

Model Equations for the Eiffel Tower Profile: Historical Perspective and New Results

Patrick Weidman

Department of Mechanical Engineering
University of Colorado at Boulder
Boulder, Colorado USA

Abstract

Two mathematical models for the shape of the Eiffel Tower are reviewed and shown to be inconsistent with Eiffel's writings. Reported here is a third model derived from Eiffel's concern about wind loads on the tower, as documented in a communication delivered to the French Civil Engineering Society on March 30, 1885. A translation of this paper reveals the underlying physics behind the construction of the tower and leads to the formulation of a nonlinear, integro-differential equation describing its skyline profile. Although its solution is exponential, the actual tower profile closely resembles two piecewise continuous exponentials with different growth rates. This is explained by specific safety factors for wind loading that Eiffel & Company incorporated in the design of the free-standing 300 meter tower.