Key Trends Driving the Architecture, Engineering, and Construction Industry

By Brenden Roche, Product Expert, Facilities Engineering, Bentley Systems

The architecture, engineering, and construction (AEC) industry is no stranger to change and ever-evolving trends. Also, the global pandemic has forced many other industries to change course, and AEC is no exception. Global players are altering their businesses in response to not only the pandemic, but also the climate emergency. A few change-inducing trends have made themselves a prominent fixture in today's AEC industry.

With that in mind, let's look at the AEC industry trends that professionals can expect to see.

The Drive to Decarbonize Construction

Today, some 56% of the world's population—4.4 billion inhabitants—live in cities. This trend is expected to continue, with the urban population doubling its current size by 2050. The surge in urban population demands that we rapidly develop new cities, which means construction of new infrastructure assets and emitting more carbon into the atmosphere. In fact, the ongoing new construction consumes a massive quantity of raw materials while contributing to an estimated 39% of the world's carbon emissions. The construction sector has, therefore, become a significant contributor to adverse environmental impacts, making it imperative that the industry players reduce their negative climate influences by decarbonizing construction processes.

Image Link:

Image Caption: The construction sector has become a significant contributor to adverse environmental impacts, making it imperative that industry players decarbonize their processes. *Image courtesy of Bentley Systems.*

Emergence of Carbon Databases

Steel and concrete used for construction are the major contributors to embodied carbon. Managing the source of these materials in a more carbon-efficient manner can help curb the emission levels. Therefore, the AEC industry needs access to the fabricators of these materials.

Various services and databases that provide detailed technical descriptions of building products have been created to help users track individual manufacturers so that infrastructure organizations can make informed choices on the suppliers and materials they use. Embodied Carbon in Construction Calculator (EC3) and One Click LCA are leading database providers that allow users to assess supply chain data while enabling the specification and procurement of low-carbon options.

The Bentley iTwin platform, the foundation for creating and managing digital twins, can be integrated with both EC3 and One Click LCA, allowing users to take quantity takeoff reports that are created using the iTwin reporting platform and export them to either EC3 or One Click LCA, thereby facilitating convenient lifecycle analysis of infrastructure projects. The Bentley iTwin platform enables users to incorporate engineering data created by various design tools. They can then export a summary of the design data through this integration, allowing them to gain insights into the environmental impacts of the infrastructure project.

Implementing Crucial Design Changes

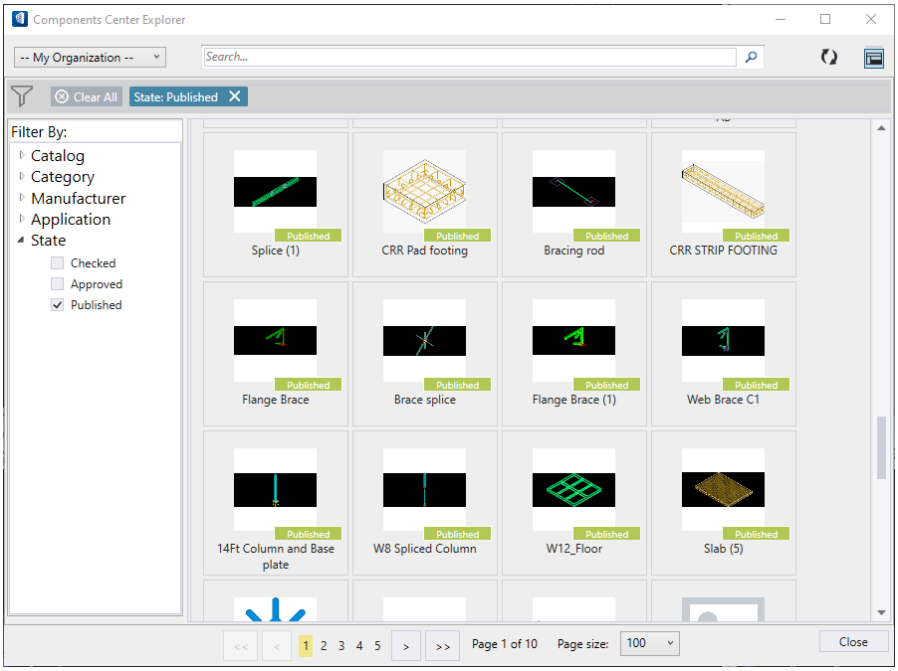
Along with choosing the suitable construction material, architects should also look to implement straightforward measures in their designs to reduce a building's carbon footprint. For instance, producing structures with underground parking is not as beneficial as creating them with parking at the ground-floor level, as the amount of carbon used to construct underground car parks is significantly high.

Drive Toward Design for Manufacturing (Dfma)

Offsite manufacturing (OSM), an effective method of enhancing construction productivity, could also help accelerate the decarbonization initiative. Manufacturing modular components in a controlled factory environment using indoor facilities on a production line and then assembling them at the actual construction site can potentially result in less waste. It also helps control the amount of carbon produced. This approach could also lower the overall environmental impact of construction sites due to reduced site traffic.

Rising Interest in Using Standardized Components

There has been a rising interest in standardizing the components used in construction. Many of Bentley's open platform users have started importing standardized components into the Bentley component catalog, enabling them to get a digital view of these components. These standardized objects can be reviewed and approved for material conformity and buildability. Users can select them with a high degree of confidence that they meet the project requirements.



