Five Critical Factors to Digital Telecom Tower Design
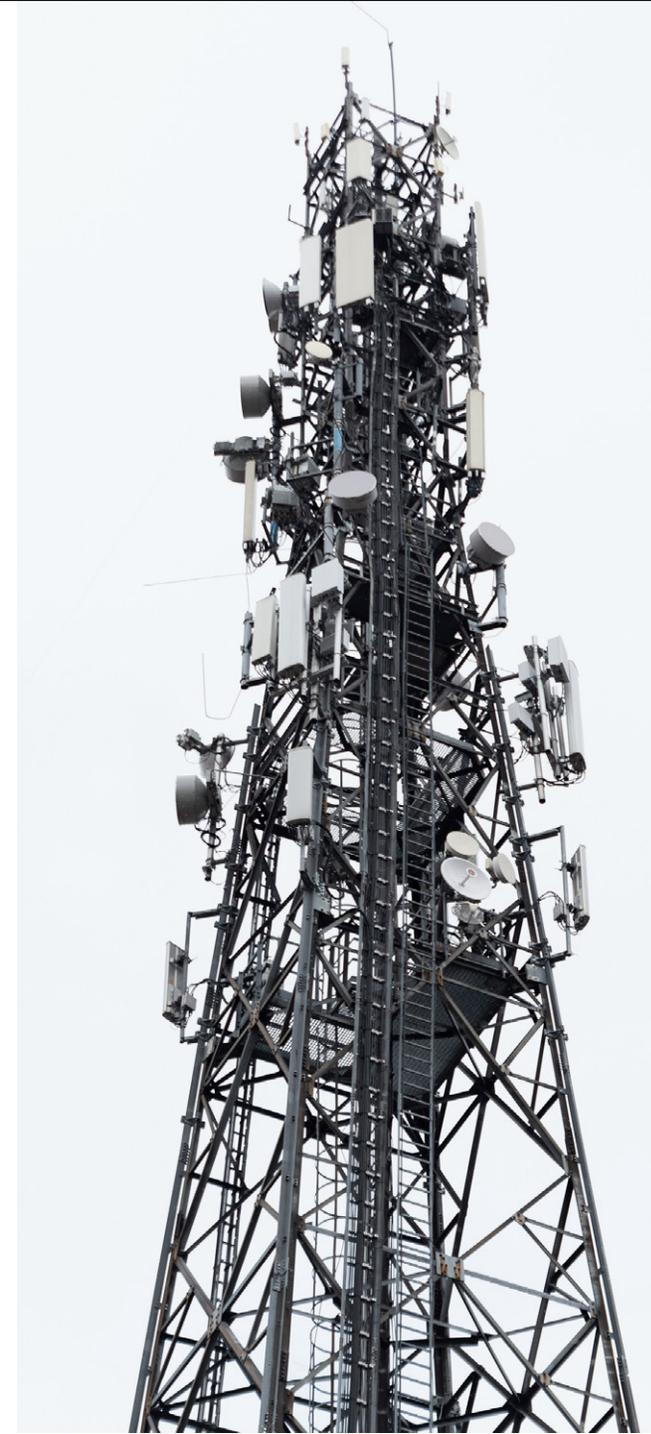
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Telecom Tower Design Transformation

Globally, the telecom tower design industry is undergoing a significant transformation. New tower designs are being developed and existing towers are being reinforced based on emerging technologies, sustainability concerns, and the demand for safer, more versatile towers that support a broader range of services.

Technologies like 5G, 6G, and the Internet of Things (IoT) require networks with the ability to handle higher volumes of traffic. Tower designs must support multiple levels of equipment, antenna types, lighter and stronger composite materials, and smart sensors and other monitoring devices to improve tower maintenance, efficiency, and safety.

The Increasing Complexity of Tower Design

Designing, gathering, and analyzing tower data and assessing current conditions is growing more complex. Tower designers and engineers must consider structural integrity to withstand the weight of the equipment and antennas, as well as the forces of wind, snow, ice, and seismic loads. They must consider safety to minimize the risk of accidents for workers and the public, as well as lessen the environmental impact. At the same time, the tower must be designed to be as cost-effective as possible.

Due to these complexities, tower designs often go through several modifications and multiple structural analyses throughout their lifecycle. In the end, massive volumes of files are created and must be examined, which can result in errors and inefficient data integrity, leading to unsafe conditions, delays, and increased costs.

