ACCELERATED TINES TECHNOLOGIES FOR TRAM TRACKS

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ABSTRACT

The article presents a way to organize repair of a tram track in the street with a large traffic load. In connection with the special location of the facility, the key aspect in the choice of technology was a short period of work, with mandatory obtaining of high technical and operational parameters ensuring long-term and reliable operation of the rail track after reconstruction.

The contractor used a TINES LC–L XL type system, the main element of which is a prefabricated reinforced concrete plate 17 m long, with a built-in ERS-M module. The repair technology and the construction of tram tracks were chosen to limit the risk of a possible extension of the project implementation time. This was in line with the investor's expectations, the main goal of which was to spend not more than 60 hours to dismantle and upgrade.

Keywords: tramway, track, track superstructure, repair, accelerated technologies, TINES LC–L XL, Krakow, quality.

Background. *Grozhezetskaya Street is one of the busiest in Krakow. It is an important road route in the public transport network, since it connects two interchange hubs – Gregužecký square and the Central covered market. Plus, it has a considerable significance from the point of view of spatial access, since it allows to provide direct access to the city center by going to Ditlja Street, and also intersecting with Starovislava Street, which goes through the second largest cultural complex – the Kazimierz district, leading to the other bank of the Vistula River.*

Throughout the day, a high traffic intensity is constantly observed here.

All these factors indicate that when repairing a track in a given location, the manager of the infrastructure has many logistical and economic problems associated with the organization of the traffic. Long periods of traffic closure become very expensive, and in addition can lead to traffic collapse in this part of the city. Therefore, there was a need for such a technology of work that would improve the condition of the tram track, provided that the time for limiting traffic is minimized.

Objective. *The objective of the author is to consider the application of TINES technologies using the example of tram track repair in Krakow.*

Methods. *The author uses general scientific and engineering methods, comparative analysis, statistical method.*

Results.

State of the track before reconstruction

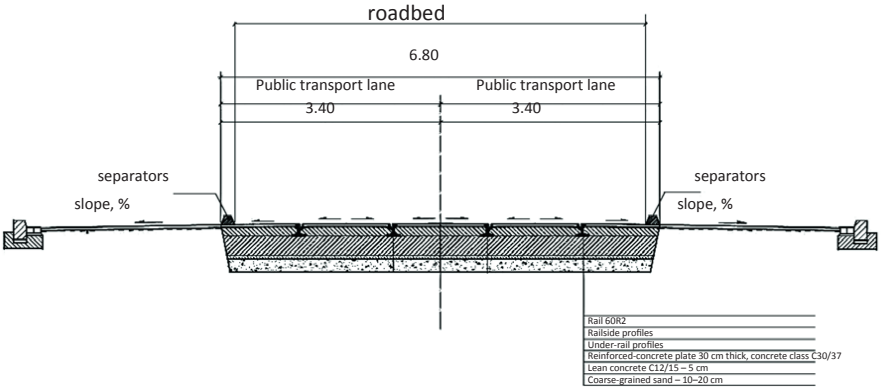
A tram track along the Grozhezetskaya street is separated from the roadway by means of concrete dividers, which do not allow occupying the lane intended for urban public transport to drivers of private vehicles. The introduction of separators was necessary to increase the traffic intensity of buses and trams.

The 17-meter-long repair site included a two-track fragment of the canvas, including the cross-road. The technical condition of the rail tracks, which was inventoried during a visit to the facility by specialists, turned out to be exceptionally bad. In the existing coating, numerous cracks in the asphalt concrete were seen, as well as the separation of rubber rail elements and rail fastening elements. Damage caused water to enter the tram tracks, which accelerated the growth of chips and cracks in the asphalt concrete pavement. In some places, especially large deformations were observed as a result of the rise of concrete plates.

The poor state of the roadbed created a threat to the movement of trams. It was found that the main defects were in the region of the transverse linear drainage. Road asphalt concrete covering, on which the city buses moved, also suffered rapid destruction. The matter has already reached the point where a rail track was detached from the concrete base in the tram track.

