



Project Summary

Organization:

iSAT Network Engineers Pvt. Ltd.

Solution:

Utility Transmission and Distribution Infrastructure

Location:

Dehradun, Uttarakhand, India

Project Objective:

- Develop a 132-kilovolt substation with a total capacity of 80 million volt-amperes.
- Design for safety and system reliability to withstand extreme weather conditions and in compliance with India's earthquake-resistant design code.
- Minimize construction change orders, project arbitrations, and delays to stay on schedule.

Products used:

Bentley Substation, MicroStation®, STAAD.Pro, Structural Synchronizer

Fast Facts

- iSAT chose Bentley's substation solution to accelerate design and improve constructability by enabling simultaneous structural, electrical, and physical design.
- Bentley's Structural Synchronizer enabled team members to minimize errors by sharing structural models between STAAD.Pro and Bentley Substation.

ROI

- Creating intelligent 3D models reduced the number of revisions required to arrive at final plans by 60 percent.
- Bentley's substation solution reduced the time required to arrive at the final plans by 40 percent.
- iSAT saved approximately 20 man-days in the process of completing the design and quantity estimation.

iSAT Network Engineers Design Substations 40% Faster with the Bentley Substation Solution

Integrated Design Solution Increases Cross-discipline Collaboration to Reduce Design Revisions and Costly Construction Change Orders

Accelerating Projects with Intelligent Design

iSAT Network Engineers is a fast-growing engineering/procurement/construction company that provides turnkey solutions for utility transmission and distribution as well as high-power testing labs. Power Transmission Corporation of Uttarakhand retained iSAT to develop a 132-kilovolt substation with a total capacity of 80 million volt-amperes in the capital city of Dehradun, Uttarakhand, India. iSAT employed a new approach for the INR 114.4 million project that unified physical, electrical, and structural substation design with Bentley's integrated applications. The Bentley substation solution enabled the use of intelligent models that increased cross-discipline collaboration, reduced revisions by 60 percent, improved the quality of cost estimates, and accelerated the overall design process by 40 percent.



iSAT integrated 2D electrical design, 3D physical layout, and structural design using Bentley Substation and STAAD.Pro.

typically numerous and expensive change orders, project arbitrations, and delays.

"To successfully design this project we needed a comprehensive solution that would simultaneously help in electrical design and substation structural design."

— *Manoj Pal, senior manager for project & service, iSAT Network Engineers*

Traditional Design Process Hindered Efficiency

"Traditionally, designs for substations in India were being produced as 2D plans without having any built-in intelligence. This made the design process complex, often requiring numerous revisions before arriving at the final plans," said Manoj Pal, senior manager for project & service, iSAT Network Engineers. The degree of complexity made it difficult to visualize the designs and impaired the project team's ability to check clearances, detect clashes, and resolve interferences. The 2D design approach also made generating bills of materials a time-consuming and error-prone manual task that often took hours or days. As a result, when plans were implemented at the construction site, there were

The traditional structural design process was also inefficient, with disconnected workflows requiring manual paper-based coordination with the electrical and physical substation designs. These inefficiencies would be a particular problem on the Dehradun substation project in which iSAT faced the task of designing the substation to operate safely and efficiently in an earthquake-prone region, where equipment support structures and foundations must comply with India's earthquake-resistant design code (IS 1893). Moreover, the structures would experience additional loads from hostile weather such as high winds and extreme precipitation. "To successfully design this project we needed a comprehensive solution that would simultaneously help in electrical design and substation structural design," said Pal.

iSAT Opts for an Integrated Design Solution

To overcome the challenges associated its traditional substation design approach and enable concurrent and coordinated cross-discipline design, iSAT chose to use a portion of the Bentley substation solution: an integrated set of Bentley software applications that accelerate design, improve constructability, and reduce the operating costs of electric substations.

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— Manoj Pal,
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project & service, iSAT
Network Engineers.

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The Bentley substation solution enabled iSAT to perform integrated 2D electrical and 3D physical substation design in Bentley Substation and substation structural design analysis in STAAD.Pro. An integrated workflow between the products, enabled by Bentley's Structural Synchronizer, allowed 3D physical models from Bentley Substation to be used in STAAD.Pro and structural models created in STAAD.Pro to be used in the Bentley Substation layouts. This sharing of intelligent models eliminated duplicate work, design inconsistencies, and inefficient paper-based collaboration.

Reaping the Benefits of Intelligent Electrical and Physical Design

By using Bentley Substation, the only integrated software product for intelligent electrical and physical substation design, iSAT unified substation layout and protection and control design on a single application. With Bentley Substation, iSAT could focus its attention on the construction of an intelligent substation model rather than a set of 2D drawings that are difficult to create, update, and coordinate. The intelligent model is built through the creation of a 3D substation layout, which supports the development of 2D electrical schematics that are linked and cross referenced to the physical layout to enable concurrent physical and electrical engineering. Additionally, 2D construction drawings are automatically created and updated from the 3D layout, eliminating countless hours of manual drafting while improving the quality of construction deliverables.

The intelligent model also enabled iSAT to increase the speed and accuracy of reporting, eliminate errors, and accelerate approvals. Unlike graphics-only 2D drawings created with traditional CAD-centric design, intelligent 3D substation layouts are comprised of objects that possess properties of the equipment they represent, the wiring connections they support, and the engineering principles that govern design. Every object is linked to a parts database, enabling the automatic and accurate generation of bills of material, purchase order lists, job cost estimates, wire lists, and other reports. Built-in error checking made possible by the intelligent model enabled iSAT to detect and report conditions including short circuits, duplicate wire numbers, and missing part numbers. “Bentley Substation also enabled us to create intuitive 3D layouts which made it easier to execute clash detection and clearance checking. The 3D layouts, which were much easier to visualize, quickened the process of plan submissions and approvals and enabled us to arrive at final plans in less time with a fewer number of revisions,” explained Pal.

Integrating Structural Analysis to Enable Concurrent Engineering

One critical requirement was to ensure that the electrical equipment (cable bus, rigid bus, strain bus conductors,



3D layout visualizations enabled iSAT to accelerate plan submissions and approvals.

switches, surge arresters, insulators, and more) was properly supported by steel structures and their foundations. Using STAAD.Pro, Bentley's 3D structural analysis and design engineering software, iSAT was able to accurately analyze and design for static and dynamic loads (including seismic accelerations, wind, rainfall, and snow) in accordance with the applicable steel design codes and standards, as well as India's seismic design code. STAAD.Pro's seamless integration with Bentley Substation allowed project team members to undertake concurrent engineering to eliminate errors and accelerate project delivery.

3D Modeling Reduces Revisions, Change Orders

“The 3D substation models were used to detect clashes and interferences before the designs were signed off. This reduced the number of revisions required to arrive at final plans by 60 percent,” said Pal. In addition, automated reporting increased the accuracy and speed of material quantity estimation. Previously, hours or days were spent on manual material take-off from stand-alone products causing errors that led to change orders during construction that could each cost hundreds of thousands of rupees. With more accurate final plans and documentation, iSAT avoided many of these expensive construction change orders.

Overall, the Bentley substation solution reduced the time required to arrive at the final plans by 40 percent. iSAT attributes this achievement to being able to perform simultaneous design and consistent modeling across structural, physical layout, and electrical disciplines. Bentley software saved iSAT approximately 20 man-days in the process of completing the design and quantity estimation. As a result, the overall design was completed ahead of schedule, yet still met the two most important requirements: safety and system reliability.