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> Traditionally, engineers would need multiple in-house equipment, software, and data files
> to design and analyze telecom towers. There needed to be a single solution that understood
> tower language, encompassing real-life workflows, including scenario evaluation,
> and also provided a living history of each tower.
>
> – *Apurba Tribedi, Senior Director, Tower Products, Bentley Systems*

A Digitized Approach to Tower Design and Analysis

Traditionally, tower design and analysis involved a series of detailed assessments, wherein engineers painstakingly evaluate a multitude of factors and variables. These factors may include load-bearing capacities, material strengths, wind resistance, seismic stability, and the specific demands to safely modify towers.

Setting up and testing each scenario involved many steps, such as using different applications, manipulating numerous files, creating copies, managing directories, and assembling components. This process is extremely time-consuming and greatly increases the chance of errors.

Utilizing a comprehensive software solution provides a completely modern approach to optimize the entire tower design and analysis process. This integrated digital strategy helps increase accuracy and efficiency to meet the needs of telecom operators and tower engineers in significantly less time. Engineers can deliver projects faster, minimize risks, and have more confidence in the outcome.
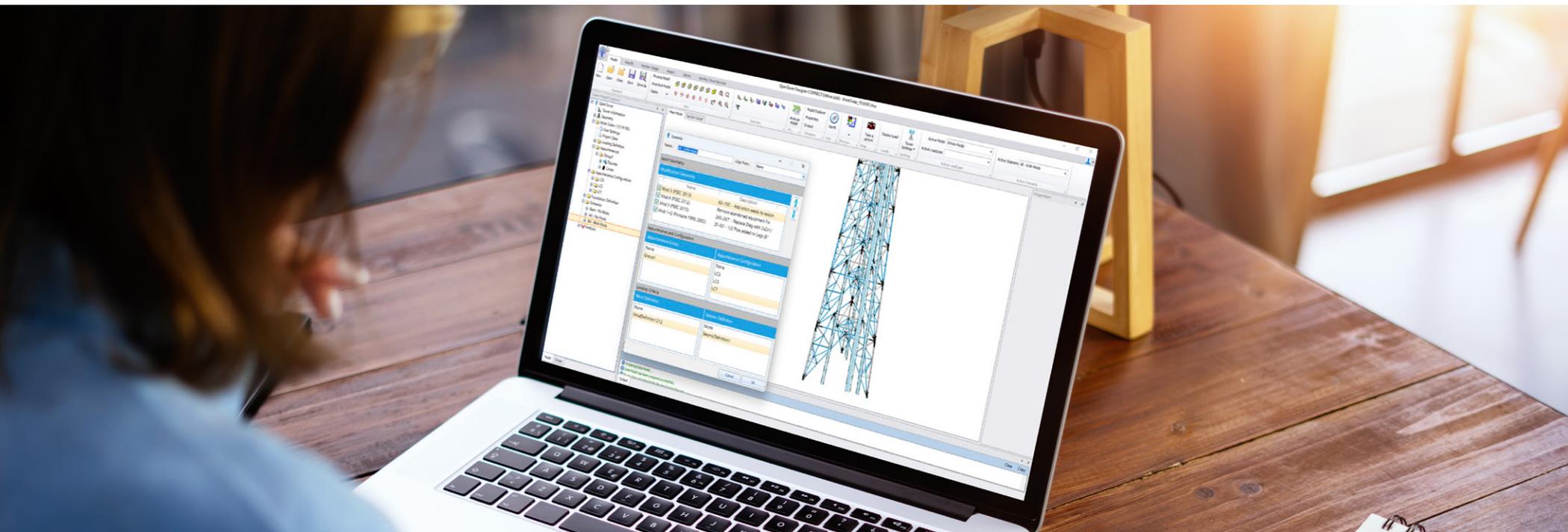
1 Accessible Libraries, Catalogs, and Tables

A digitized approach to tower design allows users to access a comprehensive library of panel types and ancillary equipment. It enables fast creation of the tower structure, either parametrically or from a legacy file import. Wind and seismic loads can be generated automatically based on the selected code for cardinal wind directions. Design checks can be quickly performed and detailed reports created to identify the behavior and stability of the tower structure.

