Wood Pole Design for Overhead Power Lines

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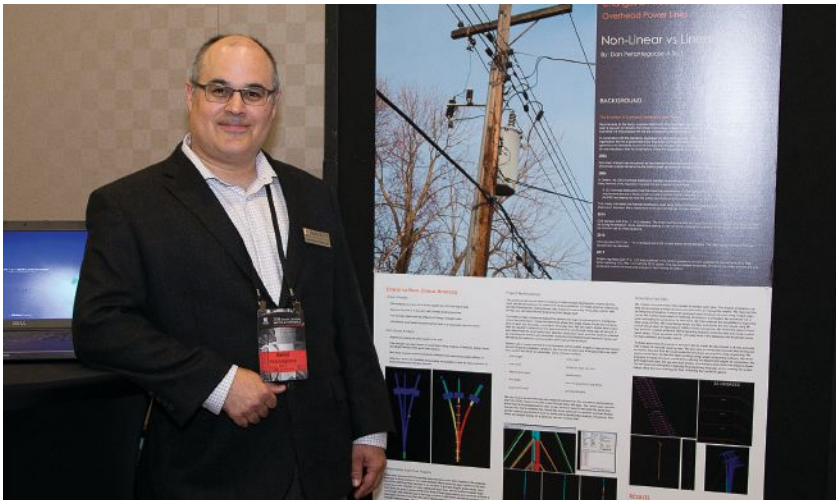

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▶ How can we continue to refine wood pole designs for overhead power lines and optimize public safety?

The availability of more robust analytical tools and the increasing frequency of intense storms have been contributing factors to changes by the Canadian Standards Association (CSA) regarding rules governing wood pole design for overhead power lines. In 2003, the CSA began the process of transitioning the industry from linear structural analysis to nonlinear structural analysis – Standard C22.3 No.1-15 Overhead Systems in 2015 completed this transition.

Previously, power line designers performed linear analysis by hand calculations or by using simple tools, such as excel-based calculators and tables. Nonlinear analysis is more complex and is performed with advanced software, which comes with increased training and licensing costs.

Recently, Stantec undertook a project for Hydro Quebec to calculate various scenarios using both linear and non-linear analysis. Stantec stored the results in a database and created a design tool to search through the database. The tool selected an appropriate pre-calculated pole class and guying solution based on input parameters. This helped Hydro Quebec comply with the standard and increase efficiency. The output data is also an invaluable tool for the design of new infrastructure, planning of upgrade programs and forecasting the impact of the code change.

In total, Stantec analyzed more than 200,000 different structures using both linear and nonlinear analysis. In many instances, nonlinear analysis was found to increase pole class size by one or more classes, a significant impact as there are millions of poles across Quebec and Canada. Each class change might cost several hundred dollars, affecting both utilities and ratepayers.

The project was performed using PLS-CADD as the main design tool for structural nonlinear analysis. A key technological uncertainty was how to capture the tens of thousands of different scenarios based on pole height, pole class, attachment height, line angle, supported length, ruling span, and so on, and feed this data into PLS-CADD.

Some poles would have to support equipment like transformers and there would also be different recommendations for size and quantity of guy wires, lead length combinations, soil class and anchor types. The initial concept development required compartmentalizing the options into structure types to intelligently control the parameters. We also had to decide what output data we needed to retrieve from the tests and store to sort through, using logic at the end. It was determined the most control over selection of structure class and size could be obtained by restricting the primary and secondary conductors to predetermined maximum values, and identifying the maximum communication point load on the structure.

As there were many thousands of structure files to create, we sought to automate this process. We created a combination of visual basic and bash scripts to generate the structures. We created test files in PLS-CADD, which analyzed many structures at once using multiple alignments and then exported the data using xml files. We then extracted the data using VBA programming, and imported and compartmentalized the data into the final database.

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