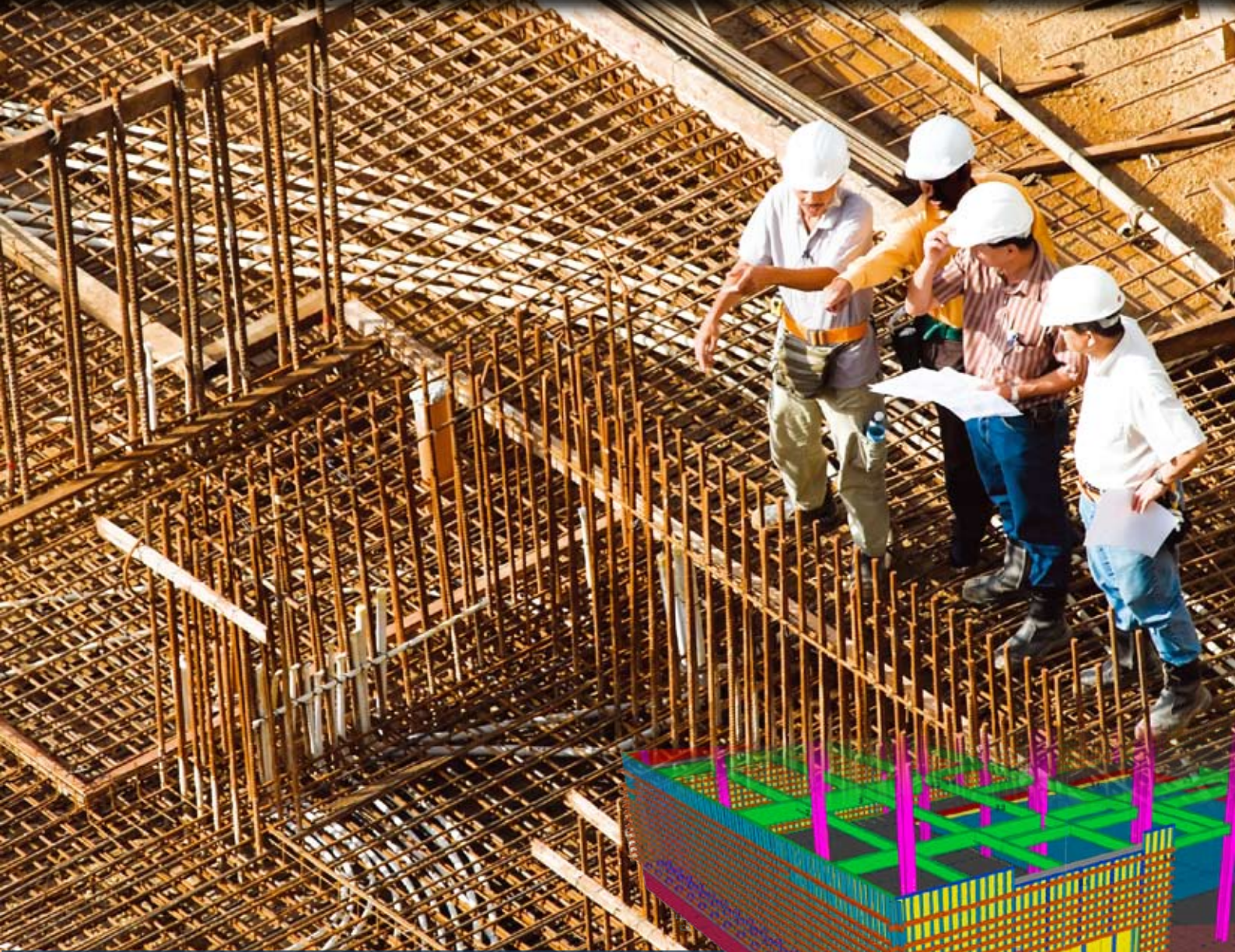




TEKLA® Structures



TEKLA STRUCTURES IN PRACTICE:

