Newport Beach, CA, USA
inter-noise
1995 July 10–12 95

STUDY OF THE ACOUSTIC FIELD ON THE HIGH SPEED TRAIN ETR 460, THROUGH MEASUREMENTS AND COMPUTER SIMULATIONS

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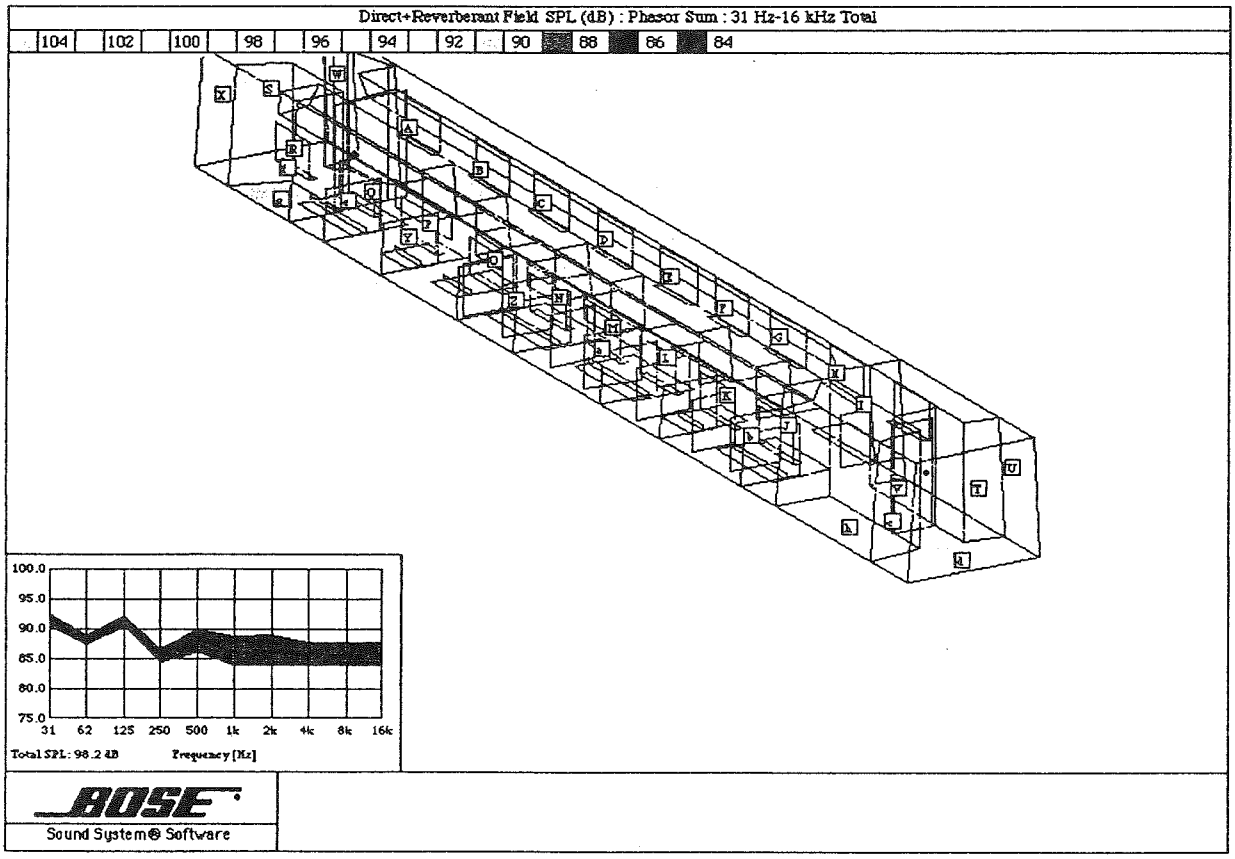
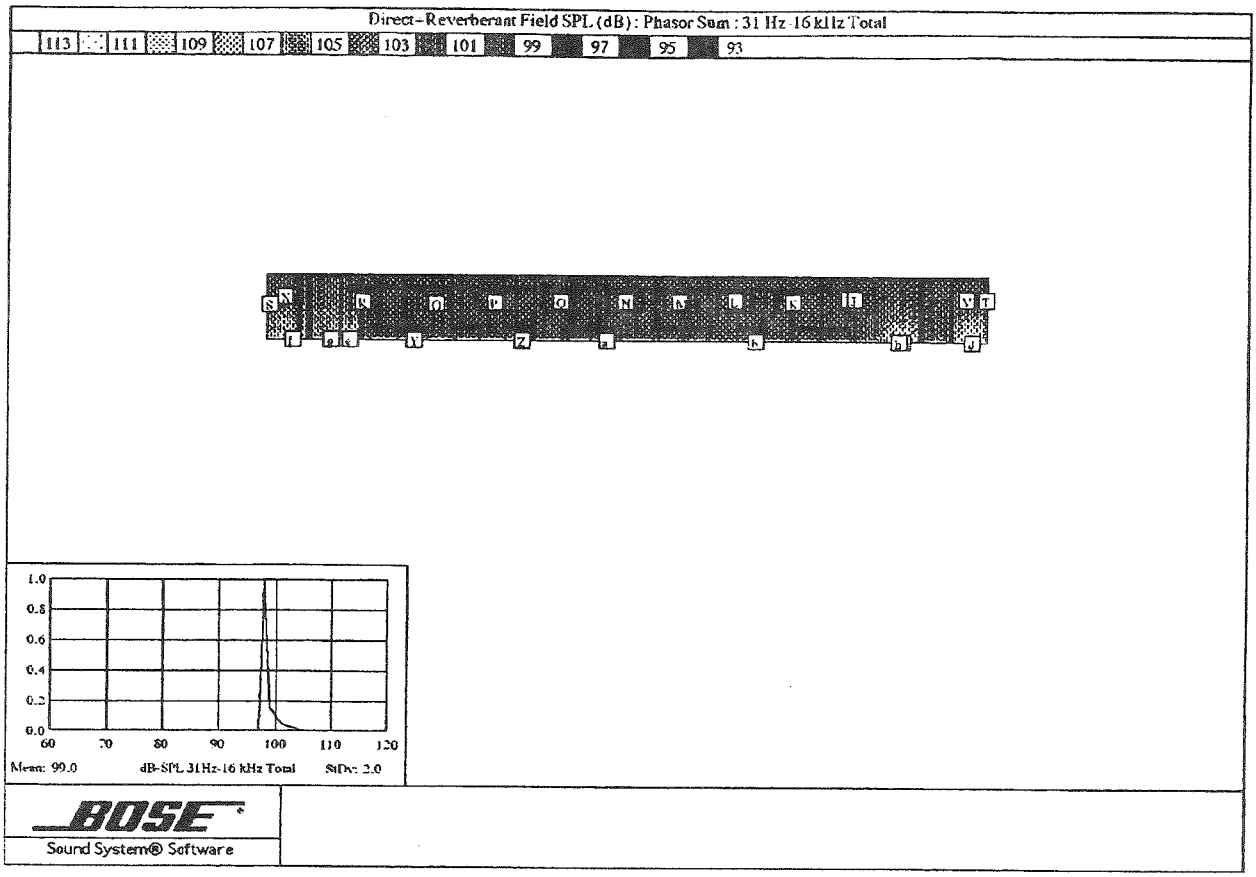
The noise emitted by high - speed trains is due to different factors, such as: speed, aerodinamic profile, wheel to track contact, pantograph to wire contact, mechanical equipment.
The main noise source in a train is caused by the rolling of the wheels on the tracks. The vibrations originated here are trasmitted through the bogies to the whole car, and are the main cause of the low frequency noise perceived by passengers.
This happens also inside the passenger coaches of the train ETR 460.
Beside this noise and vibration phenomenon vehiculated structurally, there is the airborne noise, also reaching the passenger's ears.
This noise is audible expecially when the train is running alongside a reflectant surface, or entering a tunnel, or crossing another train coming the opposite direction.
The non - omogeneous structure of the train (different coaches connected) causes more noise where the joints are, due to air turbolences and easier penetration of bogie noise through the thin layer of the elastic connection.
The noise and vibration generating discomfort to the passenger are mainly:

- low frequency vibration and shaking of the passenger seat
- airborne noise, measurable at passenger ears height above the seats.

The carriages in high speed trains are studied to solve some of these problems, mainly through the use of passive antinoise systems, such as sound insulating substaces placed in the thickness of the cabin wall.
the seats are usually covered with sound absorbant materials, and contribute to the noise abatement in the compartments.
The noise is not equally distibuted along the coach lenght, and it depends from the position of the air outflows of the conditioning system, the hydraulic system and other noisy devices.
The inside of a train coach can be schematically represented with the passenger compartment in the center, two platform at each end for the circulation (connection with entrance doors, door going to the other coaches, toilets, passenger compartment), and the bridges connecting tha carriages.
The pourpose of this study is to simulate the achoustical behavior of the train cars with means usually adopted in architectural acoustic (design or restoration of theaters and concert halls).
This because the acoustical comfort in a train is also connected with good sound distribution and high intellegibility of speech.

The first phase was the computer simulation, performed with the program "Modeler".
A 3D model of the inside of the coach was made, as close as possible to the real object, and anyway significant for the achoustical similation.
To represent the achoustical response of the car, noise souces were placed in different spots, according to data of sounds pressure measured aboard the train when it was running 200 km/h.
The noise level data were measured with phonometers, while pictures were taken with a video camera.
This allows a better analisys of the data in the laboratory, and a more precise placing of noise sources on the 3D computer model.
A second fase will consist in a model analisys of the train structure performed with a FEM-FEA computer program.
The comparison of the different data allows a better understanding of the model, for improving the overall vibroacoustical comfort of the train.