The key to quick tower design is software with customizable equipment libraries. It should include mounts, mount pipes, antennas, dishes, tower-mounted equipment (TME), feedlines, and attachments with built-in support for all major equipment manufacturers, along with attributes such as bolts, materials, and guy wires. All of these catalogs can be easily managed through the import and export mechanism in the XLS format.

With a custom catalog, users can add any number of sections and shapes that are not part of the standard catalogs. New custom and built-up sections are added parametrically. The software will automatically generate section profiles to display those sections correctly.

Engineers can use advanced options like the user-provided table (UPT) to create non-standard tower sections, materials, and both discrete and linear appurtenances. Built-up sections include industry-specific profiles, such as a split pipe or bent plate, as well as materials to meet virtually all global standards.

2 Adherence to Global Codes and Standards

Design codes are essential for ensuring the safety, functionality, and compliance of telecommunications towers. They provide a common framework and universal protocols for different industries. In many countries, it is a legal requirement for telecommunications towers to comply with applicable design codes.

The following organizations and standards are some of the most critical that enable compliant projects throughout the world:

Telecommunications Industry Association (TIA)	Canadian Standards Association (CSA)	Standards Australia	British and European Standards (BS EN)	Institution of Lighting Professionals (PLG07)

3 Maintaining a Tower Model's History in One File

Designing, gathering, and analyzing tower data and assessing current conditions is growing more complex. Tower designers and engineers must consider structural integrity to withstand the weight of the equipment and antennas, as well as the forces of wind, snow, ice, and seismic loads. They must consider safety to minimize the risk of accidents for workers and the public, and lessen the environmental impact. At the same time, the tower must be designed to be as cost-effective as possible.

Due to these complexities, tower designs often go through several modifications and multiple structural analyses throughout their lifecycle. In the end, massive volumes of files are created and must be examined, which can result in errors and inefficient data integrity, leading to unsafe conditions, delays, and increased costs.

> The flexibility of a single model to check scenarios is one
> of the greatest advantages [...] It allows us to provide our clients as much feedback
> as possible to promote a long-term relationship.
>
> *– Matthew K. Lackey, P.E., Charlotte Structural Division Manager, Tower Engineering Professionals, Inc.*

4 Reduction of Errors

A crucial part of tower design is ensuring that the foundation is stable enough to withstand the tower and attached equipment. Typically, the reaction forces of the tower would need to be transferred to another foundation software or spreadsheet.

With an advanced approach to tower design, engineers do not need a separate application for foundation design. The integrated foundation module for telecom tower analysis allows engineers to perform a foundation check with a single click after the superstructure analysis. It saves time and reduces the potential for errors when switching applications.

5 Flexible Report Generation

To help users communicate their designs and findings effectively, powerful and flexible report-generation capabilities are crucial in a comprehensive tower design and analysis application. These features generate reports using standard or user-defined templates, and export them in various formats, including PDF, HTML, and CSV. Reports can include structure data, loading analysis, and design capabilities.
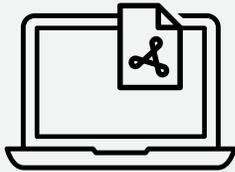
PDF
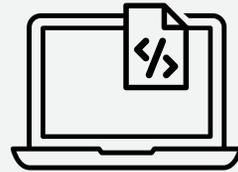
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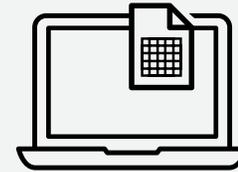
CSV

OpenTower Designer as the Industry Solution

Bentley's OpenTower Designer is a one-stop solution to design, model, and analyze telecommunications towers. This software was built in collaboration with tower owners, tower designers, and professional engineers, providing a management solution for telecom towers.

