Comparison between several railway noise prediction models and measurements. Case study: Italian railways.

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Considering the great variety of railway noise prediction models, there is a problem regarding the choice of a standard in a country without its own model. Even once the most suitable model has been chosen, it is necessary to make changes, adaptations and adjustments when applying it to a real case. The input data for the models also varies.

The main differences between the most common models used in Europe to calculate emission levels are:
- Train length and speed (Scandinavia).
- Percentage of disk brakes of the train and type of train (Germany).
- Type of engine and number of wheels (UK).
- Train speed (Austria).

Therefore, the results can be as different as the input data and the calculation methods of each model.
Consequently, a real case in a very specific and well characterized context has been studied and several European models have been compared. All the necessary parameters for each model have been introduced and the variations between these models have been analyzed.

To make a qualitative and quantitative comparison, experimental measures have been made, characterizing the noise sources. In order to simplify the problem and to avoid deviations due to different propagation models, the measurements were carried out in free field conditions that were verified before measuring.

The measurements were done following ISO 3095 *“Railway applications – Acoustics - Measurement of noise emitted by railbound vehicles”*

The instruments used were class/type 1 (B&K 2260) and all the environmental guidelines were followed in order to achieve valid measurements. More than 50 train pass-bys were measured and several Italian trains were characterized, among other, in terms of length and speed using a tachymeter.

An automatic trigger was set up to record LAF and frequency values. All data were processed and LAeq, SEL and TEL were calculated for each train pass-by.

In addition, the necessary adaptations of each model with respect to the real situation were made in order to obtain the most precise results.

A first simulation was carried out using the Lima 5.0 software. Speed, category, number of wagons and number of trains during the period studied were taken into account to set up the model. Regarding the railway track, the input data were: speed limit, track type, type of construction and individual performance of each train regarding the speed.

In order to obtain similar results between measurements and simulations, many different attributes must be taken into account. Relating Italian categories to those existing in the European models is one of the most difficult tasks. Is also very important to set up the model with the railway track type, joints and type of construction.

Thus, an attempt was made to draw up a comparative study of the deviations and necessary adjustments when using a model created with conditions different from those of the real situation.

Taking into account the available input data and how the standards are implemented in the simulation software, the lowest deviation between simulated results and the measurements were obtained with the Dutch RLM2 with ISO 9613 propagation.

	LA eq, period studied (dBA)						
	Measured	RLM2	RLM2 ISO	SRM2/ END	HARMO-NOISE	MSZ 15036	OEAL 30
1	**70,2**	67,8	68,5	67,8	67,6	65,9	64,6
2	**75,2**	73,9	74,8	73,9	73,8	73,2	70,8
3	**75,2**	74,3	75,1	74,3	74,2	73,4	71,5

Table 1. Main results of the simulations.

It is important to emphasize that lower differences between the measurements and the simulation can be obtained by changing other parameters of the models.

A follow-up to this initial phase will include in the future the study of the most important European prediction standards, and the comparison between the models implemented in *Lima (5.0, 7812 B)* and *SoundPLAN (6.4)*. The aspects that will be studied are the accuracy of each model, the input data required by the simulation programs, the difference of results and the difficulty and speed of each model in both programs.