Sound Attenuation Prediction **of High Speed Railway Sound Barrier with Actran**

Based on a technical interview with **Dr. Wenlin Hu, R&D Engineer, Vibration and Noise Reduction Laboratory, China Railway Design Corporation**

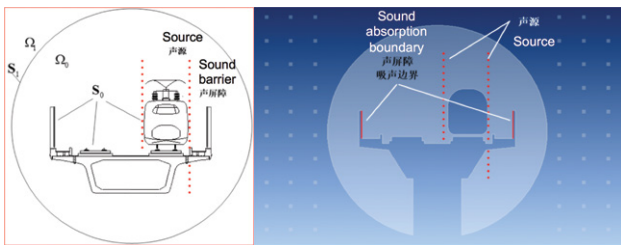
“In the past, we had a half-analytical formula with which we could only roughly calculate the vertical non-absorbent barrier. Now, we can accurately simulate the complex shape and sound absorption boundary of the sound barrier to determine its effective height and structure, and improve its efficiency in reducing noise.”

– Dr. Wenlin Hu, R&D Engineer, Vibration and Noise Reduction Laboratory, China Railway Design Corporation.

Background

The development of high-speed railways has brought many travel benefits to society over the past years, offering fast and convenient access to numerous downtowns cities. However, the related pass-by-noise has affected the sound quality of environments neighboring high-speed train lines. This has led to noise control and reduction becoming the primary problem faced by high-speed railway environmental governance. The noise emitted by high-speed railways is composed of wheel-rail noise, vehicle body aerodynamic noise, and collector system noise. The wheel-rail noise is most important, for which sound barriers are capable of effectively suppressing its propagation towards the surroundings, thus reducing the overall noise radiation level. It is therefore, a widely used method to mitigate noise emissions. Over the past years, Chinese high-speed railway engineers have designed vertical sound barriers, which are the result of long-term engineering experimentation and structural safety considerations.

In recent years, engineers have begun to rethink sound barrier design to achieve higher noise reduction and save construction costs. Therefore, an accurate and effective numerical simulation method is needed to guide and help engineers in designing more performant sound barriers.

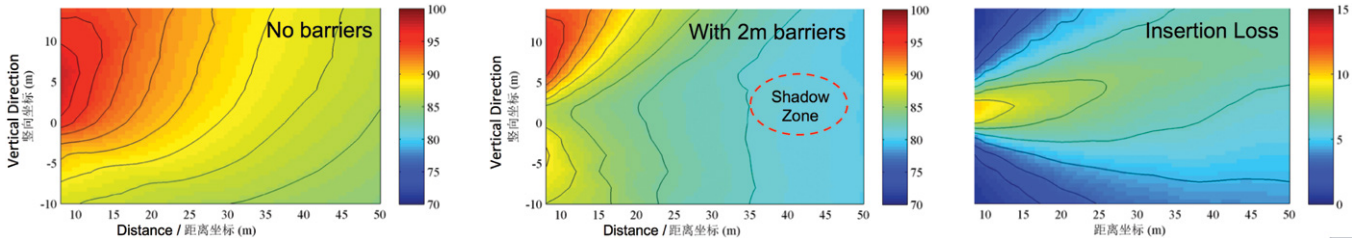


Industry Challenge

The main task of the Noise and Vibration Reduction Laboratory of China Railway Design Corporation (referred to as CRDC, former Railway Third Survey and Design Institute Group Co., Ltd.) is to perform research and development of noise and vibration reduction engineering technologies. Using test and simulation approaches, the laboratory develops noise and vibration products, promotes engineering applications, and provides noise and vibration technology services.

Prior to using simulation, the typical design process of a high-speed rail sound barrier was to involve semi-analytical formulas to predict the insertion loss of sound barriers. By using this approach, the noise source and realistic surrounding environment cannot be fully described. The obtained results demonstrated large deviations when compared to reality. A solution that is able to consider the sound barrier absorption coefficient, complex geometrical forms, and the realistic environment was needed to achieve better noise barrier performance.

Dr. Wenlin Hu, an R&D Engineer at the Vibration and Noise Reduction Laboratory, said: “Before using Actran, it was difficult to integrate acoustic research into the sound barrier design. The semi-analytical formula could only be used to verify a reduced number of sources during the design process. The insertion loss could not be accurately predicted for complex geometries and acoustic absorption properties, and the products studied were limited to vertical barriers geometries.”



