Interference Effects for Two Particular Reinforced Concrete Chimneys

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Abstract

Interference effects for new and existing chimneys at the Rugeley Power Station are studied using a simplified Fluid-Structure Interaction (FSI) approach. Instead of solving the 3D domain, a simplified setup is devised, in which 2D flow problems are solved on a number of planes parallel to the wind direction and transversal to the structures. On such planes, the incompressible Navier-Stokes equations are solved to estimate the fluid action at different positions of the line-like structures. The fluid flow on each plane is coupled with the structural deformation at the corresponding position, affecting the dynamic behaviour of the system. An Arbitrary Lagrangian-Eulerian (ALE) approach is used to take in account the deformation of the domain, and a fractional-step scheme is used to solve the fluid field. The stabilization of incompressibility and convection is achieved through orthogonal quasi-static subscales, an approach that is believed to provide a first step towards turbulence modelling. In order to model the structural problem, a special one-dimensional element for thin walled cross-section beam is implemented. The standard second-order Bossak method is used for the time integration of the structural problem. The wind is modelled as an incompressible fluid acting on the structure in a series of planes that are supposed to be independent among them. For each period of time, the fluid problem is solved, the aeroelastic analysis is carried out and the geometry of the mesh of each fluid plane is updated according to the structure displacements.