

Close the Collaboration Gap

Optimized Workflows for Improved Piping and Structural Analysis Plant Projects

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"STAAD.Pro® and AutoPIPE® saved time and effort in the design of the most complex piping systems. Easy extraction of load information, auto adjust for modifications, and easy modeling of piping cleat supports reduced overall design time."

- Larsen & Toubro Ltd.

Ammonia Plant Feedstock project, Larsen & Toubro for National Fertilizer, Ltd., India



Modern plants – whether petrochemical, power, process, offshore, or nuclear; single or multistructures – must support their piping systems that convey gas, steam, water, and other liquids at ambient and high temperatures. Complex plant design-build projects are expensive, both to design and to operate safely. Engineering firms must deliver accurate and precise plant designs to their clients that consider both the piping and structural elements. This is essential to avoid costly installation and operational failures on these USD multibillion plants.

This is no small feat. For example, an average large petrochemical plant at a minimum requires more than 10,000 pipe supports and 1,000 pipelines supported by more than 100 independent structures – all of which needs to be located, designed, and fitted together in extremely tight spaces. The volume of components and space constraints are the biggest design challenges for engineering teams to overcome.

Avoiding Inefficient and Error-prone Project Workflows

Complex plant design-build projects require expert input from both structural design and piping engineering teams. However, many project teams rely on paper documents and manual data transfer to collaborate. The design team may be in-house but dispersed across multiple offices, countries, or regions. Even for teams working in the same building, it is not uncommon for the structural team to have very little daily contact with the mechanical team.

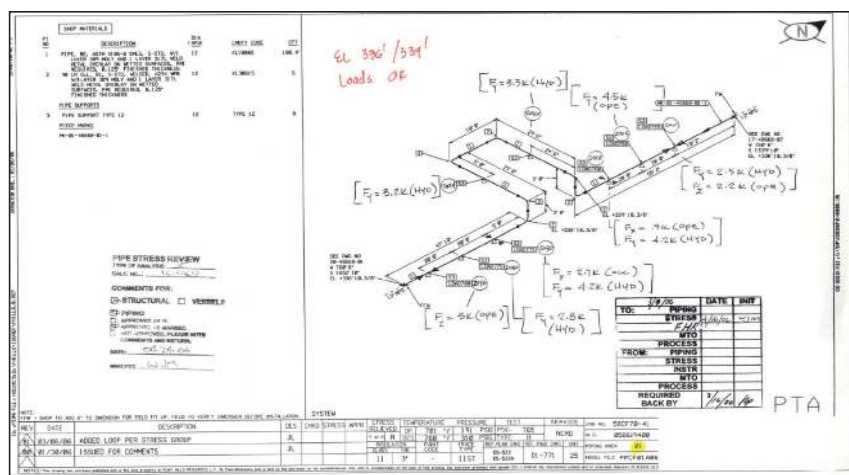
This workflow tends to be error-prone, and often results in time lags, as the information is packaged, delivered, interpreted, and entered into two systems.

Traditionally, paper digital documents, such as spreadsheets, have been used to manage and communicate the project data. These documents are handed over to other project teams who must interpret the data, apply some judgement about it, and enter the data into their own system. This process is slow and cumbersome, and is subject to errors.

The significant disconnect between pipe stress and structural engineers often leads to project inefficiencies, design mistakes, and operational failures. When conveying information, engineers typically provide the preliminary structural steel drawings to pipe stress engineers so that loads can be marked up. This traditional process is extremely inefficient and the data is disconnected because many people can be accessing different versions of the information in different ways. To streamline the process, piping engineers should add as much structural steel information onto the steel drawings so that detailing, fabrication, and erection can be done in a single pass.

"Seamless software integration from AutoPIPE and STAAD® contributed to a shortened qualification process, saving 60 percent of the analysis and design cycle time. The software also helped to coordinate with design teams on final assembly, fabrication, and production and enabled the timely market launch of the project."

- GE Water & Process Technologies, Bangalore, India

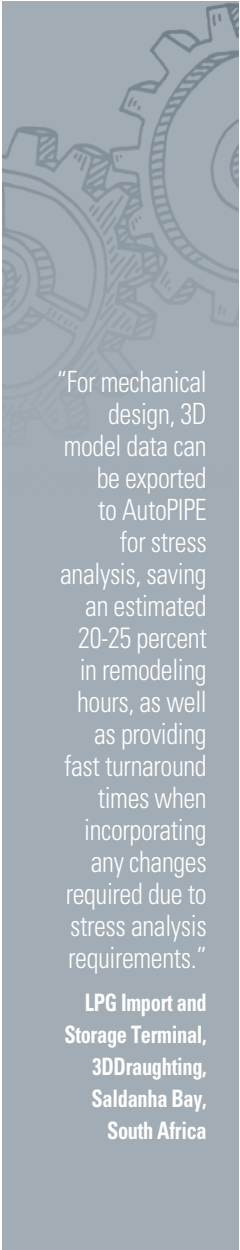


A typical workflow for the pipe stress engineer may include thousands of mark-ups from the structural engineer.

