ACOUSTIC ANALYSIS ON THE RIYADH METRO

Noise and vibration modelling is a key element in the planning and design of urban rail systems, and the issues are multiplied when you venture underground....

The challenges of noise attenuation in underground rail systems are very different to those of surface running networks. As well as train operations themselves, measuring and mitigation against excess noise from essential equipment is a complex process that requires detailed analysis and planning. Greek specialist Alpha Acoustiki carried out such an acoustic analysis for just one part of the Riyadh Metro, one of the most interesting metro projects currently underway in the Middle East.

Specifically, the objective of the acoustic study undertaken was the Tunnel Ventilation System (TVS) of Metro line 3. Alpha Acoustiki's report analysed the noise and vibration generated by the Over Track Exhaust (OTE) and Under Platform Exhaust (UPE) fan rooms and the Smoke Fan Rooms (SFR) of a typical deep underground station, including calculations about the performance of silencers and partitions in the TVS.

The analysis included noise transmission through duct and shafts as well as through walls and floors to adjacent areas.

Noise calculations

In order for this study to adequately define the issues and set a basis for any future noise control strategy, the following aspects were considered:
- Calculations concerning noise propagation inside and between rooms
- Calculations concerning the duct network and the air diffusion system.

The acoustic spectrum of the noise sources provided by each equipment manufacturer was introduced in the acoustic software and all calculations were based on these data.

The first step in the process was for Alpha Acoustiki's team to calculate the noise levels (dBA) inside the station's technical rooms, measured at 1.5m above floor level in both common operation and emergency scenarios for OTE/UPE and SFR fan rooms.

In addition, it was important to understand the noise level propagated to the wider environment, as well as the track and platform areas. This was estimated given the previous results as input data (spectrum at end point routing) in two scenarios: Platform screen doors closed and open.

In the first case, the closed platform screen doors functioned as an important sound attenuation measure, consisting of 22mm laminated safety glass that contributed to a sound reduction of at least 20-22dB. In the second case, Alpha Acoustiki took into account a train stopped very close to the platform screen door to simulate the noise emitted through the small airgap between the train and the screen.

Another element under consideration was noise control measures from the plant rooms to adjacent areas which may affect metro passengers and employees.

To avoid the transmission of noise and vibration from the fans to these sensitive areas, the maximum sound insulation is needed for the walls/floor structure, the required vibration reduction method, as well as the necessary noise reduction index of acoustic doors were proposed.

Noise analysis

Consequently, Alpha Acoustiki ended up with the proposed insertion losses, required in order to achieve the required sound levels inside the technical rooms as well as the sound pressure levels at the ends of each duct/shaft route.

According to the results presented in this acoustic study, the noise levels after the installation of silencers inside the technical rooms, in public areas at platform level and at exterior side were lower than the US Occupational Safety and Health Administration's recommended limit.

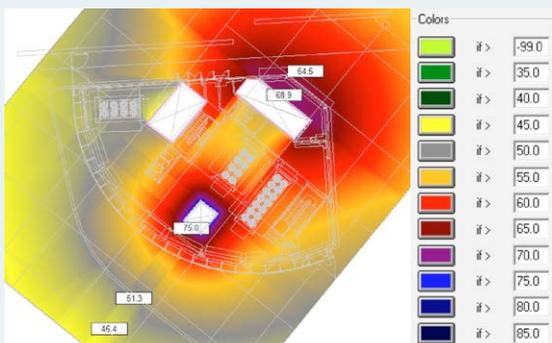They also fulfil the noise criteria and sufficiently silent to allow any kind of PA/GA system works.
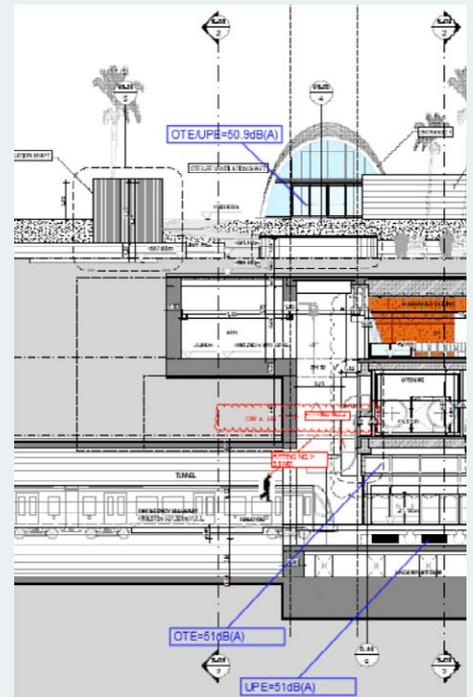
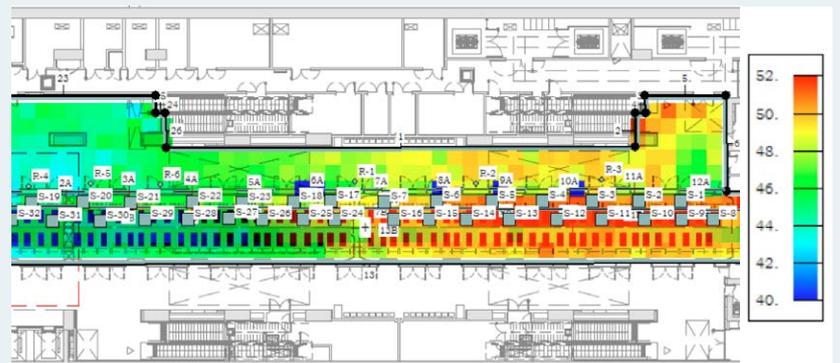▲ **Noise levels emitted from OTE/UPE towards the platform and the atmosphere.**

▲ **Prediction of the noise level propagated from OTE/UPE and SFR shafts to the atmosphere.**

▲ **Prediction of the noise level propagated from the OTE/UPE system to the platform area.**