Increasing introduction of BIM methodology within the projects is such an excellent opportunity to precast concrete industry as a way to its definitive consolidation. Both BIM and precast concrete are based on similar parameters: stricter control from design stage, quality, lower lifetime costs and, as result, more efficiency along the whole construction phases. BIM is changing the way of work in the construction sector. The aim of this article, divided in two parts, is not to present BIM methodology in depth, but to give an overall vision of its current development, to foresee how will be the scenario in the upcoming years, and to remark that the growth of the precast concrete industry will be pretty connected with the success of BIM implementation within the companies.

Basic concepts about BIM

Building information modelling (BIM) is a new approach to design, construction and facility management in which a digital representation of the building process is used to facilitate the exchange and interoperability of information in digital format.

BIM interoperability among different stakeholders in construction projects may be seen as a modern version of the Tower of Babel. For centuries people have designed, built, and maintained facilities. However, with the increasingly costly and inefficient processes used, the time, cost, material, and labor expended result in disappointing quality, value, and financial returns. Construction projects today are complex and involve highly specialized and fragmented professional services. They require strong interdisciplinary teams, with stakeholders willing to collaborate, including clients and their representatives, designers, contractors, and the range of specialist consultants with their deep domain knowledge and experience.

BIM is based on the integration of all available information of a project in an interactive 3D virtual model, gathering at least the geometry and technical data of the elements, the construction system or the spatial relations among the elements, but even also allowing other necessary information to define as best as possible the construction project as follows:

BIM 3D or how to communicate the design intent

BIM revolves around an integrated data model from which various stakeholders such as Architects, Civil Engineers, Structural Engineers, MEP System Engineers, Builders, Manufacturers and Project Owners can extract and generate views and information according to their needs. 3D BIM’s visualizations capabilities enables participants to not only see the building in three dimensions before ground is ever broken, but also to automatically update these views along the project life cycle, from earliest conception to demolition. BIM 3D helps participants to manage their multidisciplinary collaboration more effectively in modelling and analysing complex spatial and structural problems. Furthermore because accurate data can be collected along the project life cycle, and stored in the Building Information Model, new value can be added to predictive models allowing to resolve issues proactively.

4D CAD or what happens to the schedule in case of project changes

The fourth dimension of BIM allows participants to extract and visualize the progress of their activities through the lifetime of the project. The utilization of 4D-BIM technology can result in improved control over conflict detection or over the complexity of changes occurring during the course of a construction project. 4D BIM provides methods for managing and visualizing site status information, change impacts as well as supporting communication in various situations such as informing site staff or warning about risks.

5D CAD or what happens to the cost in case of project changes

It allows participants to visualize the progress of their activities and related costs over time. The utilization of 5D-BIM technology can result in a greater accuracy and predictability of project’s estimates, scope changes and materials, equipment or manpower changes. 5D BIM provides methods for extracting and analysing costs, evaluating scenarios and changes impacts.

6D CAD or how to optimize the energy consumption

The utilization of 6D-BIM technology can result in more complete and accurate energy estimates earlier in the design process. It also allows for measurement and verification during building occupation, and improved processes for gathering lessons learned in high performance facilities.

7D CAD or how to manage assets life cycle

7D-BIM is used by managers in the operation and maintenance of the facility throughout its life cycle. It allows participants to extract and track relevant asset data such as component status, specifications, maintenance/operation manuals, warranty data etc. The utilization of 7D-BIM technology can result in easier and quicker parts replacements, optimized compliance and a streamlined asset life cycle management over time.

Level of Development (LOD) Specification is a reference that enables with a high degree of clarity the content and reliability of BIM at various stages in the design and construction process. This goes from a minimum level of development or detail classified as LOD 100 - The Model Element may be graphically represented in the
Model with a symbol or other generic representation, but does not satisfy the requirements for next level (LOD 200) – to a maximum level defined as LOD 500 – the Model Element is a field verified representation in terms of size, shape, location, quantity and orientation.

Therefore a BIM model can be more than just a pretty picture. The 3D visualization allows project stakeholders to better understand the building as it comes alive before their eyes. As the model grows in complexity, it becomes the data-rich font of project knowledge. Each stakeholder can approach the model with different questions and what-if scenarios and receive near-instant analysis of the situation.

