PLP Uses GenerativeComponents to Advance Design Process on Francis Crick Institute Project

Parametric 3D Model Reduced Risk of Error and Streamlined the Design Process on $969 Million Biomedical Research Center

Project Summary

Organization
HOK and PLP Architecture

Solution
Buildings

Location
London

Project Objectives

- Design the roof structure for the $969 million Francis Crick Institute building
- Achieve rapid design iterations to meet the unique operational requirements of the biomedical research center
- Ensure the roof and facades met the objectives for reducing energy consumption and CO_2 emissions

Products Used
MicroStation®
GenerativeComponents®
Bentley Architecture

Fast Facts

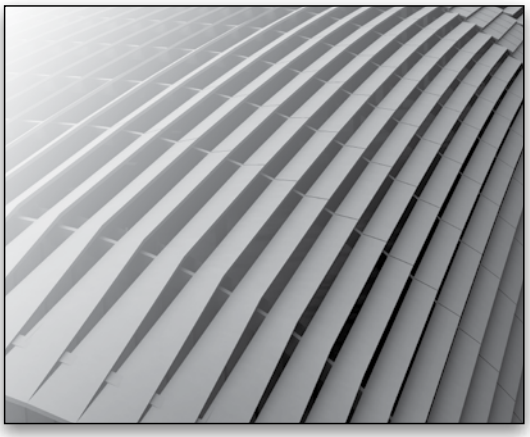
- PLP tested more than 100 design iterations with the parametric model.
- Files were exported in six file formats to meet demand for information from more than 10 organizations.
- Detailed roof information included a schedule of types, dimensions, and orientation, and a smart table of possible batches and categorization of louvers.

ROI

- GenerativeComponents provided a trusted 3D model, reducing risk of errors and streamlining the design process.
- Resolution to grant planning consent was determined 15 weeks following submission of the detailed planning application.
- GenerativeComponents enabled PLP to optimize the photovoltaics, to help achieve a BREEAM Excellent rating.
- The ability to schedule and batch complex louver types improved constructability.

Real-time Modeling Tools Used to Test Over 100 Design Iterations

The Francis Crick Institute is a $969 million biomedical research center funded by the Wellcome Trust, a charitable foundation supporting biomedical research and the medical humanities. The Institute will accommodate 1,500 researchers on a site adjacent to the British Library and London's St Pancras International railway station. Reconciling the unique operational requirements of the research center while respecting the wishes of the local community, and building a structure that would be in keeping with the look of the historic architecture was extremely challenging.



GenerativeComponents enabled PLP to produce and later verify the fabrication details for the complex roof louvers to minimize the visual effect of the gaps.

To overcome this, PLP Architecture used the real-time modeling tools in Bentley's GenerativeComponents to test more than 100 design iterations of the building's innovative roof structure and to demonstrate the impact of changes throughout the extensive consultation process with the planning authority and the local community. This rapid process enabled PLP to create a gently vaulted profile on the skyline that creates a strong identity, while the receding roof reduces the building scale and minimizes the impact on local residents.

The parametric 3D model continuously informed and transformed options for the roof geometry as well as dependent geometry of exterior walls and interior steel work. Notable features of the design included accommodating a transverse atrium and photovoltaics to attain BREEAM certification.

"The research group at PLP Architecture is dedicated to utilizing new and emerging technologies, and Bentley software helped us to overcome the challenges presented by the biomedical research center," explained Eike Schling, architect at PLP Architecture. "By using GenerativeComponents, the design process was less restrictive enabling us to complete the design of the Francis Crick Institute."

Roof Modeling Leads to Successful Planning Outcome

HOK and the Francis Crick Institute embarked on a new collaboration with PLP Architecture to review and advance the external design of the building in accordance with its civic status, aspirations of the science and academic communities, and the surrounding residential area.

Understanding the proposed design and the established precedents and constraints, the design team engaged in an integrated community consultation strategy. This resulted in a proactive and constructive debate, which alleviated neighbors' concerns, contributed to the project, and created tangible benefits for the local community.

In response, PLP's design of the facades expresses the internal organization of the building - designed by HOK, and celebrates the unusual level of public engagement for this building type, while concealing the building's servicing requirements in a recessed roof volume.

To better integrate the building with the surrounding area and the historic context, PLP assisted HOK to modify the building. Schling explained, "In the north where there is a low rise residential area we pushed down the building, and in the south towards the British library we lifted it up. We also opened up the front and pushed down the public entrance toward St Pancras. This created a natural involvement with the urban fabric."