Note: Noise reduction index or insertion loss refers to the difference in-between the sound pressure level at a certain position before and after the installation of the noise barrier. It is an indicator to describe the noise reduction performance of the noise barrier.

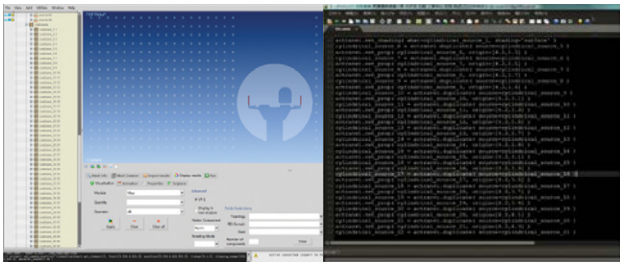
Solution

In the design process of a sound barrier, it is necessary to create a large-scale model around the high-speed train and perform a wide-frequency range analysis. Actran can meet these requirements with its modeling capabilities for near and far field acoustic propagation, distribution of multi-sound sources in near and far-field, and the capacity to model complex geometrical configurations as well as material property effects. Dr. Hu added: “In addition to the infinite element technology, the ability to consider the complex shape of the noise barrier andthe sound absorbing materials modeling are the main reasons why we chose Actran. Actran meets our needs of the product development for forecasting noise reduction.”

Due to the complexity of the high-speed rail acoustic source, a large number of acoustic sources need to be defined in the simulation model in order to simulate the distribution of the noise sources on both sides of the train and outside the bridge web. Actran’s API makes it easy to quickly define multiple sources via command line or script files.

Result

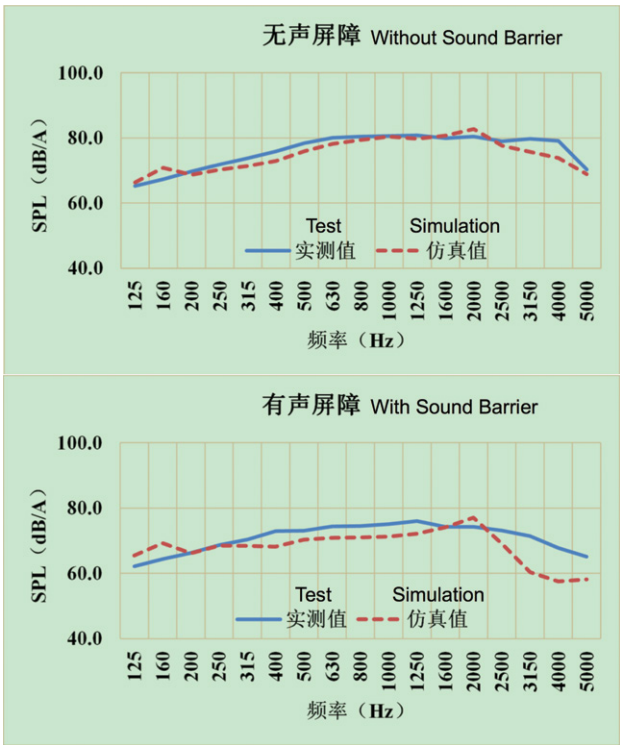
Not only does Actran achieve accurate simulation results compared with the test results, it also simulates complex geometric forms and sound-absorbing boundary conditions. Its efficient and easy modeling method provides a great solution for developing complex and better products. It has been applied in the research and development of high-speed railway sound barriers and is expected to be applied to the design of new mitigation solutions for ordinary railway and urban rail transit projects.



Use of Actran’s API to quickly generate line sound sources, and use of the Loadcases command to avoid sound source interference effects and achieve incoherent superposition of sound sources.

About China Railway Design Corporation

China Railway Design Corporation. (referred to as CRDC, former Railway Third Survey and Design Institute Group Co., Ltd.), is the only survey and design enterprise under CHINA RAILWAY(CR). It was established in 1953 and focuses on railway, urban rail transit, highway, etc. It is a large-scale enterprise group engaged in project general contracting, survey, design, consulting, supervision and project management. It is of outstanding advantage for high-speed railway, heavy-duty railway, comprehensive transportation hub, urban rail transit, new rail transit, maglev transportation, etc.



Actran simulation results and test comparison