The first consequence of BIM approach is that all the project agents are forced to work together around a same virtual design model, beyond the traditional way of work, in which each participant was generally not linked with others resulting many conflicts occurred mainly during the execution stage of the construction when the cost impact is significantly higher. We can remind the first reference to BIM on CPI [1] related to “the new professional group in the Bundesverband Bausysteme e.V.”. Then, in 2010, it was quoted “the aim of the professional group is to rearrange the transmission of data between those involved in the construction in order to make it simpler and less prone to losses”.

BIM is beginning to change the way buildings look and function and the ways in which they are designed and built. But we don’t forget that any change usually comes from economic reasons. It all begins with BIM; the designer uses 3-D modelling to investigate options and test building performance early on in order to optimize.
the building’s design. The design is then handed off to the contractor who streamlines the building process with BAM (Building Assembly Modelling), which allows for a significant decrease in construction costs. Once complete, BAM is turned over to the owner and becomes BOOM (building owner operator model). This allows the owner to manage the building over time and ensure optimized building performance throughout its entire life cycle [2]. If we compare the impact cost of each stage, any change during the project process (BIM) would be 1 cost unit, while a modification during the construction stage would be approximately 20 times higher and if the incident is happened during the building/infrastructure life service will be approximately 60 times higher.

One of the most remarkable BIM aspects lies in making all the agents (designer, contractor and subcontractors, suppliers of building materials, etc.) to work together around the same virtual model, which leads to better communication and fewer conflicts, especially during the design phase. BIM methodology induces a continuous flow of information to the project, so it is important to define previously how this information is provided and the responsibilities of each agent. As a result, a great amount of common mistakes of the building process (project modification, unnecessary waste, delays) can be avoided, thus saving costs.

**Use of software**

Software applications increasingly drive construction management and building work in general. BIM methodology needs the use of specific technical software.

There is no single software platform or system that can support all functionalities required for the construction industry. So we can’t describe all the existing BIM tools but what it is clear, it is that all of them are being adopted to BIM approach. The most used BIM software tools could be the following:

ARCHICAD was the first object oriented BIM Architectural application available in the commercial market, and the only BIM architectural application running on the MAC platform, as well as Windows Built on the Revit platform, Autodesk REVIT Architecture software is a complete, discipline-specific building design and documentation system supporting all phases of design, from conceptual studies through the most detailed construction drawings, documentation and schedules.

AECOsim from Bentley fully integrated multi-disciplinary products empower architects, structural engineers, civil engineers, electrical engineers, mechanical engineers, energy assessors, site designers, and other professionals to design, analyse, construct and manage buildings of all types and scales.

Google SKETCHUP Pro is used to quickly create accurate 3D models for pursuit and marketing, preliminary estimation, detailing, site logistics and staging, design and construction validation, sequencing and line-of-sight analysis. It enables collaboration and communication between the various stakeholders on a project.

TEKLA STRUCTURES enables the creation and management of accurately detailed, highly constructable 3D structural models regardless of material or structural complexity. Tekla models can be used to cover the entire building process from conceptual design to fabrication, erection and construction management.

VICO OFFICE allows GCs to combine BIMs from Revit, Tekla, ArchiCAD, CAD-Duct, etc. The “whole model” (whatever its level of detail) can then be coordinated, scheduled and estimated.

Each one of them has different features, for instance, the whole building or only the structural design. Beyond of these differences, all of them usually use a common language, being IFC (Industry Foundation Classes) the most widely accepted format, developed by the international association BuildingSMART. IFC is a publicly defined data schema for storing building information over the building life cycle and exchanging it among software applications used in construction. IFC objects represent geometry, relations, processes, materials, performance, fabrication, and other properties needed for design and production using data modelling language.

Commercial BIM applications often take pains to shield users from this and charge you for it accordingly. The business logic is that you should get more value, faster, for your company. Free software, on the other hand, may not have the same business perspective. Depending on how deeply you want to get into the software itself, you may prefer to pay for a packaged, user-friendly solution; or make the effort required to exploit the power and flexibility of certain free or open source solutions, such as BIMx from Graphisoft or FreeCAD.