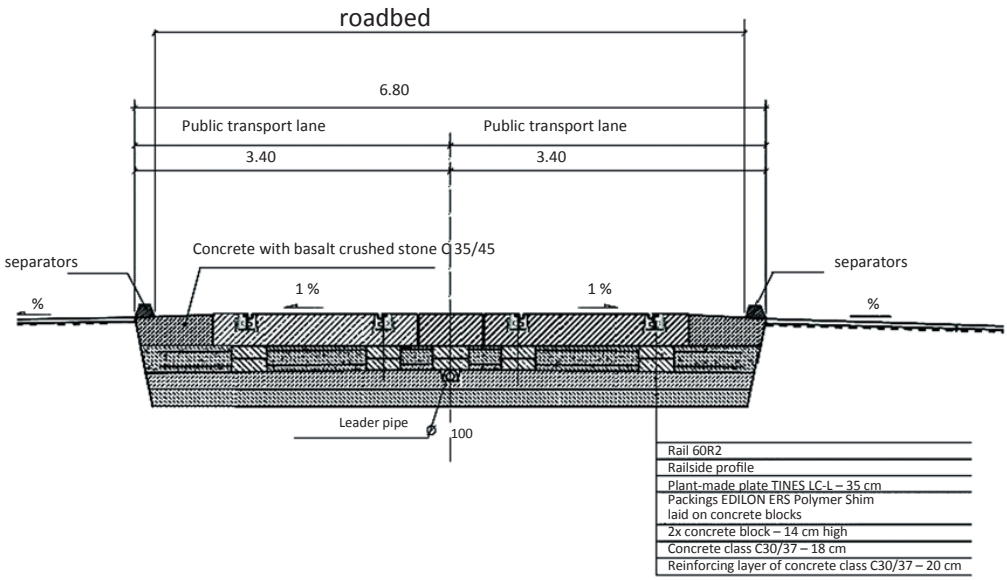
According to the design documentation provided to the contractor, the tram track was made in the technology of continuous rail support in a monolithic reinforced concrete slab. However, during the disassembly work, it turned out that the design of the existing roadbed is different from the one stated in the design documentation (Pic. 2), which led to an increase in the duration of dismantling.

Pic. 1. Significant cracks and chips in the covering.



Pic. 2. The cross-section of the tram roadbed on the street. Grzhezhetskay – the construction before the repair.

Pic. 3. Factory made plate TINES LC–L XL.



Pic. 4. Cross section of the roadbed on the street. Grzegorzeckaya with the TINES LC–L XL system.

Waiting for the investor

In connection with the above-mentioned features of the Grozhezhetskaya Street in the urban traffic system, priority for the investor in the reconstruction of the defective site was the reduction of the work time and the maximum conservation of traffic. The main objective was to limit the costs of changes in the traffic organization, the possible transport collapse at the site where the interchange hub is located, as well as the use of such a design track that would guarantee long-term operation with minimal maintenance costs.

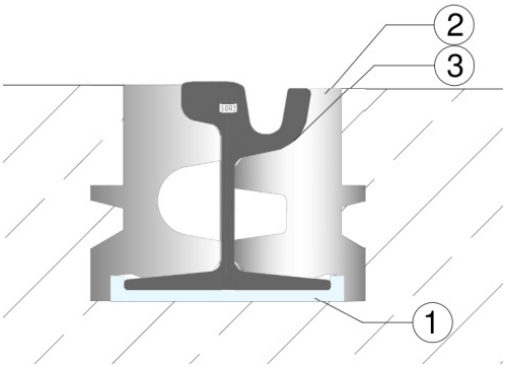
When choosing the covering, the key role was played by high resistance to the intensive movement of public modes of transport: trams and buses. The infrastructure manager wanted to minimize further costs for maintenance and guarantee users a trouble-free system for years to come. Due to the proximity of the building, including residential buildings, a significant factor was the provision of an acceptable level of vibration isolation, a reduction in the dynamic impact from passing vehicles to nearby buildings. High, but reasonable requirements of the investor already at the initial stage excluded most of the structures and technologies used in Poland.

Actually, then TINES applied to the investor, offering the use of the integrated railway-road cover TINES LC–L XL. It is designed to minimize construction and installation work when replacing the track superstructure and provides the highest quality standard. The technical and operational characteristics of the TINES LC–L XL coating guarantee a long service life, a minimal maintenance cost, and also an important condition for the city, such as vibration isolation, achieved by the solid support of the rail.

Features of the solution used

The integrated railway-road cover TINES LC–L XL consists of large-sized rebuilt reinforced concrete plates with fixed rails in the ERS-M protective layer fixed in a modular system at the factory manufacturing stage. The rail rests on the under-rail profile and is fixed by means of rail profiles made of rubber granulate.

The full factory availability of the TINES LC–L XL covering significantly reduces the time of its installation, which was the main goal of the investor. In addition, the proposed design of the track met the requirements for vibration isolation, as well as the minimization of work on the current content of the system during its subsequent operation. The ERS-M fastening method guarantees a solid, reliable and resilient rail support, noise reduction, and good electrical isolation of the rail line.