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Making Better Use of Existing Stock

Every infrastructure asset has embodied carbon, which is spent while constructing the building. Then, there is the operational carbon generated from the day-to-day economics of powering the facility to adapt it when its business purposes or internal functions change.

While performing carbon lifecycle assessments, professionals can consider a cradle-to-gate or cradle-to-grave approach. In the cradle-to-grave practice, one has to consider a building's end of life when demolished and the carbon cost of those actions, including any material recycling. In the cradle-to-gate approach, users consider adaptions or refits. They can be significant in carbon terms and may occur more than once during a facility's lifespan. Both of these approaches are part of the circularity concept. Should designers then consider adaptability and flexibility in their initial design planning to make gate stage changes less costly in terms of carbon and, consequently, extend the facility's life and the need to demolish as much as is currently done?

Early planning during design phases can help control operational carbon emissions from a building. Several layout options can be assessed from energy and material considerations for lifecycle and operating costs, allowing professionals to arrive at the greenest option. As for embodied carbon that has to be considered, not only during initial construction but also during refits and adaptions, one approach is the concept of Buildings as Material Banks, which is based on reversible building design and material passports. The latter is information about

material reuse and recovery, and the former is about the efficient access to and retrieval of materials during adaptions and refits.

OpenBuildings Energy Simulator—the energy analysis capability of Bentley's OpenBuildings Designer—allows engineers, architects, and designers to integrate lighting, thermal, and solar analysis into their workflow, as well as empowering them to develop sustainable building designs. Users can predict energy behavior and fuel efficiency while analyzing the thermal properties of different construction materials to design more energy-efficient buildings that consume less energy during operation.

Digital twin technology can also play a crucial role in helping decarbonize existing buildings. Owners and facility managers can use OpenCities 365, Bentley's infrastructure digital twin solution for cities and campuses, with Microsoft Cloud to create digital twins of their physical assets. By integrating digital twins with Internet of Things sensors and devices, owners and facility managers can comprehensively understand how a building is used and reduce its environmental footprint by decreasing energy consumption from various components and systems. Users can also understand the building's carbon lifecycle and predict future carbon emissions across the asset lifecycle, helping them make informed decisions about the building's expansion or modification plans.

The Push for Openness and Collaborative Working

Interoperability, or the flow of graphical and nongraphical data between software applications or technology platforms, has always been a challenge for the industry. In the post-pandemic era, the adoption of new technology platforms, such as the cloud, has changed the technology landscape while increasing the importance of the push for openness. Also, the search for new ways of working has increased.

The International Foundation Class (IFC) standard has been at the heart of many approaches to solving these issues. Its status as ISO 16739-1:2018 has seen it being used in typical vertical construction for years. The IFC4.3 standard, which has been submitted to the ISO council, has expanded this approach for linear projects, such as road and rail, thanks to behind-the-scenes work by the buildingSMART organization to incorporate various aspects of infrastructure. IFC standards are the heart of data sharing and data flow within the emerging cloud-based carbon databases and calculators, thus helping the industry drive decarbonization from construction projects.

The pandemic and the subsequent changes to remote working patterns have provided challenges that have been met by the adoption of better work-sharing options, such as ProjectWise and ProjectWise 365 with ProjectWise Drive. This latter offering mixes the power of the ProjectWise collaborative common data environment platform with the convenience of the Microsoft's OneDrive document platform.

Image Link:

Image Caption: Post-pandemic, adopting new technology platforms, such as the cloud, has changed the technology landscape while increasing the importance of the push for openness. *Image courtesy of Adobe Stock.*

Many users are realizing the benefit of the Bentley iTwin platform, where engineering data and data from enterprise systems, IoT sensors, and data lakes can be brought together. iTwin.js—built as an open platform with published, freely available application program interfaces—is extensible for users to create integrations with other available systems. One prominent example is the ability to connect to external APIs like One Click LCA and EC3, which allows data to be published directly from iTwin to One Click LCA/carbon calculators. We may see more vendors publishing or opening APIs to facilitate openness and work sharing.

More examples of the drive to openness and collaboration are the connections made via the Bentley iTwin platform to NVIDIA's Omniverse platform, the Unity engine platform, and the Unreal Engine platform; all are powerful collaboration platforms used in the design industries to deliver more effective and sustainable solutions.

Innovations and Disruptions

Mixed reality (MR) combines augmented reality (AR) with virtual reality (VR), offering new and exciting benefits to the construction industry. MR headsets can provide architects and engineers with virtual tours of models or construction sites, such as on the ITER Project. They can also allow workers to hear and see step-by-step instructions for installations and repairs and then overlay that information onto the things they are working on.

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Some advanced use cases also include AEC professionals leveraging MR to control remote equipment or owner-operators using MR to monitor HVAC, lighting, and access control systems remotely. Inputs from laser scanning or photogrammetry of a site or an existing building can be fed into artificial intelligence and machine learning-enabled applications to automatically tag equipment or assets, leading to reduced manual intervention while ensuring higher accuracy and time savings.

The future of MR technology in the AEC industry looks promising. Ultimately, the wider adoption will depend on the readiness of the industry to go through digital transformation and the maturity of the technology itself.

A Paradigm Shift

The AEC industry is going through a major paradigm shift as it transitions from physical to virtual environments. This article has covered a few opportunities within the AEC industry for engineering and architecture firms, as well as owner-operators, that are willing to leave their comfort zone and transform themselves with evolving technology.

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