DPR CONSTRUCTION
UNITED STATES





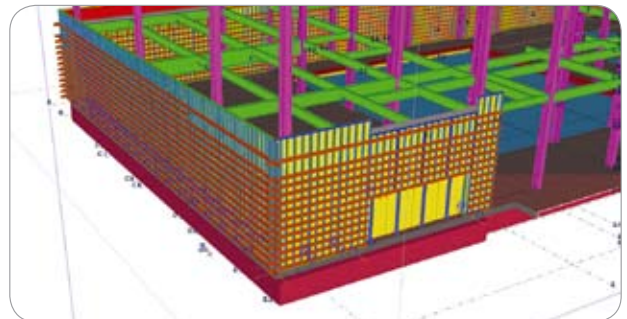
TEKLA Structures

CONCRETE FORMWORK

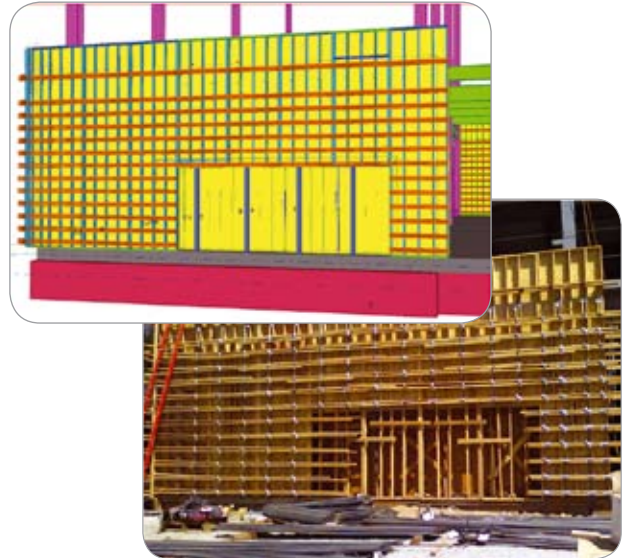
LAYOUT AND MATERIAL MANAGEMENT



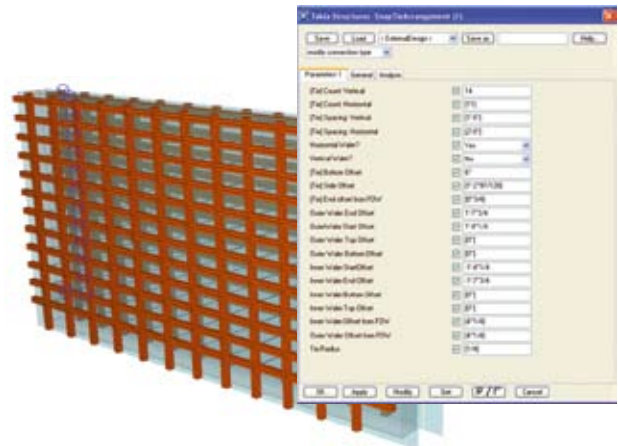
> The challenge for DPR Construction's Concrete Division was to increase productivity by rapidly generating formwork layout options that would automatically adapt to the varying characteristics of buildings to be constructed. Tekla Structures BIM (Building Information Modeling) software provided the technology to create adaptive formwork and to manage the required formwork material.



➤ "THE ABILITY TO CREATE PARAMETRIC TEMPLATES IN TEKLA STRUCTURES AND ITS ABILITY TO HANDLE EXTREME DETAILING MADE IT THE MOST SUITABLE SOFTWARE SOLUTION TO MODEL TO THE SNAP-TIE LEVEL OF DETAIL."



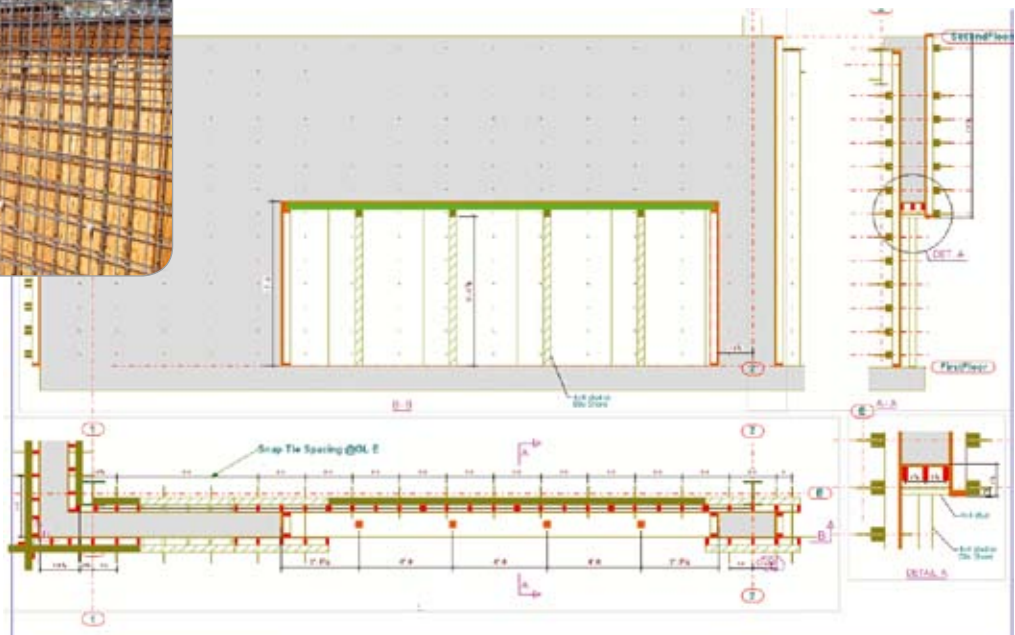
➤ The manufacturing and construction industry are often compared to each other. However, one conspicuous difference between the two is that while the manufacturing industry mass produces the end product using one process flow, the construction industry delivers similar products in different physical settings. Even though similar construction projects have the same set of construction activities, unique physical settings pose many challenges to maintaining productivity.



