



# SIKA AT WORK

## Manufacturing of sound-absorbing railway noise plates, Athens-Piraeus Electric Railway, Section 1

CONCRETE PRODUCTION: SikaRapid®-2, Sika® ViscoCrete®-210 HE, Sika® ViscoCrete®-125 P, SikaFiber® PP-940/50, SikaFiber® PP/18

ELASTIC JOINT SEALING: Sikaflex®-11 FC+

BUILDING TRUST



# PRODUCTION OF SOUND ABSORBING RAILWAY NOISE PLATES



## GENERAL

Transportation is essential for economic competitiveness, trade, economic and cultural transactions. With the adoption of the European Commission's 2001 White Paper on a single transport policy, the framework for a common European transport policy has been set, aiming to achieve a sustainable restoration of the balance between modes of transport, decisive efforts to combat congestion and focus on safety and quality of services.

Railways remains a mean of transport with significant potential, which is nowadays seriously re-integrated into daily transportations.

The European Union's policy of increasing the rate of rail use has as an immediate effect the simultaneous elevation of the levels of environmental noise in the areas adjacent to the railway line. High noise causes considerable nuisance and adverse effects to the ability to work and to the health of people exposed to high levels of noise. The debate on railway noise has become particularly important in many European countries as rail transport is growing and plays a more important role in achieving a more environmentally friendly transport. For the implementation of the sustainability targets set by the European Commission, the environmental impacts of railway operations (noise, carbon emissions, energy consumption, etc.) should be minimized to support the shift towards rail, in order to reduce the environmental impact of transport as a whole.

## PROJECT DESCRIPTION & DEMANDS

The renovation of the line of the former Athens-Piraeus electric railway (Line 1) from Piraeus to Kifissia began in 2003 with the refurbishment of the stations. The refurbishment had to take place for reasons of safety and reliability of the network, mainly due to age, but also due to maintenance costs, as the latter determines the proper & health functioning of transport organizations. In addition, speeding and noise reduction were key requirements that were taken into account during the renovation process. This refurbishment has brought about a change in the entire line. The whole underground part had to gain a fixed substructure design – meaning the removal of the gravel - as well as the larger part of the restored line from Faliro to Kifissia. The term "fixed substructure" is associated with the construction of concrete panels, which are positioned on the line between the rails and at a short distance from the outer sides of the rails. Of the 23,5km double-track, the 15km were designed to be steadily substructured and the remaining 8,5km with gravel.

The new type of substructure is better, as it offers better rolling quality without gaps on the rails and clearly reduced maintenance and downtime. However, mainly due to the increased speed and vibrations produced by train circulation and the dynamics of the trains themselves, the noise is almost transferred unchanged through the soil to the surrounding area. There is production of airborne noise, as well as vibrations in the ground causing a nuisance.

In order to cope with the generated noise, the installation of sound absorbing plates in the structure of the fixed substructure was examined and evaluated. The goal of sound absorbing plates is to absorb part of the incident sound. The great advantage of this solution is that each sound absorbing plate is an additional piece that is placed over the existing infrastructure, immediately changing the noise that the tram generates when passing through the point. Nor the sleepers, neither the sound absorbing plates are apparent, the latter reaching the rail height. This solution also offers the advantage that it can be replaced either due to wear over time or due to damage.

#### SIKA CONTRIBUTION

Sika admixtures were used for the precast concrete slabs. The high performance superplasticizer/high range water reducer **Sika® ViscoCrete®-210 HE** in liquid form/**Sika® ViscoCrete®-125 P** in powder form and **SikaRapid®-2** strength accelerator were incorporated in the mix. Using this combination of admixtures, the mix design was optimized on the one hand, while on the other hand we achieved increased plant productivity (faster de-moulding, shorter mould re-use times) and reduced costs of disposing and repairing produced products, as well as reduced cost for steam curing. **Sikaflex® PP-940/50** synthetic macrofibers were also incorporated into the concrete mix at a dosage of 2kg/m<sup>3</sup>. **SikaFiber® PP-940/50** are state-of-the-art, high performance synthetic macrofibers, based on innovative High Performance Polymer technology. Their main advantages include:

- The possibility to reduce or totally replace the conventional reinforcement for ground slabs
- Their geometric shape, which is specially formed to resist extrusion from the cement paste
- Increasing residual strength (Residual Stress) in plastic state
- Increased mix consistency and reduced possibility of separation
- Their composition, as they do not rust and they are alkali resistant
- Reduce wear on equipment in relation to metallic fibers
- Safety and ease of use, compared to traditional methods
- Faster completion of the project, as grid placement work is not required (in ground slabs)
- Lower project costs due to reduced material and labor costs

Their huge advantage is that they limit cracking and the extent of created cracks. This produces a concrete that requires considerably less steel reinforcement than a conventional reinforced concrete, but it is still as durable if not even more.

**SikaFiber® PP-940/50** macrofibers are used in many types of floor screeds to improve the workability of fresh concrete, while in the hardened phase they increase quality and durability by controlling crack distribution and reducing shrinkage. In the hardened phase, no individual wide range cracks occur, but they are rather divided into many, smaller and finer with significantly reduced risk of damage. Fiber reinforcing also significantly improves the strength of the mortar in impact and fracture. The use of fibers in concrete slabs, in general, significantly reduces shrinkage at the early stage and assists in the stability of the mixture. The fibers also result in improved flexural strength and increased impact resistance.

As a result, the reinforcement can be reduced and the distance between the required joints can increase. The fibers also help reduce the brittleness of the edges of the construction. Consequently, the durability of elements produced with reinforced concrete increases significantly.

The 1-component, elastic, polyurethane joint sealant & adhesive **Sikaflex®-11 FC+** was used both for plate bonding and for joint sealing between the plates. **Sikaflex®-11 FC+** features good mechanical strengths and resistance to weathering (environmental aging), while being sound and vibration-absorbing.

#### SALES IN VOLUMES:

Precast high range water reducer, liquid **Sika® ViscoCrete®-210 HE**: 7,5 tn

Precast high range water reducer, powder **Sika® ViscoCrete®-125 P**: 1,0 tn

Strength accelerator **SikaRapid®-2**: 7,5 tn

Synthetic, state-of-the-art macrofibers **SikaFiber® PP-940/50**: 11 tn

Elastic, polyurethane joint sealant & adhesive **Sikaflex®-11 FC+**: 13.200 sausages

#### PROJECT PARTICIPANTS:

Owner: **Statheres Sygkoinonies S.A.**

Contractor: **KASTOR S.A.**

Production of precast sound absorbing panels: **ASPROKAT S.A.**





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**Sika Hellas ABEE**  
15 Protomagias Str.  
145 68, Kryoneri  
Athens-Greece

**Contact**  
Tel.: +30 210 8160600  
Fax: +30 210 8160606  
[www.sika.gr](http://www.sika.gr) / [sika@gr.sika.com](mailto:sika@gr.sika.com)



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