With OpenTower Designer, engineers are able to create precise tower models more quickly and easily. Tower models can be created from the ground up with 3D renderings of equipment and feedlines. Engineers can experiment using different designs, make modifications, and reanalyze existing towers with discrete and linear appurtenances drawn to scale. Realistic model visualizations of towers can be used to communicate design concepts to stakeholders and identify potential problems before construction begins.
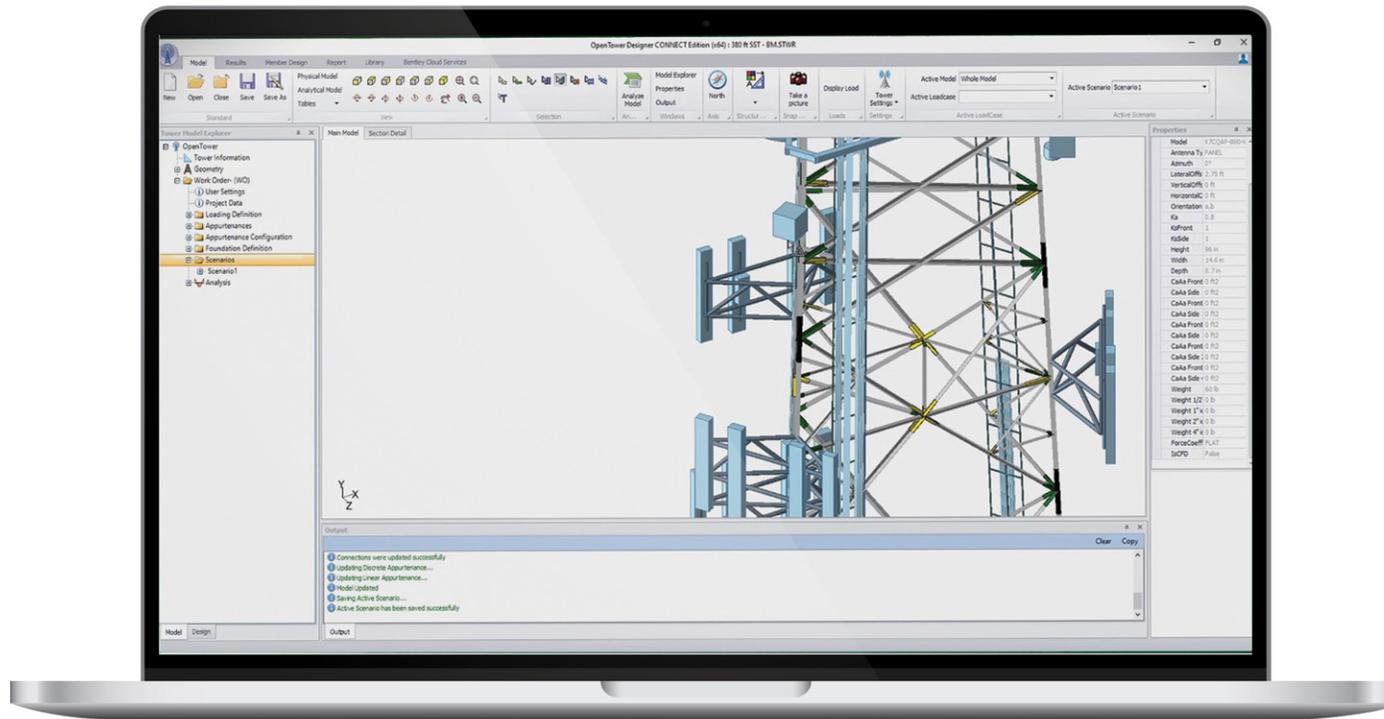
Supported Tower Types

OpenTower Designer increases efficiency in designing these tower types:

Monopoles
Tapered, Stepped, and Hybrid

Design Codes Supported:
Imperial and Metric Versions
TIA-222 (Rev F, G, H)

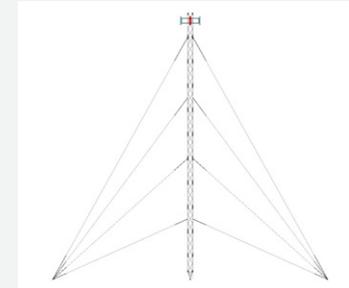**Metric Version:**
AS 3995, AS 4100
CSA-S37–18
PLG07

Self-supported Towers
3-sided and 4-sided

Design Codes Supported:
Imperial and Metric Versions
TIA-222 (Rev F, G, H)

Metric Version:
AS 3995, AS 1170.2021, AS 4100
CSA-S37–18
Eurocode 3 UK NA

Guyed Masts
3-sided and 4-sided

Design Codes Supported:
Imperial and Metric Versions
TIA-222 (Rev F, G, H)

Metric Version:
AS 3995, AS 1170.2021, AS 4100
CSA-S37–18
Eurocode 3 UK NA

As purpose-built telecommunication tower analysis and design software, OpenTower Designer captures and improves real-life workflows, such as multiple scenario evaluations, foundation checks, and connection designs.
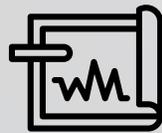
The software is available in an Imperial version and Metric version, with both versions supporting all three tower types.