Typical Snap-Tie Whaler Arrangement template



Layout Drawings Production





VIEW FROM THE FIELD

"With Tekla formwork modeling we were able to rapidly try out various formwork options enabling us to choose the arrangement that worked best with regards to cost and constructability. It also helped us reuse the same formwork material most efficiently in the next portion of our work. Accurate quantities from the model helped in verification of estimated quantities and concrete pour optimization. One of the biggest time savers was 3D visualization of complicated areas instead of trying to visualize it from 2D plans. This ability saved on guesswork and rework. One situation that comes to my mind is the complex areas around the beam column intersections where, with the help of 3D formwork model, we were able to figure how to build formwork. We were able to address constructability issues to the structural engineers and get a reply back even before the steel was erected. I have nothing but good things to say about the input and support from Tekla formwork modeling."

- Karl Goeking (Concrete Superintendent on UCSC, Digital Arts Facility)



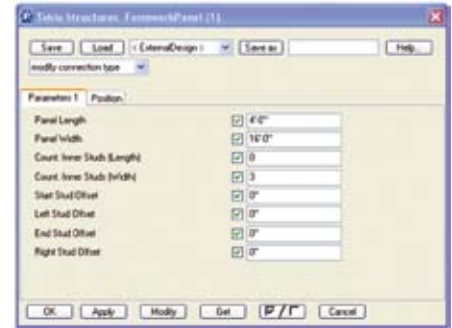
THE CHALLENGE AND ITS BIM SOLUTION

> While building the Digital Arts Facility at the University of California Santa Cruz, the challenge for DPR Construction was to rapidly generate concrete formwork layout options adapting to the site and the building. Tekla provided the technology to create adaptive formwork components which could generate the formwork layout for different shapes and sizes of walls with varying details in different physical settings. DPR created custom components (intelligent templates) in Tekla Structures that adjusted to shape and size of the wall and automatically generated a formwork layout.

CAPTURING KNOWLEDGE FROM THE FIELD

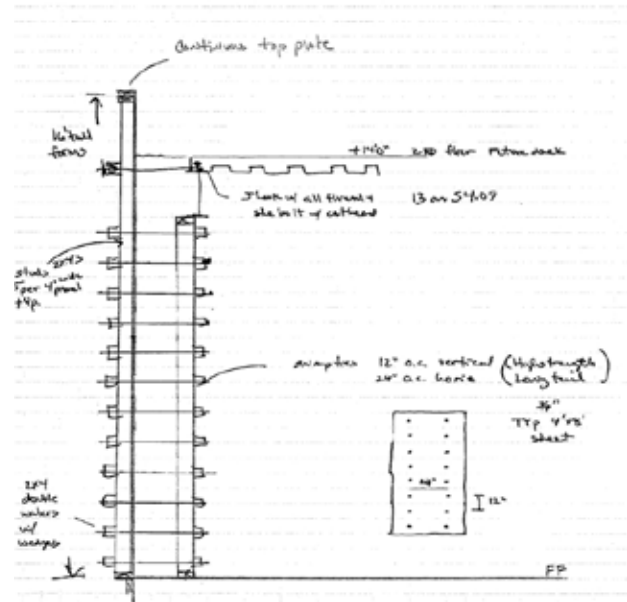
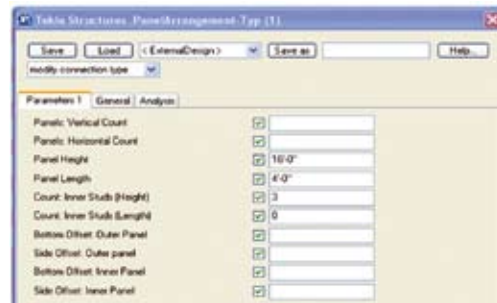
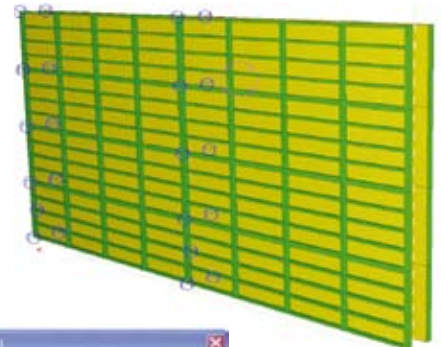
> The ability to create parametric templates in Tekla Structures and its ability to handle extreme detailing made it the most suitable software solution to model to the snap-tie level of detail. In the process of automating the formwork layout process, DPR discovered a powerful method for capturing formwork layout knowledge from experienced foremen and superintendents. Sample hand sketches of the formwork layout were the foundation for the Tekla Structures formwork components that were created.