Structural engineers often need to filter through massive amounts of data to find pertinent data information such as pipe support locations, and then need to manually match up all the piping forces with each pipe support. Pipe stress engineers carry out the stress analysis based on isometric drawings to manually generate a stress model; usually engineers need to input a huge amount of data during the transfer.

In the meantime, the structural engineer receives the stress marked-up isometric drawings and then must take time to determine where the pipe support locations are. Often, the structural engineer needs to go through pages of marked-up drawings and tables to look for the piping forces for each pipe support. All of this information must be re-entered manually into the structural analysis application for every pipe support in the structure. This manual data research and data re-entry is very time consuming and is frequently error-prone.

Data on thermal loads and piping movements, spring supports, and anchor points have special details, as well as high loads. Structural engineers can't guess where these things are going to be or what they will look like. This vital information must come from the piping engineer in a timely manner and in a usable and interoperable format for effective collaboration.



"For mechanical design, 3D model data can be exported to AutoPIPE for stress analysis, saving an estimated 20-25 percent in remodeling hours, as well as providing fast turnaround times when incorporating any changes required due to stress analysis requirements."

LPG Import and
Storage Terminal,
3DDraughting,
Saldanha Bay,
South Africa

The Pressure is Mounting

In a competitive market, engineering firms feel the pressure to become more productive, reduce costs, complete designs more quickly, and get sites up and running sooner. But they face many challenges. What happens when engineers need to identify clashes between piping, steelwork, equipment, and electrical when the project has a maze of piping? What happens when pipes move due to temperature, seismic, wind, or extreme loading?

How do engineers identify hot clashes caused by pipes heating up or by other loads like wind or earthquakes? How can the project team efficiently check 3,500 pages of pipe stress displacement data for 241 different load cases and locate these movements in the plant model? And how long will that take?

These are questions that engineering teams are faced with every day. As organizations become increasingly dispersed and the projects become larger, this practice of working in isolation often becomes more pronounced. When teams maintain their traditional processes, their burden is magnified.

To address this, they cannot rely on existing procedures. They must adopt more effective and collaborative workflows between their teams to achieve their productivity goals.

Modern Applications Optimize Workflows, Save Time, Reduce Errors, and Risk

Modern design and analysis applications can finally break down traditional barriers and close the collaboration gap between piping and structural engineers.

Bentley's interoperable plant design and analysis applications support true collaboration. For example, the structural engineer now can locate the forces from the pipes without having to rely on the pipe stiffness for stability. This process is much more efficient for engineers. They can avoid working through and interpreting typically hundreds of printed documents associated with a project. The piping engineer can now include the actual flexibility of the supporting structure to more accurately analyze the stresses that develop around nozzles that can have critical effects.

If a project requires the production of multiple pipe runs modeled in several models, the data can all be brought together in a single shared repository so that the structural engineer can extract the forces from all the pipe runs as required. As a result of reducing errors and optimizing the workflow, engineers can confidently produce precise and accurate designs to greatly reduce the risk of operational failures.

“Using AutoPIPE and its interoperability with STAAD.Pro helped us save 220 resource hours from the design and build on this short project, as well as reducing material costs by 10 percent.”

Knowsley SK,
Offshore Production
Platform Deluge
Skid, Manchester,
United Kingdom
2012 Be Inspired
Award nominee

Bentley’s structural and piping applications, such as STAAD.Pro and AutoPIPE, work well together, and work well with other vendors’ applications. Using PipeLink, structural and piping engineers can share needed data between STAAD.Pro and AutoPIPE. PipeLink does not hold all of the data from each application, but shares just the necessary overlap. Once the link is established, the data can be updated by either team. The new data is then refreshed in the complementary team’s models, resulting in additional time savings and improved data accuracy.

Structural and piping engineers can work better and more efficiently when they are using STAAD.Pro and AutoPIPE. While working without specific detail of the structure, pipe engineers can produce a data file for the structural engineer that includes important pipe locations and support forces. This valuable data is used to make design corrections where necessary. The resulting structural data is then passed back to the piping engineer who validates that the structure does not adversely affect the assumptions he or she has made. If necessary, modifications can be issued back and forth quickly and efficiently, saving days of work for the overall project.

