Company Name

Steel Structure Engineering Company of China Construction Eighth Engineering Division

Project Location

Guilin, China

Project Software

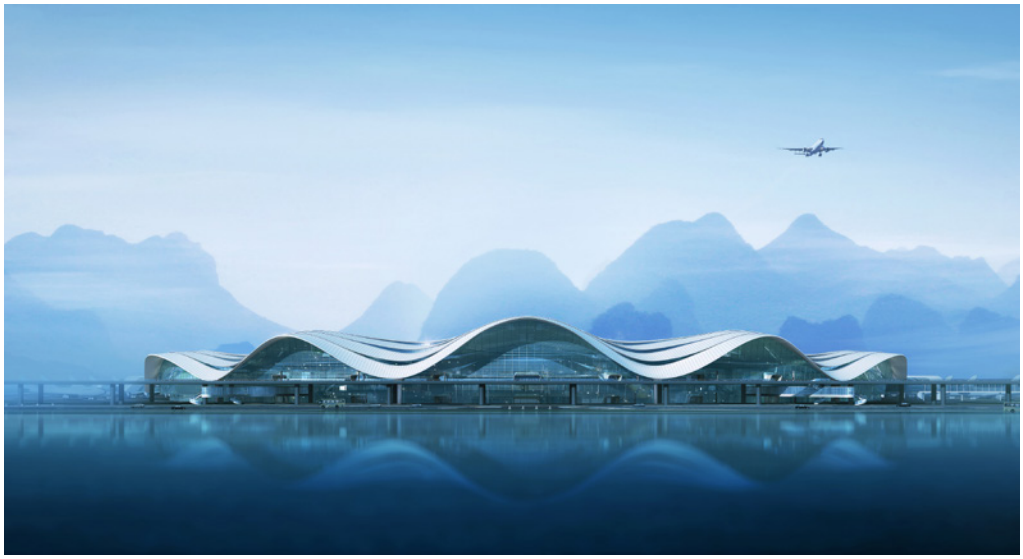
Autodesk® Advance Steel®
Autodesk® Dynamo
Autodesk® Revit®
Autodesk® AutoCAD®

Guilin Liangjiang International Airport

– Application of Advance Steel in Complex Steel Projects

When applying BIM, instead of being constrained by existing software and design models, the practitioners should actively research and explore new technologies and tools. Advance Steel has provided us a new approach to solve the difficult points in the project.

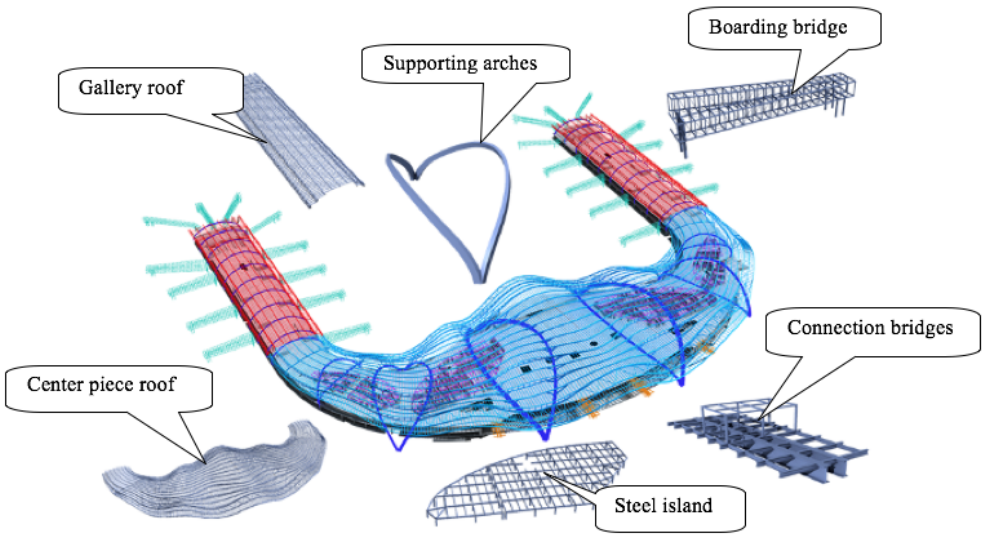
– **Qichen Jiang**
Director of BIM center of Steel Structure Engineering Company of CCEED



China Construction Eighth Engineering Division ("CCEED"), a subsidiary of Fortune 500 giant China State Construction Engineering Corporation, is a large state-owned construction enterprise.

