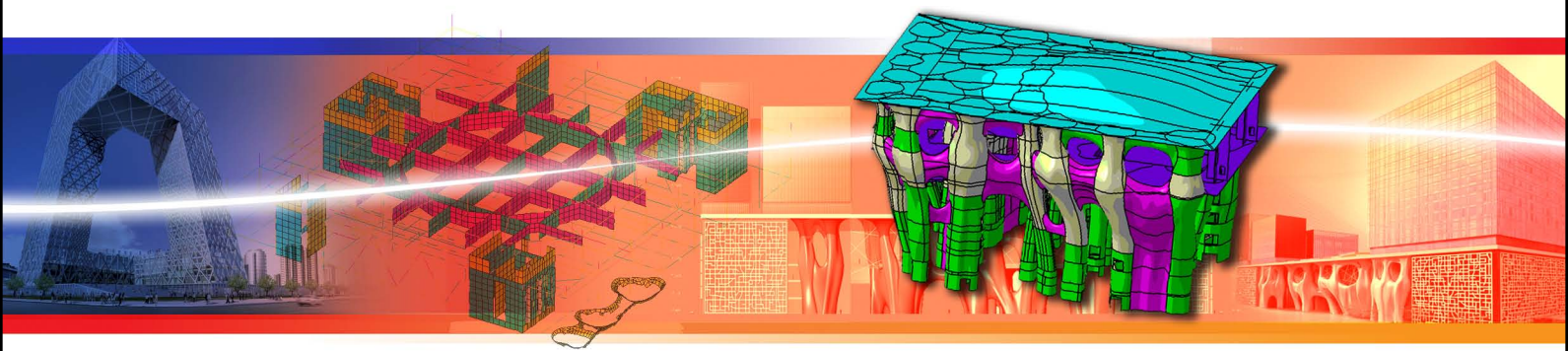
Shanghai Xian Dai Architectural Design

Creating world famous structures with Dassault Systèmes PLM solutions



Overview

Challenge

Shanghai Xian Dai Architectural Design Group needed to design innovative structures while maintaining excellence at the lowest possible cost.

Solution

Shanghai Xian Dai Architectural Design selected CATIA, SIMULIA, ENOVIA SmarTeam and 3DVIA Virtools to address the complexities inherent of architectural projects and to optimize design quality.

Benefits

The DS solutions have enabled Shanghai Xian Dai Architectural Design to shorten development times while improving design quality and reducing costs.

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Wang Guojian
Vice Chief Engineer & Senior Engineer,
Shanghai Xian Dai Architectural Design

Designers of world class architecture

China-based Shanghai Xian Dai Architectural Design Group (SXDA) is a cutting-edge scientific and technological company specializing in architectural design. Ranked in the top three of the Top 100 Nationwide Prospecting & Design companies in China by the State Ministry of Construction, it is also listed in the Top 150 Global Design Firms by US magazine Engineering News Record.

Modern architecture has become increasingly complex due to artistic and technical requirements, which pose new challenges to architects attempting to create unique and never before built structures. SXDA is China's top design company responsible for world famous projects such as Shanghai's World Financial Center, the CCTV TV building, the Zendai Himalayan Art Center, and the Taihu Pearl Hotel.

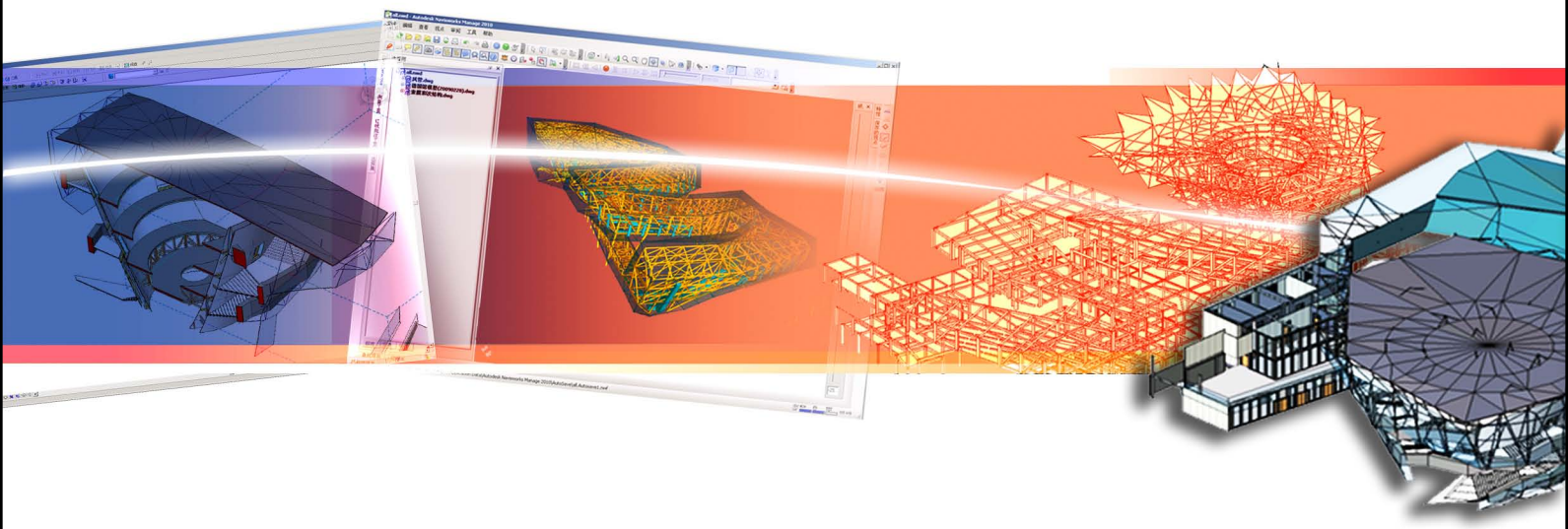
Concerned with reigning in costs, customers expect shorter design times without sacrificing quality. To meet these challenges and improve its competitiveness, SXDA chose Dassault Systèmes (DS) Product Lifecycle Management (PLM) solutions for all its design-to-construction processes.

