Design Review of Ice Loads on the Confederation Bridge

Client: Canatec Consultants and Buckland and Taylor Ltd.

Mr. Ron Ritch was a member of the design verification team responsible for reviewing and checking the design ice forces on the piers of the Confederation Bridge. The Confederation Bridge is the world's longest bridge over ice-covered water and links Borden-Carleton, Prince Edward Island with Cape Jourimain, New Brunswick, Canada.

As part of the design verification ARCL was responsible for the development of a probabilistic framework for the prediction of ice loads on the bridge piers. The model was used to predict the design forces on the structure for various return periods. The modeling framework uses Monte Carlo techniques to predict the expected ice features which would interact with the bridge. Several different ice-structure interaction models were used to predict the force generated by level ice, rafted ice, and ridges with the bridge piers. A limit driving force model is included in the modeling framework to ensure there is adequate driving force available, due to winds and currents, to generate the force to actually fail the ice feature against the structure. The modeling framework was developed as a group of modules which allows the framework to be easily modified for different geographic locations and structures.

The model included over 30 different input variables. The input variables included such parameters as freezing degree days, snow cover, ridge keel porosity, air temperature, wind speed, current speed, and tidal variation. For incorporation into the model framework, a probability distribution was developed, based on available information, for each variable. In cases where limited information was available, distributions were developed based on previous experience and literature review.

In any modeling process, there is uncertainty that the input parameters are accurate and that the mathematical model used accurately represent the natural physical process which are occurring. As a final step in the modeling process and reliability assessment, an uncertainty analysis was performed to develop error bounds on the predicted ice forces on the structure