"GenerativeComponents enabled PLP to share 3D models with a team of 70 people during the project, as well as planners, the local community, and key component suppliers."

– Eike Schling, architect, computational design, PLP Architecture

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PLP then created a single sweeping design for the roof. This fluid rounded roof shape encompasses the physical plant, including HVAC and other mechanical systems located on the top two floors. The curved receding roof provided a huge south-facing area to support photovoltaics oriented toward the sun, while maximizing daylight and minimizing the impact on the neighborhood and creating an overall visual identity for the Institute.

Increased Design Efficiency

PLP decided to use GenerativeComponents to test and inform the design and advance design discussions; helping to gain the support of the planning authority.

"Once PLP had designed the roof, it was essential to know every single module of that roof by dimensions and to change it quickly and efficiently – which is why the decision was made to use GenerativeComponents," Schling confirmed.

The associative parametric modeling system enabled PLP to rapidly explore a range of design alternatives, model geometry, capture relationships, and generate forms using scripts and/or direct manipulation, enabling highly creative flexibility. While traditional 3D software may have restricted tests in the same time scale to potentially 10 options, GenerativeComponents allowed PLP to test up to 100 options.

Achieved Planning Approvals Quickly

Critically, this activity was not limited to closed meetings within the architectural offices but also played a fundamental role as a presentation tool in discussions with city planners and the team of consultant engineers to meet the project's environmental criteria.

GenerativeComponents allowed PLP to test up to 100 options.

The use of GenerativeComponents also helped PLP respond to last minute requests prior to the planning meeting, including lowering the front of the roof by up to 3.5 meters. "The speed of iteration was critical. It made an immense difference and allowed PLP to refine and further develop the design of the roof and, following ongoing appraisal by the planning authority, the detailed planning application achieved a resolution to grant planning consent within 15 weeks," Schling confirmed.

Improved Information Sharing

Another challenge HOK and PLP had to overcome was the fact that PLP used Bentley's MicroStation, while HOK used Autodesk products. Using traditional information sharing techniques, HOK would have had to continually produce 2D extractions of PLP's 3D model to insert into their own drawings, which would have made the process inefficient, not only for communicating between PLP and HOK, but also communicating with the entire project team. Bentley Architecture was used to streamline the process and integrate design development and feedback from all team members both to advance the design of the roof and the facades in the parametric model. The information was then incorporated into the lead architect's model, and reissued in various formats to the consultants.

The roof geometry and dependent geometry, such as walls and interior steel, was modeled in a single GenerativeComponents file and shared with a team of up to 70 people.

Accurate Visualization

The detailed model based on parametrically placed cells was also shared directly with contractors – including the fabricators of the steel roof louvers supported by a number of cantilevers that range significantly in height. In addition to the digital model used to cut sections, PLP created an information model – a polygon grid providing the dimensions of the louvers. Loading this information into an Excel spreadsheet with the exact number of each type and length of panels allowed the fabricator to rationalize and batch fabricate louvers within 30 or 50 millimeter iterations.

Once the fabricator had completed its batch schedule, PLP fed that information into its 3D model. "PLP remodeled the entire roof using data from the fabricator," Schling said. In some areas the remodel revealed the gaps were too big as a result of the batching, enabling PLP to request changes to minimize the visual effect.

"Using traditional modeling techniques, this would have taken at least two weeks; taking every number, modeling each louver, and trying to place it correctly," Schling said. "It would have been far more complex and time consuming to do so."

Sustainability principles are embedded in the design and operational concept for the Francis Crick Institute. The roof and façade design addresses the environmental impact of its orientation, minimizing solar heat gain while maximizing daylight. By using MicroStation's ability to calculate the solar exposure of the building's façade, PLP was able to maximize the efficiency of the photovoltaics. The development is expected to achieve a rating of BREEAM Excellent.

Achieved Better Productivity

PLP's experience with GenerativeComponents on the Francis Crick Institute has reinforced the company's commitment to this approach. Indeed, GenerativeComponents is now being used across a number of building projects and the company is teaching GenerativeComponents to create a larger pool of architects who are able to take advantage of the cost and efficiency benefits of the software.

"Reputation is critical. The Francis Crick project is PLP's first project using GenerativeComponents; the productivity we have achieved and the timeline of the development will undoubtedly provoke interest from prospective clients. PLP's GenerativeComponents expertise, combined with design innovation, should deliver significant competitive advantage," he concluded.

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