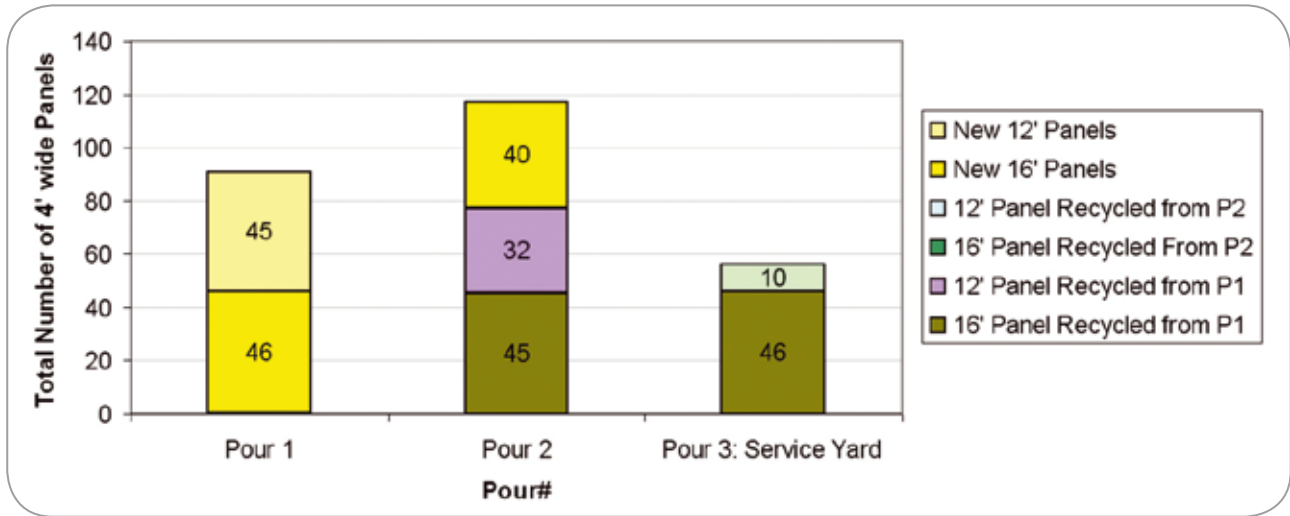
In addition, considerations for erecting the formwork in complex areas like the bottom of beams, around steel columns and wall openings, at wall transitions, were incorporated into each of the components. These components are now being used on other concrete projects in the company resulting in knowledge transfer and increased efficiency across projects; which has always been a challenge in the construction industry.



Typical Formwork Panel template

Knowledge captured forever in Templates. Templates are intelligent which help generate formwork layout with respect to the physical parameters that keep changing from project to project.





Formwork reuse chart

QUANTIFIABLE BENEFITS

> Like other BIM activities using Tekla Structures, formwork layout automation saved the field crew considerable time by eliminating the need to layout formwork for every wall in the building manually. The layout drawings were then given as handouts to the foreman to erect the formwork in the field. Formwork layout has traditionally been a 2D process, field situations are often overlooked, inadequately accounted for, resulting in stripping and redoing of the formwork. By generating the formwork in 3D, complex issues and project specific issues were easily identified and preempted at an early stage. As a result, there was no rework related to formwork erection on this project.