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1.0 0.8 0.6 0.4 0.2 0.0
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Mean: 99.0
dB-SPL 31Hz-16 kHz Total
StDv: 2.0
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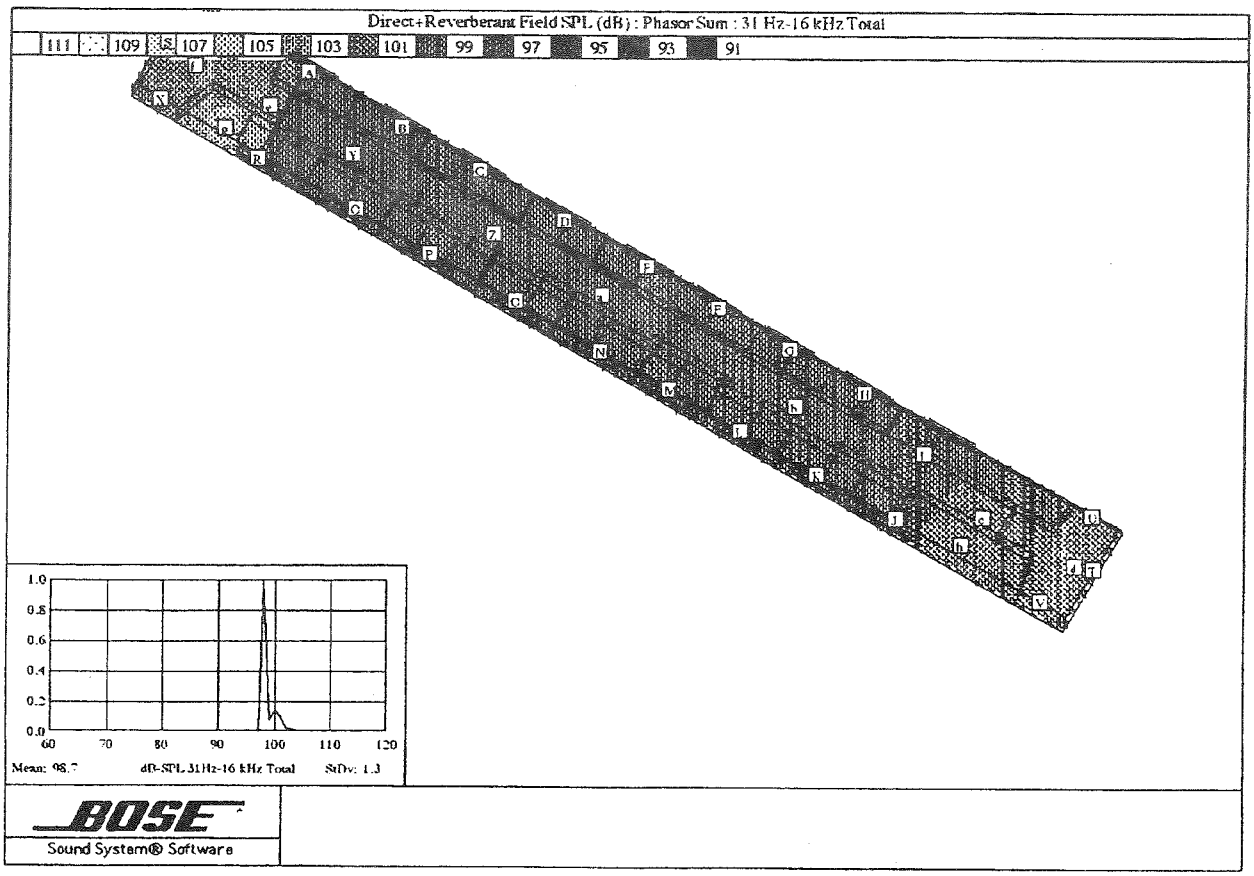
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StDv: 1.3
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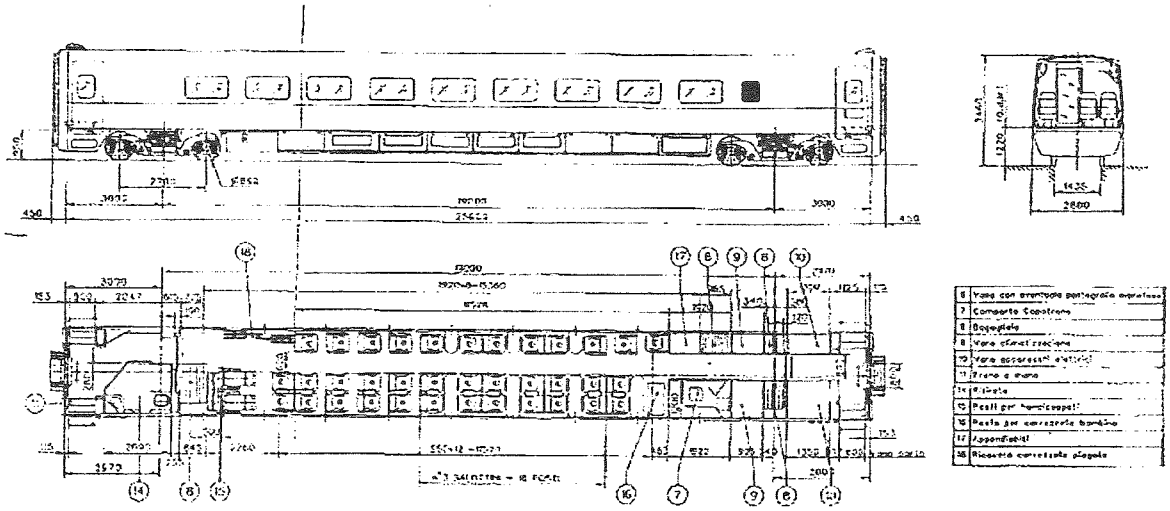

