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Costanera Norte

Installation of jet fans with slanted silencers e.g. "Banana Jets"

Introduction

HBI Haerter Ltd has been involved with the basic design of the ventilation system of the tunnel Costanera Norte. Based on this work, local designers have elaborated the detailed design.

As an independent consultant, HBI Haerter Ltd. defers from recommending single manufactures or products as it would bias the market place. In this particular case, we have been asked by Witt&Sohn to conduct a technical assessment of their "banana jet" for the Costanera Norte project, which is the purpose of the current document.

HBI Haerter Ltd. exists as a tunnel ventilation specialist since 1963 and has one of the largest tunnel ventilation divisions. In 2002 alone, we conducted ventilation studies of more than 100 road-tunnels world wide.

Technical evaluation

The principle of the jet fan is to produce a jet at high speed at a velocity of, say, 40 m/s. The difference between the velocity of the jet and the flow in the tunnel enhances the velocity of the tunnel air. Consequently, the larger the difference in speed between the tunnel air and the jet, the more efficient the jet fan is.

Since the jet fans are located near the tunnel wall, a significant friction loss occurs. This loss increases when the distance to the tunnel wall decreases. Due to restrictions in the civil works, it was planned that the jet fans in the tunnel Costanera Norte were to be installed in niches, which results in even higher losses as a larger proportion of the jet stream will be in the vicinity of a solid surface.

The advantage of the "banana jet" is that it diverges the jet away from the wall, which inevitably results in lower friction losses. On the other hand, the turning of the air stream inside the jet fan implicitly causes loss increases. Consequently, it is a balancing act between aerodynamic benefits achieved outside the jet fan and the additional losses inside. Currently, the "banana jets" from Witt&Sohn have a slanting angle of about 7°. In this case, the additional internal losses are bound to be insignificant. Consequently in the tunnel Costanera Norte and from an aerodynamic point of view, it appears without any

reasonable doubt that the banana jets would be more efficient than conventional straight jet fans.

“Banana jets” have been ordered for the tunnels Balmenrain and Uznaberg (Switzerland) and Lefortovo (Moskau). Furthermore, we consider such jet fans for the tunnel Schweizerhalle (Switzerland) as the fans have to be installed between structural pillars that otherwise would block about half of the air stream emerging from the jet fan.

HBI Haerter has a vast experience conducting factory acceptance tests of jet fans and in translating the results of straight jet fans in order to predict their performance in a tunnel environment. On the other hand, we have not adequate measurements in order to quantify the aerodynamic benefits of “banana jets” compared with conventional jet fans. Therefore, we will conduct aerodynamic measurements in the tunnels Balmenrain and Uznaberg. The factory acceptance tests of the envisaged “banana jets” were successfully completed in April 2003.

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