Furthermore, the Tekla Structures model helped the superintendent to manage material and pour size definition. The model was useful in identifying the panels that could be reused between pours resulting in cost savings. Formwork panels were prefabricated on site based on the Tekla Structures model. Quick generation of formwork arrangement helped the team run through multiple scenarios of how to arrange the panels so that minimum material and field cuts were required.



> "FURTHERMORE, THE TEKLA MODEL FOR FORMWORK HELPED THE SUPERINTENDENT IN MANAGING MATERIAL AND DEFINING THE POUR SIZES."

For example, a vertical arrangement of 16' high panel was better than a horizontal arrangement as it required fewer panels and in turn less material and labor. Savings in material and labor to construct and put into place formwork assemblies are estimated at \$25,000.

"Tekla Corporation is pleased to see DPR take Tekla Structures into use to solve problems and add efficiency," says Andy Dickey, Business Manager of Tekla North America's Contractor group. "It's interesting to see how Tekla Structures has been used in this case to increase both 'office' and 'field' efficiency. In the case of the office, formwork layout and drawings have been automated thereby creating efficiency and cost savings. In addition, they have freed time to look at more efficient ways of installing their formwork, creating increased value in the field as well. These are the real problems facing the industry and it's great to see an innovator like DPR solving them."



> DPR Construction, Inc. is a forward-thinking general contractor and construction manager specializing in technically complex and sustainable projects for the Advanced Technology, Corporate Office, Healthcare and Life Sciences markets. A privately held, employee-owned company, DPR has grown to more than \$1.7 billion in volume, making it one of the largest general contractors in the US and a great story of entrepreneurial success. Founded in 1990 by Doug Woods, Peter Nosler and Ron Davidowski (The D, P and R), the company's mission is to be one of the most admired companies by the year 2030.

DPR continuously looks for opportunities to improve the construction delivery process and provide a higher level of quality service on projects of all sizes and complexities. A proven leader in green building, building information modeling, and lean/integrated project delivery, DPR has built projects for such world-class companies as Apple, Banner Health, Bayer, Digital Realty Trust, Genentech, Kaiser Permanente, Pixar Animation Studios, The Scripps Research Institute, Sutter Health, and Yahoo!

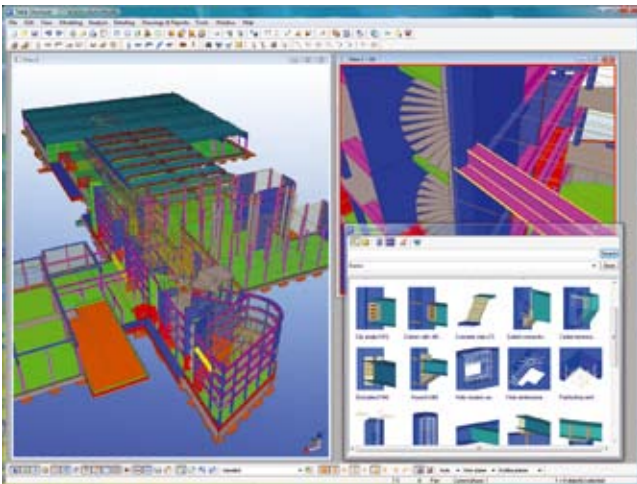
More information at www.dprinc.com



TEKLA STRUCTURES – INTELLIGENT 3D MODELING



> Tekla's model-based software products make customers' core processes more effective in building and construction and infrastructure management. **Tekla Corporation** has area offices and partner organizations worldwide. International operations account for more than 80% of net sales. Founded in 1966, Tekla is one of the longest operating software companies in Finland.



> Tekla's technology creates new opportunities for the disciplines in the construction industry: **Tekla Structures** is the most advanced BIM (Building Information Modeling) software on the market that provides an accurate, dynamic, and data-rich 3D environment for structural engineers, steel detailers and fabricators, concrete detailers and manufacturers, and construction companies to share.

The highly detailed as-built structural models created in Tekla Structures enable effective visualization and management of any project from sales and bidding to follow-up. Openly integrating model and non-model-based data into the model allows collaborative workflows to streamline the design, fabrication, and construction stages for the highest level of constructability and integration in project delivery. Centralizing project management into the model not only increases productivity in each stage, but also enhances the value of structural modeling throughout the value chain of building.

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