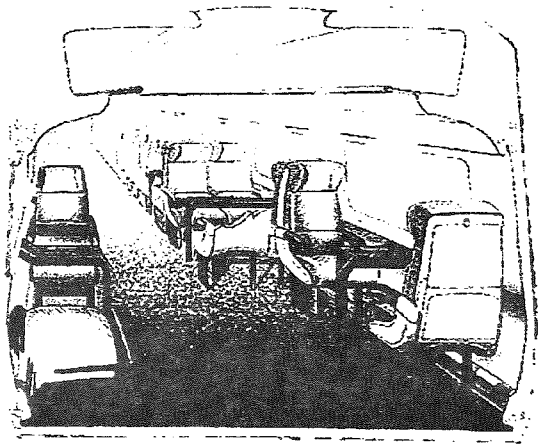

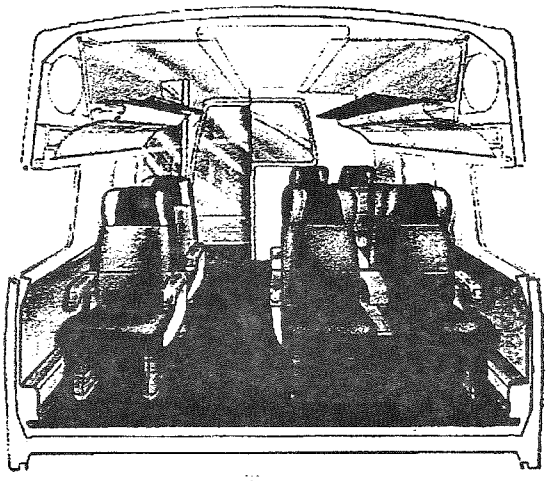

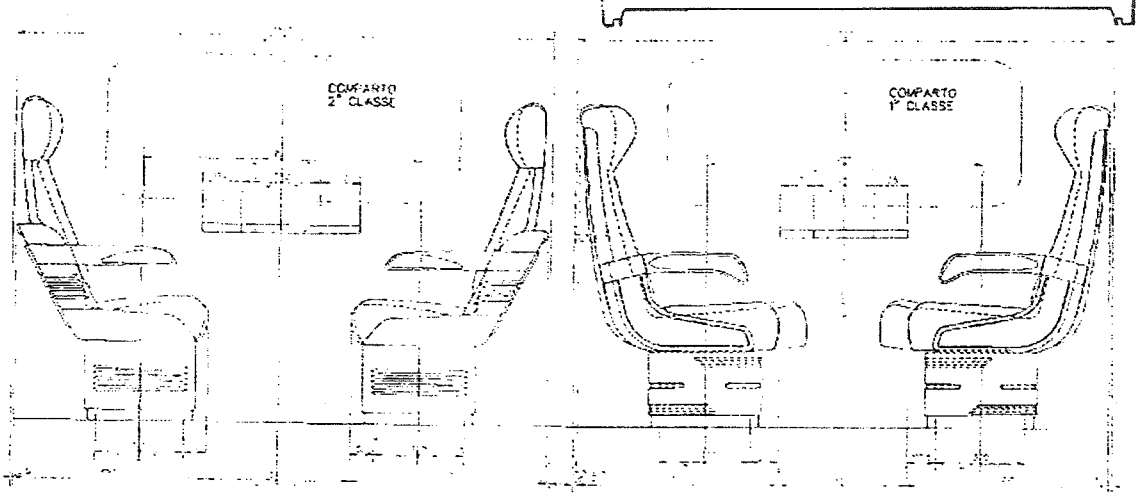
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