Accepted Manuscript

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PII: S0022-460X(18)30587-X

DOI: 10.1016/j.jsv.2018.09.008

Reference: YJSVI 14358

To appear in: *Journal of Sound and Vibration*

Received Date: 21 December 2017

Revised Date: 14 June 2018

Accepted Date: 3 September 2018

Please cite this article as: A.H. Dawi, R.A.D. Akkermans, Direct and integral noise computation of two square cylinders in tandem arrangement, *Journal of Sound and Vibration* (2018), doi: 10.1016/j.jsv.2018.09.008.

Direct and Integral Noise Computation of Two Square Cylinders in Tandem Arrangement

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Abstract

The present paper presents a comparison between two different approaches for calculating far-field noise of two square cylinders in tandem arrangement. Experimental data show that a flow past such an arrangement results in aeolian tones as well as broadband noise. The turbulent flow past the cylinders is computed using a compressible solver for low-Mach number flows. In order to validate the direct computation of acoustic waves, the complete span including endplates is calculated. Wind tunnel measurements show two different but stable flow states past the cylinders: a quiet state, where no vortex shedding is present in the wake of the upstream cylinder, and a loud state, where separated shear layers flow into the gap between the cylinders intermittently. Different initialisations of the velocity field are used in order to capture both flow states. Mean flow quantities as well as surface pressure spectra are compared to wind tunnel measurements. Far-field noise is calculated directly using the compressible solver, as well as indirectly using a hybrid method based on a Ffowcs Williams Hawkings formulation for stationary rigid surfaces. Far-field spectra and directivity patterns are compared to wind tunnel measurements. Results of both methods show good agreement with experimental data.

Keywords: IDDES, DNC, FWH, two struts

1. Introduction

The continuous increase of customers' demands regarding comfort aspects lead to a significant reduction of engine and wheel noise in the automotive industry. Moreover, the continuous employment of electric engines results in an almost complete elimination of engine noise. This leads to an increasing importance of reducing wind induced noise resulting from externally mounted parts. One example of such mounted parts are the exterior side-mirrors, which have become the main noise source for vehicles driving over 100 km/h.

In order to estimate the wind noise level, different **C**omputational **A**ero**a**coustics (CAA) approaches can be employed. Regardless of which approach is used, a validation of each method is required to ensure its usability. A flow past a side-mirror produces acoustic waves which propagate to the surface of the window. At the same time, the turbulent wake of the side mirror as

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