It must be added to BIM software tools the as built data acquisition technologies which enable capturing very comprehensive and accurate as built condition information, supporting the integration between BIM and facility management systems. There are two major types of such technologies: photo/video-grammetry which is an image based technology that involves capturing still images/video frames and processing them into 3D point clouds using computer vision techniques such as Structure from Motion. And 3D Laser scanning technology, a range based technology that measures 3D coordinates of the target object/scene and produces 3D point cloud as output.

Finally, the main challenge to be solved by software developers is the interoperability among software applications to achieve the full potential of BIM.

**BIM libraries**

Besides the software, other essential part of BIM are the object libraries. They contain an increasing collection of construction products and systems as BIM digital files, both brand name manufacturer and generic. For instance, software such as REVIT or TEKLA have their own libraries but there are other open platforms in which any designer can freely access and download any element to be used on his project, regardless the software it is being used.

**BIM OBJECT** is the Europe’s largest and fastest growing digital content management system for BIM objects. Its unique solutions for manufacturers provide development, hosting, maintenance, syndication and publication of the digital replicas of manufactured products as BIM objects. It also has several Apps which enable to download and use objects from the library with software such as SketchUp, Revit or ArchiCAD.

**BIMETICA** has an ever growing database, thanks to the active participation of the various product manufacturing companies and its
distributors, continuously adding new products and updating information. Because of this, professionals have free access to product information, from manufacturers or distributors, and download BIM objects such as Revit families, Archicad objects, IFC files, AECOsim files, 2D/3D CAD files, technical specifications, etc. with specific information for use directly in projects.

NBS National BIM Library is the official library in the UK, with an extensive collection of both generic and manufacturer BIM objects ranging from building fabric systems to mechanical and electrical objects.

**Current status of BIM implantation**

It is necessary to note that BIM methodology has certain development degrees in its application, from a basic project level (shape, geometry and general information about the building / infrastructure and the construction system) to a maximum level when the virtual model completely corresponds to the built project.

In spite of this methodology came up in USA, the first national standard was approved in Norway in 2008. Since then, some European States like Finland, Sweden, Denmark and the Netherlands have been developing their own normative. It’s worth mentioning
the recent adoption in the United Kingdom of the BIM level 2 of 3, intended to reduce in a 33% the costs of public projects. In Germany, private sector (with government support) promoted a plan through some pilot projects. In France, the plan started in 2014, and the use of BIM will be compulsory from 2017.

Concerning to Spain, it’s remarkable the development happened in recent years. First national poll, made in 2011, showed that a large 43% of the people enquired did not know what BIM was, whereas in 2016 a 73% identifies BIM methodology with the future of construction project management, and a 75% agrees with the suitability of BIM for public projects. However, only 10% of the people think the sector is ready for the change. The final push should be promoted by the Ministry of Public Works and Transport, who created in 2015 the es.BIM commission. It is a multidisciplinary group which aims to lead the entire implantation of BIM in Spanish public projects by December 2018 for buildings and by July 2019 for infrastructure projects.

Other important milestone boost should come from the Directive 2014/24/EU of the European Parliament on public procurement, which says: “For public works contracts and design contests, Member States may require the use of specific electronic tools, such as of building information electronic modelling tools or similar”.

It is also remarkable the role of the European Committee for Standardization CEN/TC 442. This committee will develop a structured set of standards, specifications and reports which specify methodologies to define, describe, exchange, monitor, record and securely handle asset data, semantics and processes with links to geospatial and other external data. In other words, to speak the same language: BIM.

BIM’s “I”, as engine for construction industrialization

BIM Users, or “Bimmers” (as they call themselves), often state that BIM implantation must bring an increase of construction industrialization, and therefore, more precast concrete elements. Projects based on these construction systems must be completely and univocally defined, (the same way as BIM methodology does), starting from the shape (with higher geometric accuracy as a result of the industrial process) and the technical features of each individual element (a beam, a precast panel…), to the entire construction system (a building structure, a façade…).

We’ll talk about the BIM challenges to be faced on this way and how we believe that the industry have tackle them at the second part of the article.

References


FURTHER INFORMATION

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