted to heal cuts and wounds.

Crystalline additives in the form of alumina nanofibers and cellulose nanocrystals are added to the concrete mix. When they react with water and other constituents in the concrete, they form needle-shaped crystals that grow to fill the cracks.

Another approach, which is producing promising results, is to add living organisms such as the bacillus bacteria which thrive in the high-alkaline conditions of concrete. The bacteria lie dormant in the hardened cement until a crack forms. Once this occurs, oxygen, water and other molecules become available to the bacteria causing it to produce calcium carbonate which fills the cracks.

Such self-healing materials are still new and very expensive. However, further research and applications in markets will, no doubt, lower the costs and persuade construction contractors to include it among their material of choice. Moreover, the pioneering research can tap into the wider world of scientific knowledge where nanotechnology is already widely applied in the aerospace industry and in the production of fire-resistant coatings.

New innovations transforming the industry

At the same time research and development is taking place into other materials and construction processes which will further transform the industry. Translucent wood, which is stronger than traditional wood, is used in the production of facades and door frames. Bricks that absorb pollution are now being used with greater frequency in the building processes.
Researchers at the Massachusetts Institute of Technology have developed components that self-assemble into a pre-defined structure. Such materials are 3D-printed and can change their physical shape when exposed to heat, light or water.

There is no doubt that the South African construction sector will be among the early adopters of new innovations. The sector is well-known for its creativity and the need for innovation and technological advances in the construction industry has never been greater.

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Green materials and design

Already we are seeing a strong movement towards investments in green design and energy-saving technology. 3D-modelling software is revolutionising the industry. With the use of augmented reality designers, builders and subcontractors can plan every single detail of a project prior to the start of activities on the building site.

Clients are also increasing their demands for the utilisation of green materials and construction methods to reduce the environmental impact of construction. The recycling of construction and demolition waste to create engineered aggregate is becoming standard practice and reflects a desire within both the industry and the wider society to make more sustainable choices.

Sharing in the benefits of new research, technology

A major challenge would be to ensure that the benefits of green technology and cutting-edge research do not only accrue to the large and established players in the construction sector. Emerging contractors and enterprises owned by women and the youth should also become participants in a futuristic construction environment and the benefits of new research and technology should be spread across the entire sector.

ABOUT BONGANI DLADLA

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