OpenTower Designer's Capabilities and Benefits

OpenTower Designer enables users to complete projects more efficiently and cost-effectively than ever before within a single interface. Engineers can keep pace with the demand for building and maintaining towers using the following features:

| Use editor or graphical mode for data input | Connect to equipment databases to automatically generate wind and seismic loadings | Analyze the tower structure | Check the strength and connection design | Generate custom reports | Create comprehensive foundation design assessments |

Johnson Broderick Engineering, LLC

Assess the Value of Precision Graphics-enabled Tower Analysis

Johnson Broderick Engineering, LLC, has a long history of structural and civil engineering services. They specialize in structural analysis of new and existing towers and telecom system services for public and private entities in the Pacific Northwest and Northern California. The firm invested in OpenTower Designer from Bentley Systems in April 2020.

Aaron Broderick, principal of Johnson Broderick Engineering, LLC explained, "Older programs are kind of a black box that are fed information and spit out results. There's no visual reference to where antennas or feedlines are located or what the equipment looked like, and limited foundation analysis capabilities."

The realistic graphics were one of the biggest advantages of the software for Broderick. The interactive user interface shows every detail with an approachable way to see appurtenances on a tower, including face and elevation, and generate intermediate results throughout the analysis for review. With the click of a mouse, a user can generate reports and fine-tune components as needed, unlike traditional tower analysis applications.

Of particular use to Broderick is the foundation analysis feature, which is designed to evaluate the most common foundation types (e.g., mat, drilled piers, guyed anchors) as well as the associated structural requirements for each. OpenTower Designer automatically handles multiple forces and load combinations based on code requirements. Broderick was able to integrate foundation engineering with the tower analysis to model unusual tower configurations with ease and streamline the entire workflow.

> "For sites that are analyzed repeatedly, there is approximately 20% time savings.
>
> – Aaron Broderick, Principal of Johnson Broderick Engineering, LLC

TOWER
ENGINEERING
PROFESSIONALS

Tower Engineering Professionals, Inc.

Optimize Workflows with OpenTower Designer

Tower Engineering Professionals, Inc. (TEP) is a wireless and wireline engineering and infrastructure services provider to tower and telecom customers. With multiple engineering firms working for large vendors and various leg modification methods being utilized, TEP constantly had to model and analyze different types of leg modifications. They had to evaluate four to five loading combinations to provide cost feedback to clients and carriers.

With their legacy software, engineers had to first draw these shapes in either AutoCAD or ShapeBuilder, then go into their current software to manually input the sectional properties.

Using OpenTower Designer's shape creation feature, users can draw the same shapes in two to three minutes instead of 10 to 12 minutes. TEP experienced a 400% time savings in analyzing one site on 16 separate occasions over the last five years.

The flexibility of a single model to check scenarios using the file tree and scenario analysis tool in OpenTower Designer allowed engineers to use one file as the basis for the site moving forward.

By keeping all modification designs in one file—with the ability to turn them on or off with the click of a button—TEP estimates savings of 30 to 60 minutes per applicable site. On average, using OpenTower Designer is estimated to save engineering firms 20% per project.

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> OpenTower Designer's rich graphics present every detail visually and provide an interactive user interface that you can delve into, which offers an approachable way to see what appurtenances are on a tower, including face and elevation.
>
> *– Matthew K. Lackey, P.E., Charlotte Structural Division Manager, Tower Engineering Professionals, Inc.*

Advancing Tower Design

OpenTower Designer is comprehensive tower design software that helps designers and engineers address the challenges of modern tower design and analysis. It simplifies the process, digitizes data and workflows, and integrates with OpenTower Mount Analysis and OpenTower iQ, which uses digital twin technology, artificial intelligence (AI), and machine learning (ML). It is interoperable with a variety of other software solutions, including tnxTower, MStower, and STAAD®.

This comprehensive digitized approach allows tower designers to create safer, more versatile, and cost-effective towers that meet the needs of telecom owners, operators, and the public in much less time. Engineers can deliver projects smarter and faster, minimize risks, and have more confidence in the outcome.

Start improving your tower design efficiencies and streamlining your workflows.

Shop Now