STAAD.Pro, with its ease of use, has become the global standard application for structural analysis. Industrial plant designs are often simple initially, but can suddenly require complex modifications. For instance, the introduction of a rotating component to an existing structure would require the investigation and validation of a dynamic response. STAAD.Pro provides the capability and simple method to add the component quickly so the project is not delayed.

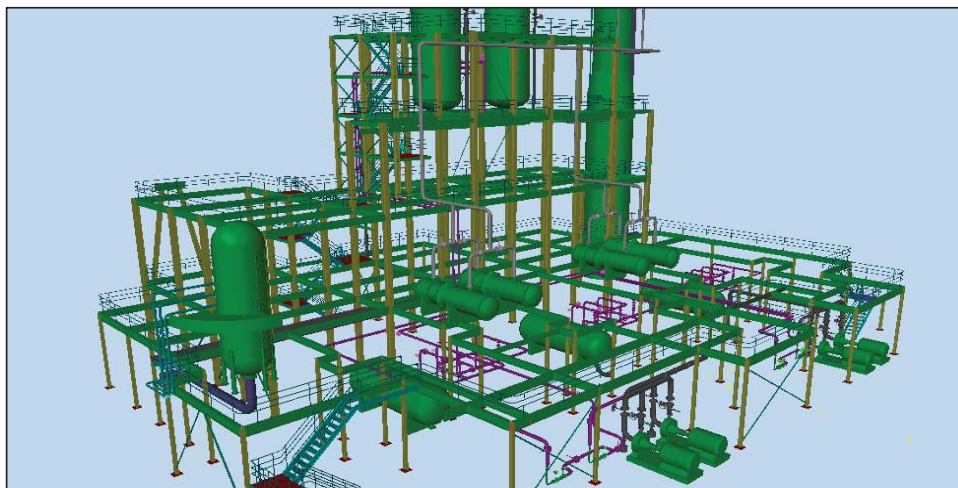
STAAD.Pro’s wide range of design codes ensures that multinational organizations can be confident that their structural teams are equipped to work on projects across the globe.

Using Bentley’s AutoPIPE, engineers can increase productivity and improve quality control with an intuitive modeling environment and advanced analysis capabilities. Additionally, the interoperability of Bentley’s applications with third-party products is unique, powerful, and provides unparalleled workflow efficiencies and quality assurance. AutoPIPE is also easy to use, and typically delivers a 40 percent improvement in workflow time. Besides, AutoPIPE offers an innovative feature named Support Optimizer that enables piping engineers to determine the optimal pipe support locations that require the least number of supports, without sacrificing quality or safety. Engineers can quickly evaluate multiple design alternatives to ensure the best scenario, saving time and money.

3D clash detection is unique to AutoPIPE and provides a simple workflow to ensure deflected pipes will not interfere with other components within the plant design. AutoPIPE can export the deflected shape of load combinations with the highest deflections to a file that can be opened in Navigator. The piping model can then be combined with the structural, equipment, plant, and other models, and a clash detection can be performed to ensure that the deflected shape in the critical load combination is not “clashing” with any other components in the full plant model.

Closing the collaboration gap between design teams with interoperable design applications will bring powerful change to dispersed design teams using varied software applications.

This interoperability and clash detection capability allows engineers to determine how the pipe moves due to different loads being applied and ensures that it won't hit other components, such as a staircase, pump, or steel column. Avoiding these clashes in production lowers the chance of expensive plant failures.



Hot clash detection - Pipe is clashing steelwork.

Running hot clash detection in AutoPIPE allows engineers to easily generate a hot deflected DGN pipe stress model. Teams can quickly discover hot clashes to help avoid costly operational failures that might otherwise be undiscovered using traditional manual methods.

The Future: Collaboration for piping and structural design teams

Closing the collaboration gap between design teams with interoperable design applications brings powerful change to dispersed design teams using varied software applications.

Using modern workflows with interoperability, firms can save countless resource hours and lower project costs. Project teams across all disciplines can be confident that all stakeholders have access to the most up-to-date information, shared across the piping, structural, and CAD departments, and they can ensure that their piping and structural designs automatically adhere to current standards and codes. Using optimized workflows, engineers can confidently produce precise and accurate designs to greatly reduce the risk of operational failures for their clients.

For more information **visit** www.bentley.com



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