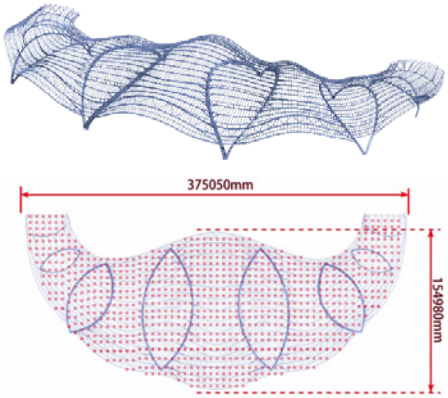
CCEED has class A state qualification as a general contractor and grade I qualification for steel structure work. Steel Structure Engineering Company ("SSEC") of CCEED is a large state-owned steel structure enterprise, with integrated capabilities in design, R&D, consultation, construction, and manufacturing, supported by proprietary steel structure design institute, producing site (grate I qualification), testing facility, labor service company and installation operators. SSEC is committed to innovation and excellence in its industry and has received "Gold Award of China's Construction Engineering Steel Structure" and many other credentials. Headquartered in Pudong Shanghai, the company sits at the board of multiple professional associations and magazines.

Guilin Liangjiang International Airport is located in Guilin Guangxi. The architectural style of "landscape laurel" represents the natural beauty and cultural heritage of Guilin. Terminal 2 is an expansion of the airport. It has a U-shaped structure, 377m long and 355m wide. Comprising 3 floors above ground and 1 floor underground, it is 39.80m tall and 105,000m^2 in floor space. The terminal has 24 connection sets for boarding bridge. The roof is a large-span, bidirectional and double-curved arch steel structure, consisting of center piece roof, gallery roof, supporting arches, boarding bridge structures, connection bridges and steel island structures, with a total weight of 11,000 tons. Designed by Beijing Institute of Architectural Design (Group) Co., Ltd, it is a BIM project in which Autodesk Revit was used for both architecture and structure design.

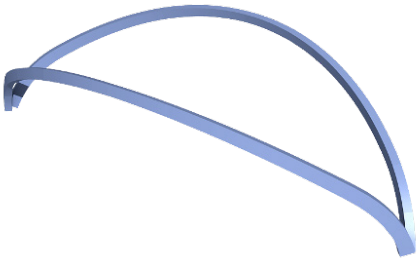


The project is an engineering challenge, with heterogeneous components and complex spatial coordinates. Given the tight schedule, detailing this complex spatial structure is most demanding. The difficulties lie in:

(1) The center piece roof is corrugated, making it very hard to locate and fix bar components. Components and sections vary in specifications, all of which must be factored in the detailing model;



(2) Designed to provide 2D and 3D double-curved support, the support arches are trapezoidal across, tapering off toward the far end. Their internal reinforcement plates make modeling even more difficult;



(3) It's difficult to ensure precision processing of the double-curved components. Assembly and welding have to be sequenced to ensure the accessibility and strength of welding. Meanwhile, contracting and deformation caused by welding must be mitigated to deliver the designed shape and specification of the whole structure.

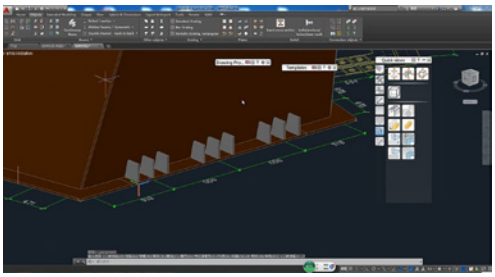
Through trials and benchmarking, the project team selected Advance Steel for detailing modeling, because it outperforms competition in the design and processing of bi-directional double-curve structures, and maintains data integrity in the transmission of IFC files.

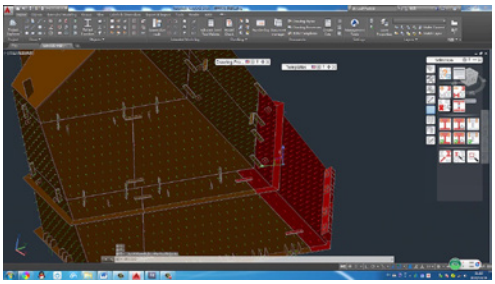
Competitive advantages of Advance Steel:

a. Easily create plates to save modeling time

To meet the need for detailing modeling, Advance Steel offers options to create plates. Users can draw or import CAD closed polylines to create expected plates. Alternatively, rectangular plates can be created by capturing the midpoint, diagonal points and any other three points thereof. Polygon plates thus generated can be further cut and split up. Such features are not available from competing detailing solutions.

The arch springing is a user-defined component composed of plates. Advance Steel offers flexible cutting methods for detailing access holes or fillet weld seams. For example, when detailing the access holes, by selecting tool and clicking the target plate, the user can generate all parameters of the access holes for further editing. The parameters can be batch applied to other access holes, saving time for piecemeal generation and editing.

