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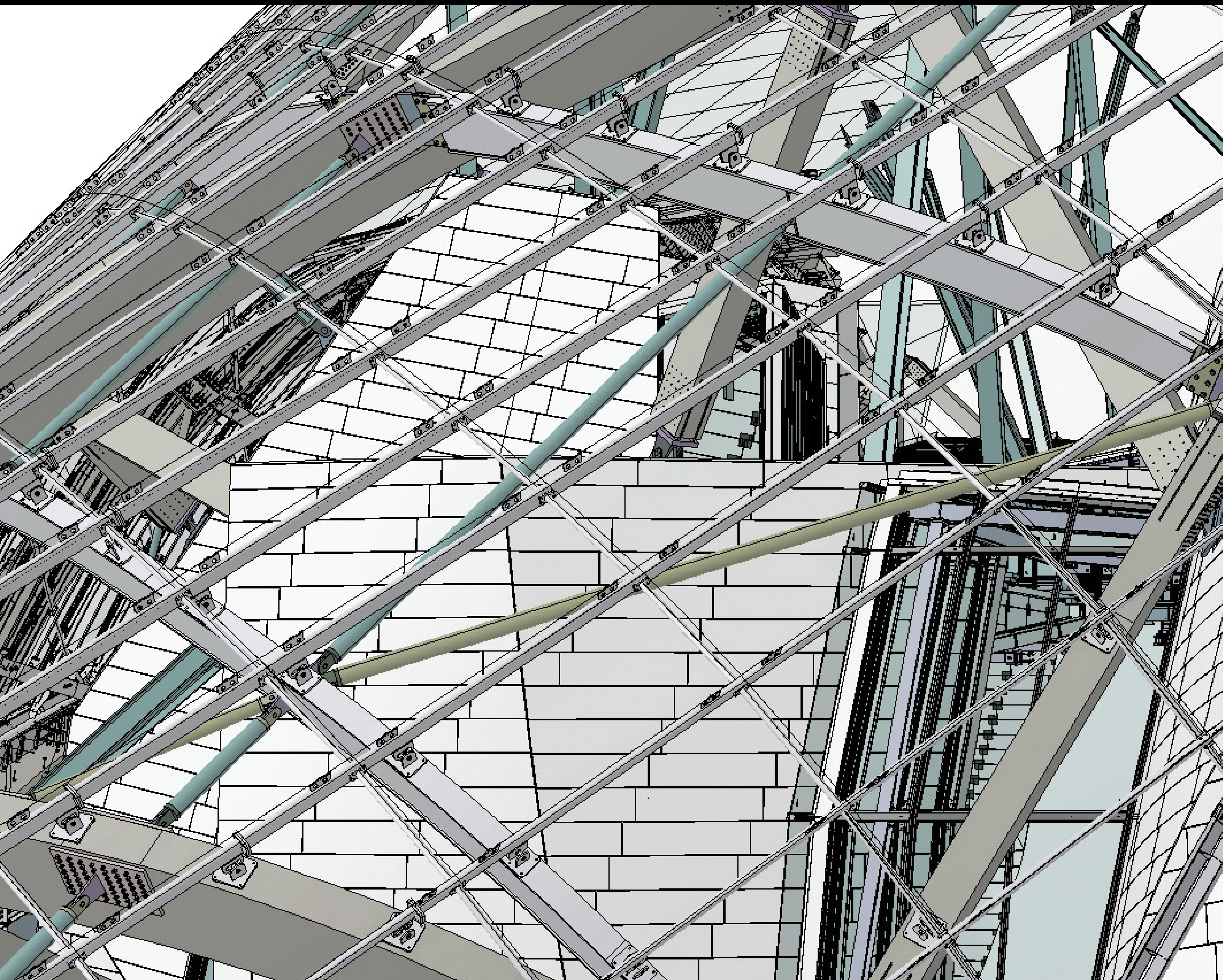

BIM Really Can Be a Team Sport

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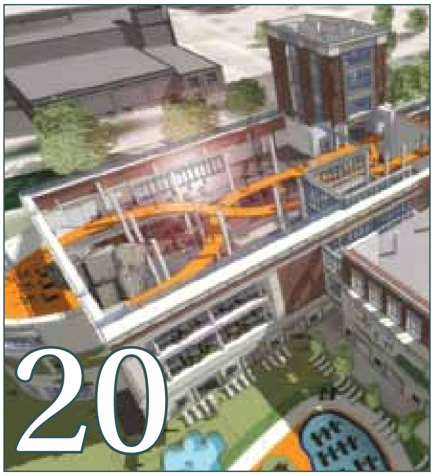

On the cover: The Fondation Louis Vuitton, a new art museum in Paris, is pushing the limits of BIM technology and demonstrates how BIM, enabled by a cloud-based file management and project collaboration platform, can help large distributed teams work together. The 3D cover image, produced by Digital Project™, shows the façade of the Fondation Louis Vuitton.

