

### Coal Combustion Product Type

Fly Ash

### Project Location

Regional Municipality of Niagara, Ontario

### Project Participants

Lafarge Canada Inc., Rankin Construction, Boralex Inc., Enercon Canada Inc., WSP Canada Inc., Borea Construction, Pumpcrete Corporation, Mammoet, Degrandis Pumping, Salit Steel

### Project Completion Date

2016

### Project Summary

The Niagara Region Wind Farm comprises 77 wind turbines spread out over a 170-square-mile area in south-east Ontario. Collectively, the turbines, each 425 feet high, utilized 2.6 million cubic feet of ready-mix concrete and 1.3 million cubic feet of precast concrete. Challenges included an aggressive time schedule—the turbines were installed in only 16 months—and the placement of concrete during winter months, which complicated curing operations.

### Project Description

Niagara Region Wind Farm is the first in the province of Ontario to be built with concrete towers. Concrete was selected over steel for a variety of reasons. It allows for taller tower heights, which translates into additional wind power generation. Prestressed concrete also has higher material damping properties than competing materials, boasts elevated fire resistance, and is less susceptible to fatigue or dynamic failure. Finally, the energy required to manufacture a precast concrete tower, factoring in end-of-life recycling, is significantly lower than that of a steel tower.

The compressed timeframe within which the project needed to be completed meant placing one cast-in-place concrete base per day during times when pouring operations were being carried out. Each base required approximately 34,000 cubic feet of concrete, which was placed continuously. The bases had to meet 28-day strength requirements while controlling for heat of hydration to prevent thermal cracking during mass concrete placements.

To control the heat of hydration and lower mix costs, materials supplier Lafarge Canada and general contractor Borea Construction chose a 50-50 fly ash/general-use (GU) portland cement mix. A more traditional slag approach was rejected given fly ash's superior heat reduction capabilities. Lafarge also opted for a combination of ice and chillers (cooling tap water to 37-39° F rather than the 59-64° F used under normal conditions) in place of a more expensive liquid nitrogen procedure, saving an estimated \$100,000.

Lafarge teamed with Rankin Construction to provide two mobile ready-mix plants that met volume and scheduling requirements. One plant was supplied for the concrete bases and the other for the precast segments. Locally based plants provided supplementary volume and loads as needed. To ensure proper temperature for the curing of the concrete segments during the cold winter months, project developer Enercon Canada constructed a heated tent onsite and enlisted the use of a specialty crane to enable the safe transport of concrete segments.

Over the course of roughly five months, Borea Construction placed a volume of concrete twice that of Toronto's famed CN Tower (which reigned as the tallest free-standing structure on land for over 30 years). Shortly after meeting the 16-month construction schedule, the Niagara Region Wind Farm was commissioned in November 2016. It subsequently earned recognition as one of 10 exceptional projects at the 2017 Ontario Concrete Awards.



Credit: CNW Group-Boralex Inc.