

# New concept of high voltage overhead line between Avelin and Gavrelle – structural and dynamic design

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## Abstract

This paper considers a project of a new high voltage line for which the insulator chain supporting the high voltage cables is designed to remind the sail of a boat changing shape as the wind blows. Such a design with moving parts in the structure reveals new engineering challenges on how to ensure structural integrity while respecting architectural wishes. This paper presents the main structural issues of this design and how modern calculation methods allow to tackle them and prevent them.

**Keywords:** wind; dynamic; whiplash; parametric excitation; resonance.

## 1 Introduction

The new concept of high voltage overhead line (Figure 1) consists of the replacing of the old line with a new doubles circuit, but with a new concept of the support designed by Hugh Dutton & Associés architects on behalf of RTE as project owner and built by Eiffage as prime contractor.



Figure 1 : The new concept of high voltage overhead line between Avelin and Gavrelle (France)

This 400kV line, 16km long, is in northern France between Lille and Arras, more specifically between Avelin and Gavrelle. These steel electrical towers are 69m in height and have a wingspan between 33m and 36m. The architectural intention of this new concept is to remind the shape of sails filled by the wind. As the line layout must consider the topography, there are 5 types of pylons for which the geometry of the “sail” is slightly different depending on the deviation in the horizontal plane that the HV lines have with the support. Figure 2 shows the different components of the support:

- A mast
- A lower and an upper bracket fixed to the mast
- 4 insulators and 3 HV line supports connecting the lower bracket to the upper bracket on each side. These are the two insulator chains.
- Tie-rods connecting the upper bracket to the mast
- Stay cables connecting the lower bracket to the mast.