Paris Museum Proves that BIM Really Can Be a Team Sport

By Andrew J. Witt

FOR MANY YEARS, BUILDING INFORMATION modeling (BIM) has been lauded as the antidote for inefficiencies that pervade the architecture, engineering and construction (AEC) industries and, now, the use of digital building models has become a standard part of the building process. But as projects become bigger and more distributed, some teams struggle with the collaborative aspects inherent to BIM. Then again, some teams don't.

This article describes how BIM and BIM technology are being used very effectively on a high-profile and extremely complex project, the Fondation Louis Vuitton, a new art museum in Paris designed by Gehry Partners. The building is a showpiece—not only of art, but also of design and technology. The project is pushing the limits of BIM technology and demonstrates how BIM, enabled by a cloud-based file management and project collaboration platform, can help large distributed teams work together.

The project includes:

- 15+ design teams from around the world;
- More than 400 model users and collaborators;
- Nearly 100 gigabites of BIM-based model data;
- Over 100,000 version reiterations of the building model;
- 19,000 unique CNC molded glass reinforced concrete panels; and
- 3,500 unique CNC molded curved glass panels.

PROJECT BACKGROUND

The Fondation Louis Vuitton is an iconic new museum under construction, located in a massive park, the Bois du Boulogne. It will host a permanent art collection as well as rotating exhibitions, performances and lectures. The building itself will serve as a gateway to the Jardin d'Acclimatation, a popular zoological garden and children's amusement park.

The structure has been likened to a sailboat with billowing glass sails **(FIGURE 1)**. The use of glass as the primary exterior material plays a principal role in the architecture of the building, ensuring that it will complement the surrounding natural environment. The design includes a series of large curved-glass "sails" and dozens of fibrous concrete "iceberg" surfaces.

Key collaborators on the project team included Gehry Partners; the owner, Fondation Louis Vuitton; the façade engineer, RFR/TESS; executive architect, Studios Architecture; structural engineer, SETEC Batiment; mechanical engineer, IBE; the façade contractor, EIFFEL; and the general contractor, VINCI. The project's BIM delivery process was orchestrated and is being managed by Gehry Technologies (GT). The 3D project delivery system includes Digital Project™ for all 3D design and the technology now resident in GT's recently-announced BIM collaboration platform, GTeam™.

CHALLENGE

The unique shape and curved glass façade **(FIGURE 2)** of the structure necessitates very close teamwork amongst a spectrum of design disciplines and fabricators, as well as the general contractor and the owner. Therefore, one of the primary challenges is the effective collaboration of this geographically-dispersed project team. The design architects are in Los Angeles, while most of the rest of the design team are in offices in Paris. Other team members are in the United Kingdom, Germany and Italy. In all, there are over 10 companies involved in the design process, all of whom require some level of access to current building information. And many of the design teams need to define certain aspects of the geometry parametrically in the same model. As such, the project requires distributed, multi-user, simultaneous access to a single model.

In Paris, the key project participants—executive architect, structural engineer, façade engineer, mechanical systems engineer and GT—are all co-located in trailers on the construction site. This improves communication but still poses barriers to model integration. There is a wide range