Pic. 5. Detailed section of the rail fastening system in the TINES LC–L XL system: 1 – solid under-rail profile; 2 – railside profile; 3 – glue for profiles.

Technology of work execution

The repair of the track was planned for the weekends, taking into account the decrease in traffic intensity at this time. Construction work began on Friday, in the evening hours. After the movement was closed and the preparatory operations (including the disconnection and transfer of the contact network) were completed, the asphalt concrete, the road concrete and the base plate were disassembled. For dismantling, excavators with hydraulic hammers, backhoe loaders and dump trucks with rear unloading were used.

The resulting trench was profiled and leveled, and the base was compacted using a 500 kg WACKER plate compactor. At the next stage, geotechnical surveys were carried out to assess the condition of the base characteristics (measurement of the compaction factor, the deformation modulus of the protective layer along the branch of its secondary loading, the value of which should be not less than 120 MPa). When it was confirmed that the base meets all the requirements, reinforcement was made in the form of reinforcing steel grids Ø8 with dimensions of 5000 x 2150 mm (in two layers). In the meshes, holes were cut out to accommodate the assembly concrete blocks, and on them special pads were put to adjust the position of the plate in the vertical plane. Laying a cover 17 meters long became a serious challenge from the point of view of high-altitude binding to the existing roadbed.

After completing the preparatory work, the stacking of the prefabricated slabs on the mounting

Pic. 6. Dismantling the existing roadbed.

Pic. 7. Laying of the slab TINES LC–L XL.

Pic. 8. The plates of the intertrack space of the factory made coating TINES LC–L XL.

Pic. 9. Laying the plate of the intertrack space in the sewerage area.

supports was carried out. The transfer of the slabs was carried out with the help of a five-axle truck crane with a maximum carrying capacity of 250 tons with a counterweight of 69 tons and a special telescopic traverse with a span of 10 meters.

When geodetic control was performed, the plates were adjusted in the vertical and horizontal planes. The marks of the rail head were controlled by the surveyor, the cases of deviations from the design documentation were corrected by adding / removing the thin adjusting pads after the plate was pre-raised. Following the installation of track slabs, similar technological operations were performed for the plates between the tracks, which were located on both sides of the sewer hatch located in the axis of the blade.

Space in the sewerage area was filled with concrete at the next stage of the track superstructure arangement. After laying the plates, termite welding of rails and grinding of welded joints were carried out. Then there was gluing of the railside and under-rail profiles in the places of welded joints in order to preserve the homogeneity of the structure of the track superstructureture. After the completion of the «formwork» made of expanded polystyrene on the sides of the plates and the protection of technological seams between the TINES LC–L XL plates and the sewerage hatch, the installation of a

Pic. 10. Installation of polystyrene foam formwork before pouring out the concrete mix.

Pic. 11. Rail coating after repair with the system of plates manufactured by the manufacturer TINES LC–L XL.

fast-curing concrete mixture C30 / 37 began under the plate.

A space between the existing track superstructure and factory-made plates TINES LC–L XL is also filled with fast-hardening concrete.

The finishing work included the filling with the elastic casting mass of Edilon Corkelast TO of joints between the monolithic concrete slab and the TINES LC–L XL track plate, the installation of drainage elements in the slab, and the pouring of the concrete mixture in the sewerage area.

Conclusion.

1. The described technology of track repair works and the construction of the tram track superstructure took into account not only the short time of closing the traffic, but also the risk of delays in the execution of certain stages of the program. This allowed satisfying the investor's expectations, the main of which was the time to decommission of the road bed for no more than 60 hours.

2. A 2x17 meter long single-track road with an intertrack space was dismantled and reinstalled using the integrated TINES LC–L XL railway and road covering for 59 hours.

3. The high factory readiness of covering of the tram track allowed to shorten the terms of the project as much as possible, and with them the deadlines for closing the street for tram, bus and automobile traffic.

4. The repair of the track in Krakow on Grzhezhetskaya Street was the first project in Poland, where large-sized plates of factory manufacturing were used. The task was not only to perform construction and assembly works, but also to manufacture prefabricates and transport them to the construction site.

5. The developed system of the track superstructure will help organizations, which manage the tram infrastructure, to repair and reconstruct damaged lines in places where the key goal is to reduce the time of traffic and ensure high quality of work with regard to vibration isolation and electrical insulation parameters. ●

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