CCC-FHDI is renowned as an integrated large-scale investigation and design company both at home and abroad. Over the past five decades since its founding, FHDI has conducted its business in more than 50 countries and regions all over the world. Founded in 1964, CCCC-FHDI Engineering Co., Ltd. is a wholly-owned subsidiary of China Communications Construction Company Limited.
Modern port design is a complex, multi-disciplinary exercise that deals with all aspects of a project, from the geological assessment to wharf construction. In order to facilitate the collaboration between the various professions involved in port engineering survey and design, CCCC-FHDI has developed an in-house integrated 3D system for handling all aspects of port engineering: the Harbor Investigation and Design Application System (HIDAS).

CCCC-FHDI Engineering Co., Ltd., a renowned engineer and construction services company, with a focus on port engineering survey and design, has built a base platform for engineering design, resolved key technical problems of geology, geotechnical analysis, hydraulic design and the collaborative design process, and enabled 3D visualization of geological information through the construction of 3D models with HIDAS. The system allows users to carry out geotechnical analysis for slope stability, subsidence, etc.; 3D modeling of high pile wharfs; planar and spatial calculations on a 3D geological model; as well as automatically adding reinforcements inside of concrete structures. Moreover, it automatically produces various construction drawings and detailed material lists, fully integrating all process data for geology, geotechnics, and hydraulic design.

CHALLENGES

Through in-depth investigation, CCCC-FDHI discovered that none of the 3D design software currently available on the market (e.g., Revit, CATIA, MicroStation, etc.) can fully satisfy the needs of the company’s site surveys, structural design, reinforcement and drawing production. In addition, the licensing costs are high and with limited ability to developed extensions in house. However, developing a solution in house that:

- Can satisfy the basic functions needed for professional 3D modeling, visualization, drawing production, etc., and;
- Meet the needs of each of the relevant professional engineering and technical personnel,

represents an extremely large burden in terms of both manpower and financial resources, as well as involves major risks. Therefore, even from the initial stages of a project, it became clear to CCCC-FHDI that the best approach would be to develop industry-specific applications based on a commercially available, industry-proven 3D modeling toolkit.

In terms of modeling, HIDAS must support the needs of geological, geotechnical, and hydraulic modeling design and reinforcement. These needs force the selection of a robust and stable modeler which can support advanced Boolean operations on large data sets.

In addition, HIDAS must allow users to interact with systems containing an extremely large number of elements and assemblies, placing a huge demand on display performance of the system.

**Challenge:**
None of the 3D design software currently available on the market could fully satisfy the needs of the company’s harbor design business.

**Solution:**
Develop a custom solution based on Spatial’s 3D ACIS Modeler and HOOPS Visualize, using the AGM as a 3D application development framework.

**Results:**
- Lowered development costs.
- Accelerated product development.
- Increased product competitiveness.
After the 3D design is completed, the HIDAS system also supports the production of 2D construction drawings for onsite work. This requirement means the software must be able to produce accurate 2D projections with hidden-line removal.

The other challenge facing the CCCC-FHDI development team was the lack of in-depth experience in developing 3D design solutions or even having a design framework to allow for future expansion and enhancements. Further complicating the issue was the tight schedule allocated for the project.

**SOLUTIONS**

At the beginning of the project, CCCC-FHDI undertook a detailed investigation, and after several rounds of consultation with Spatial, finally decided to license Spatial’s software development toolkits:

- 3D ACIS Modeler for the 3D modeling kernel
- HOOPS Visualize for 2D/3D visualization
- Constraint Design Solver (CDS) for real-time manipulation of geometric objects with direct and interactive creation and modification of dimensions and constraints.
- CGM Hidden Line Removal (HLR) to produce high-quality hidden line views, engineering drawings, and technical illustrations.

The CCCC-FHDI development team used these toolkits as the foundation for their custom application and business layers.

"Through our cooperation with Spatial, CCCC-FHDI has access to the world’s leading 3D components and application development framework. The Spatial SDKs allow us to devote our research and development energies to the development of higher value-added specialized applications. This partnership has lowered our development costs, accelerated the pace of our software development, and raised the competitiveness of HIDAS."

Dr. ZHAO Hongjian
Head of HIDAS Development

For over 30 years, 3D ACIS Modeler has led the 3D modeling kernel market, delivering flexible solutions that enable manufacturing, engineering, and design application providers to meet the demand for high-quality 3D applications in less time and with lower development costs. Powering hundreds of commercial and internal applications with over two million seats in use world-wide, 3D ACIS Modeler is industry proven and is improved and enhanced by millions of users over decades of industrialization. CCCC-FHDI employed the powerful 3D ACIS Modeler for 3D modeling modules for geology, geotechnics and members, and 3D reinforcement of concrete members.

Supported by the 3D ACIS Modeler for use in a wide range of applications, the CGM Hidden Line Removal (HLR) enables users to rapidly produce high-quality hidden line views, engineering drawings, and technical illustrations. CGM HLR provides rapid, reliable results even on large and complex models, and provides the tools and configurability to adjust the resulting accuracy and behavior. CCCC-FHDI took advantage of these capabilities to produce accurate 2D engineering drawings.

HOOPS Visualize is the industry’s most powerful, portable and complete graphics development component for creating or enhancing 3D applications. Developers use the advanced graphic API to accelerate high-performance 3D applications geared to desktop, cloud, or mobile applications (it supports iOS and Android mobile platforms). HOOPS Visualize uses an open modularized architecture, and users can visit a set of the most basic integration packages with powerful functions in order to realize the maximum customization. CCCC-FDHI employs HOOPS Visualize for human-computer interaction, large model visualization, animation, analysis result post-processing and display of 2D engineering drawings.

CDS is a reliable and flexible thread-safe constraint solver used in Dassault Systems’ CATIA V5 and V6. It can quickly solve the dimensional and logical constraints required by 2D/3D contours and assemblies and supports under- and over-constrained situations. The object-oriented design provides a clear C++ interface with diagnostic tools, operating independently of any geometric modeler. CDS can be integrated into any 2D/3D applications. CCCC-FDHI licenses CDS for constraint satisfaction in 2D sketch design.

AGM is a 3D application development framework designed by Spatial to reduce customer development risks and accelerate 3D application development. This framework is based on 3D ACIS Modeler (or CGM) and HOOPS Visualize and features many application-level functions, such as maintaining the relationship between model geometry and displayed objects, selection highlight management, application and un/redo, command mechanisms and custom storage. AGM supports C++ and C#, supporting plug-in design and has very strong expandability. The base platform for HIDAS application development is built on AGM.
RESULTS

Lowering Development Costs
By employing Spatial’s 3D modeling SDKs, it alleviated the burdens on CCCC’s development team by not having to write a complex modeler, support large model visualization, and develop constraint satisfaction routines. The costs of licensing Spatial SDKs are much lower than funding in-house development.

Accelerating Product Development
By using the robust and user-friendly development framework with its specialized templates, CCCC-FDHI was successful in developing many specialized modules with extremely limited resources in a relatively short time — modules that have already been successfully used in many CCCC-FDHI projects.

Raising Product Competitiveness
In addition to the enhanced development environment and accelerated development that Spatial SDKs enable, they also provided developers with an extremely flexible interface — one that empowered CCCC’s developers to quickly develop specialized applications that met the needs of their end customers. These new applications have helped to increase the efficiency of CCCC’s engineers, exceeding the capabilities of other commercial solutions. Spatial SDKs have enabled CCCC to develop world-class solutions.