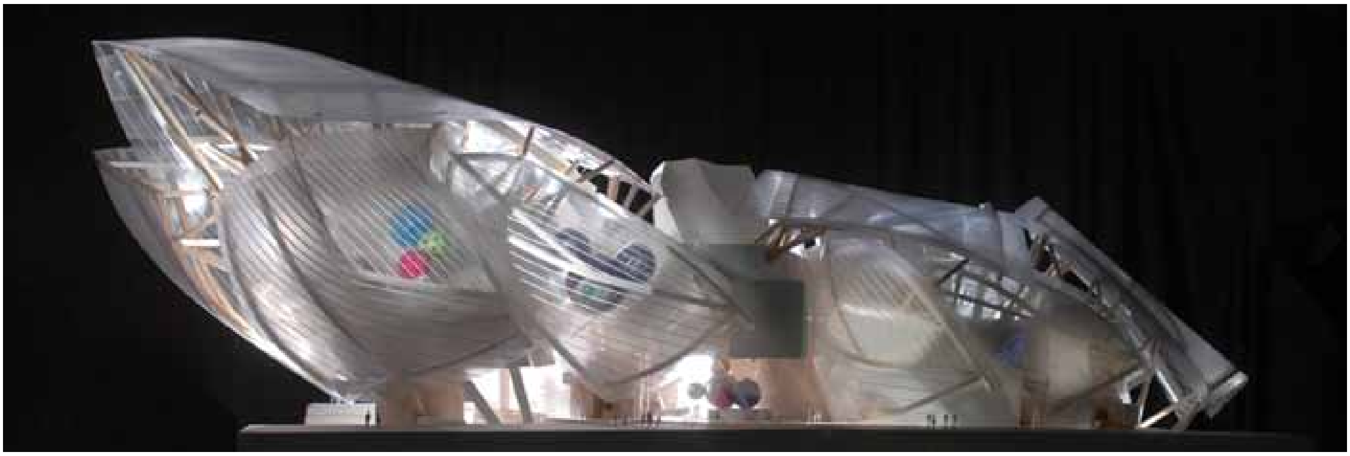

Figure 1. A rendering of the Foundation Louis Vuitton art museum.

NOT JUST
SOME OF IT

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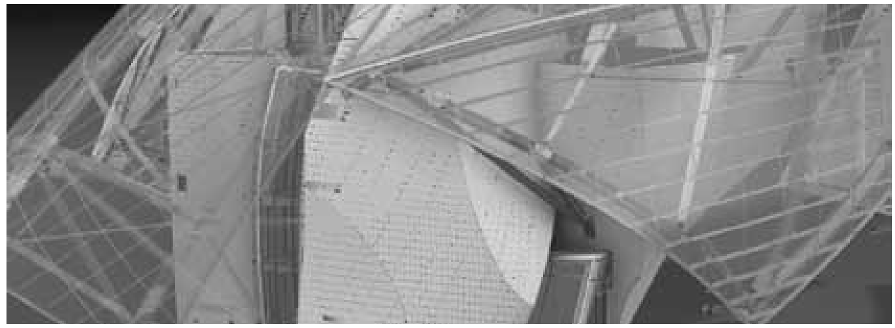

Figure 2. The design includes a unique shape and curved glass.

of authoring tools being used on the project, including Digital Project, Tekla, SketchUp, AutoCAD, Bocad, SolidWorks, ANSYS, STRAUSS, NASTRAN, SOFiSTiK, 3DVIA composer and Solibri.

The generous use of glass on the curved façade poses another significant challenge. Normally, curved glass is formed with metal molds. But that manufacturing technique would have been cost-prohibitive on this project, as each panel has a unique shape, requiring over 3,500 individual molds. Instead, the building team is using CNC molded curved glass panels. In addition, the “iceberg” surfaces are composed of 19,000 different CNC-molded glass-reinforced concrete panels. To keep costs in check, this abundance of uniquely shaped exterior panels requires mass customization.

SOLUTION

The architect’s goal of lightness and transparency for the structure is being realized through the close collaboration among the architect, engineers and fabricators. This process of continuous and concurrent design and engineering involves approximately 15 firms and 400 individuals working together using BIM software and a cloud-based collaboration platform. By combining advanced parametric models with an online collaboration platform built specifically for BIM and AEC professionals, the Fondation Louis Vuitton project team can communicate, synchronize and share BIM data and files from anywhere in the world. Moreover, BIM facilitates a close partnership between the architect and the client—a critical component of this owner-led project.

A precise structure for the organization of the data allows distributed team members to collaborate in a structured way on a single project model. This core project model is a Digital Project master model but the team members also use a range of other software tools to create and consume models in various file formats that suit their own specific workflows. With approximately 100 people creating 3D content and 400 people accessing it, the project team relies on the technology of GTeam’s™ open collaboration platform to bring all those disparate files into a common format. Thus, the team members can contribute parametric model content regardless of their different locations and the entire team can access that model information without the need for the native modeling software. The model is an essential tool for project coordination and the definitive arbiter of how the building is being built.