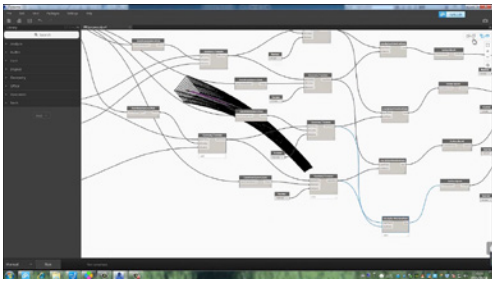


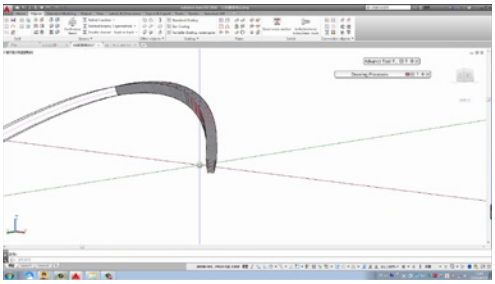


b. Interoperability with Dynamo to optimize heterogeneous detailing

Bidirectional double-curve spatial modeling of the arch was the most complicated part of the project detailing for the airport. It had a strict requirement for accuracy and time-to-deliver. The project team combined Advance Steel and Dynamo for this detailing task.Using Dynamo, the structural engineer defined the steel structure using the center axis

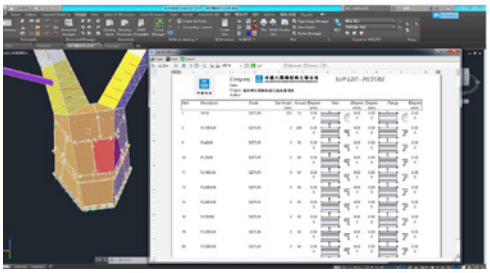
line of the architectural topology. To ensure accuracy, the center axis was divided into 250 equal parts (251 points). The engineers then calculated the normal plane at each point to compute and create 4 points in the normal plane. With these points were used to form 4 sided geometries and control lines in Dynamo. To help give the steel fabricators an accurate geometry set for the steel frame, the engineers synchronized the geometry with Revit and exported 3D control lines to Advance Steel. Based on the imported 3D lines, Advance Steel used the command of "create twisted/folded plates" in the user-defined plate tool to create the arch. It is very intuitive and time-efficient when the arch modeling is created, it can be flattened out to generate drawings. Advance Steel's accurate modeling and flattening feature led to precise drawings.





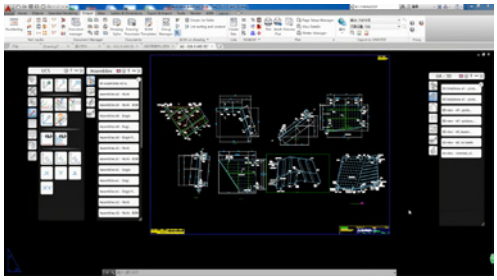
c. User-defined BOM to facilitate quantity calculation

When generating drawings, Advance Steel can load BOM template and provide component information as needed. Many templates are offered to make the process user-friendly. Section shape of components is inserted by default, improving visibility with engineers and facilitating BIM-based quantity calculation.



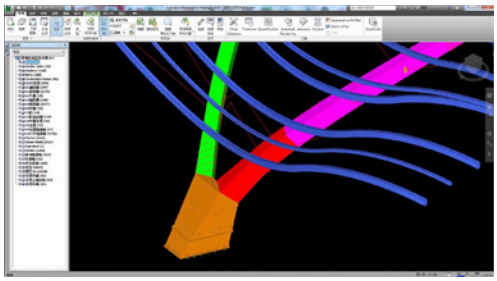
d. Powerful drawing generation

Advance Steel can generate a whole range of drawings, including layout drawings, construction drawings and parts drawings. Sections are automatically provided with relevant drawings. For standard components, their specifications and legends are marked by default.



e. Interoperability with Navisworks

The project team export all components from Advance Steel to Navisworks for construction simulation, which sets the basis for implementation. Advance Steel ensures data integrity and matching in Navisworks, with components classified in Naviswork selection tree window by AS layer. No need to reselect objects for sets. Moreover, construction simulation created in Autodesk 3D Max are imported to Advance Steel, to simulate and visualize solutions to construction difficulties, facilitating communication and confirmation with the construction staff.



For the complex steel structure project of the Terminal 2 of Guilin Liangjiang International Airport, the project team's adoption of Advance Steel helped them meet deadline and quality requirements. Compared with the steel structure tool used before, the team estimates that they saved 20% on labor and were able to shorten the estimated detailing time from 6 months to less than 5 months by switching to Advance Steel. Advance Steel is intuitive, user-friendly, and functional. It is efficient in modeling, with remarkable enhancement in efficiency and precision for heterogeneous components. Its seamless links with other Autodesk BIM solutions are a blessing for BIM penetration in the steel structure industry.

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f. Multi-user feature ensures flexibility and security

Detailing engineers are allowed to create nodes between different components created by multiple users. When a component is used by one user, other users are denied access. This setup ensures flexibility and security, preventing instantaneous editing of the same object by multiple users. Efficiency is improved by saving time in model checking and error detecting.

g. User-friendly interface based on AutoCAD

The interface of Advance Steel is based on AutoCAD, and it supports all AutoCAD functions. For example, the AutoCAD drawings and modeling can be imported directly for layer editing and management, enabling fast detailing. When beam/plate/column tools are activated, the created models are saved in their corresponding layers by default.