In this paper, semi-empirical engineering models for the three main wind turbine aerodynamic noise sources, namely, turbulent inflow, trailing edge and stall noise, are introduced. They are implemented into the in-house aeroelastic code HAWC2 commonly used for wind turbine load calculations and design. The results of the combined aeroelastic and aeroacoustic model are compared with field noise measurements of a 500kW wind turbine. Model and experimental data are in fairly good agreement in terms of noise levels and directivity. The combined model allows separating the various noise sources and highlights a number of mechanisms that are difficult to differentiate when only the overall noise from a wind turbine is measured.