World class architecture

The Zendai Himalayan Art Center in Shanghai's Pudong district is a symbol of the region's recent economic growth. In order to create this innovative building, SXDA decided to use CATIA for the design and SIMULIA for the virtual structural integrity testing.

The Center's structure is bionic, which in architectural terms means it is an expressive building whose layout mimics a natural entity, in this case, a root. Unlike traditional rectangular layouts and design schemes, the Zendai Himalayan Art Center uses many curved forms and surfaces reminiscent of structures in biology or fractal mathematics.

DASSAULT SYSTEMES



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CATIA’s powerful 3D shape design and styling capabilities helped engineers generate an accurate 3D model of the outer, inner and middle surfaces of the structure. “The impressive 3D shape design capability provided by CATIA made the design and construction of this bionic structure much easier,” said Wang Guojian, vice chief engineer & senior engineer, Shanghai Xian Dai Architectural Design. “Thanks to CATIA, we accomplished mission impossible.”

Engineers used Abaqus Unified Finite Element Analysis (FEA) from SIMULIA to analyze the structure of the art center. The analysis showed specific areas in the structure that needed reinforcement, which improved safety, and even highlighted areas where extra steel could be removed without compromising structural integrity. “The customer was amazed when we announced a 10% savings in steel thanks to optimization of our design using Abaqus,” said Wang.

Chosen for the online 2010 Shanghai World Expo, 3DVIA Virtools, DS’s interactive real-time solution for 3D lifelike experiences, is used in many scenarios such as product experience, city planning, and simulation-based training. SXDA used 3DVIA Virtools to design and plan Shanghai Hongqiao Hub in a virtual environment. Engineers simulated the flow of people and vehicles with 3DVIA Virtools enabling them to better plan the transportation hub. “It’s a good beginning and we believe there will be wider use of virtual 3D technology in architectural projects in the future,” Wang added.

Using simulation to make skyscrapers safe

The safety of skyscrapers is an important issue for all architects. SIMULIA provides realistic simulation solutions that allow accurate predictions of strength and deformations in structures in linear as well as nonlinear and thermal configurations. The modeling, meshing and results visualization technology, coupled with robust and proven analysis solvers, provide a complete and reliable solution for structural analysis. Static, modal, and dynamic analyses can be performed

using a wide range of material models and loading/boundary conditions. Building structures along with the foundations can be modeled simultaneously and detailed effects due to contact and damage can be included in the analyses.

Earthquake response analysis is a good example. Concrete buildings subjected to earthquakes may undergo damage in the first few seconds of seismic activity that can affect their response in the later phases of the earthquake. Analysis of this phenomenon requires estimation of damage in structures and the inclusion of the post-damage behavior in a fully dynamic large displacement analysis.

Because of its strong nonlinear calculation capabilities, Abaqus FEA is perfectly suited for this type of analysis. The Shanghai World Financial Center, the highest building in China, is 492m tall totaling 101 floors. SXDA architects used the unique combination of implicit and explicit technologies in Abaqus FEA for the dynamic analysis of the building's response to earthquake motion.

Li Chengming, vice director & senior engineer, Shanghai Xian Dai Architectural Design said, "Realistic simulation solutions from SIMULIA provided us with the most accurate and practical data that enabled us to fulfill the complex nonlinear earthquake-resistant analysis. We are impressed with the computing and analysis capabilities of Abaqus, which enables Chinese architects to virtually test the structural integrity of world-class high-rise buildings."

ENOVIA for efficient data and project management

SXDA uses ENOVIA for global collaborative lifecycle management to manage design data and enhance collaboration. In the past, SXDA was faced the challenge of managing large amounts of design data. Working on different versions of design data instead of one single version of the truth caused unnecessary delays and increased costs. To improve the overall level of its IT infrastructure, SXDA implemented a national research project. One of the topics explored was product data management solutions.

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SXDA implemented ENOVIA SmartTeam at one of the group's subsidiaries to store and manage all product-related data. Thanks to ENOVIA's powerful data and project management capabilities, SXDA engineers can easily access all up-to-date data and share the latest version of a design at any time. The collaborative working environment provided by the ENOVIA business process platform also eliminated considerable rework and mistakes, which were common in the past.

"ENOVIA, which has been used for quite some time in the manufacturing industry, has now been introduced to Chinese architecture," said Wang. "ENOVIA SmarTeam, which can seamlessly combine multi-CAD and diverse data, enabled us to design more easily and efficiently. We are planning to extend the use of ENOVIA SmarTeam to other subsidiaries in the group and even to the entire industry."

Better quality and higher efficiency

The benefits SXDA has accrued through its use of DS solutions include the unique bionic design of the Zendai Himalayan Art Center, the dynamic earthquake analysis of the tallest residential building in China, and the buckling analyses of the overall structure of the Expo's axis.

Professor Wang indicated that DS PLM solutions are an asset when tackling complicated nonlinear analyses and 3D architectural design. "The DS solutions significantly enhance the quality of our designs and the safety of our buildings. Both SXDA and our customers benefit from an increase in quality and lower design costs," he said.

The use of the DS PLM solutions is poised to spread to other Chinese architectural firms as part of a nationwide sponsored project implemented by SXDA, which itself has become a reference for other companies that want to further develop and sharpen their engineering expertise throughout China.

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Images courtesy of Shanghai Xian Dai Architectural Design

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