The 3D project delivery system has versioned over 10,000 distinct archived iterations of a design model consisting of more than 5,000 core files and tens of thousands of auxiliary files. It has already facilitated the distributed calculation of over 100,000,000 design optimization iterations for material-specific and fabrication-specific panelizations and details.

PROJECT MODEL

The centralized Digital Project parametric is stored on a central server and is automatically synced to individual team members’ computers. This allows users to work with the actual model files transparently, while maintaining project control and accelerating the communication of project data. GTeam™ also manages the distribution, versioning, access and security of the model.

The product model provides a natural way to hierarchically organize work on the model. Since the project itself has a certain organization chart, the chart can naturally be mapped onto the project structure to modularize the associated work. In effect, the structure of the model becomes the work packaging plan for the design and construction of the project. This product structure has a natural mapping to a file organization, which again mirrors the organization of the project itself. Ultimately, it is at this file-system level that the hierarchical organization is connected to GTeam's™ versioning tools, which store a master copy of the model in the cloud.

Another interesting aspect of the project is that very few of the collaborators (outside of Gehry Partners) had ever used a 3D design process prior to this project. As a result of this inexperience, there was some understandable skepticism around the 3D process and particularly about collaboration on the 3D model. The challenge of implementing an ambitious collaboration system was as much social and organizational as it was technical. To overcome the lack of 3D experience on the project, GT implemented a series of project-based continuous training classes on Digital Project and GTeam™ for project participants.

MASS CUSTOMIZATION

Generative methods are most commonly used for design explorations, where implicit geometry or a very few rules of thumb suffice for validating design feasibility. However, the mechanical processes of fabrication often have decisive impacts on the design geometry itself, particularly at the detail level. Validation on this level often requires the analysis of dozens of parameters for each assembly piece, even for apparently simple systems. To this end, the project team has developed hundreds of self-adapting 3D details. These intelligent components enable the design team to create thousands of categorized variants throughout the project in a generative and consistent manner, using rules to, for example, optimize panel sizes and control joint distances between them.

Since these modules, like the rest of the model, are stored on a model server, the engineers can modify their details with full technical knowledge while other team members can still validate the pure spatial aspects of the designed details. After the design of the initial prototype, the generation of these details is distributed to all the team members' machines by the model server.

The centralization and redistribution of the model also facilitated a new scale of design computation and optimization, which ultimately was necessary to address some of the complex geometric issues of the project. Since many analyses and generative exercises for the building were computation-intensive and time-consuming, an early initiative of GT was to facilitate the off-loading of this processing to other low-demand machines, essentially creating a private cloud for generative geometry and optimization. This capacity was leveraged to generatively model and detail the most complex parts of the building.

COMPLETING THE FABRICATION CHAIN

The use of intelligent components kept complexity, cost and quality under control throughout the design process. Now, computer-controlled fabrication processes are having a similar effect during construction. Fabricators rely on the master building model to automatically produce individual shop drawings. Every extrusion is being custom CNC cut and made to order directly from the master building model.

The model also represents the sole source for managing and validating change—from design to fabrication and installation. By linking the construction schedule to the master model, the general contractor is using 4D modeling for its construction planning, which helps optimize onsite resources and construction sequencing. In addition, fabricated panel components are laser scanned and virtually positioned in the model to confirm correct tolerances and configurations ahead of shipping and installation.

The project consultants and subcontractors also integrate engineering intelligence into the model, which the owner can use for operations and maintenance. This includes information such as warranty details and anticipated replacement dates for routine maintenance planning.

SUMMARY

Fondation Louis Vuitton is on schedule for opening in 2013. The project exemplifies how BIM can enable design, fabrication and construction excellence. In recognition, Fondation Louis Vuitton was selected as the 2012 recipient of the prestigious BIM Excellence Award, given by the American Institute of Architects (AIA) Technology in Architectural Practice Knowledge Community.

The project draws from building expertise around the world. BIM software and cloud-based collaboration enabled concurrent design, advanced parametrics brought the project to the next level and an automated CNC process is completing the fabrication chain. BIM has increased clarity and project understanding throughout the project team and supply chain, resulting in faster cycle times and more automated higher-quality fabrication processes. ■

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