

# LANDSCAPE RENOVATION OF THE HISTORICAL RAILWAY LINE IN RUSE

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**Abstract.** Transport and communication landscaping is the link between landscape planning and transport design. A different proposal for the landscape renovation of the 200-kilometer railway line "Ruse - Varna" within the framework of its passage through the city of Ruse has been made. The proposal optimizes the existing railway line and addresses anthropogenic factors in urban areas, showcasing the synergy between landscape architecture and transport infrastructure development. The result will be a better sustainable urban environment.

**Keywords:** Transport and communication greening, Landscape renovation, Railway line

## 1. INTRODUCTION

The ninth main railway line, "Ruse-Varna," is a single-track line. It is electrified and has a standard gauge, and an official length of 142 km. Despite its huge logistical importance since its opening in 1866 [1, 10], the uneven development of the regions along the line and the persistent financial problems the Bulgarian railways have faced have, over time, led to a number of restructuring measures, such as reduced passenger and freight services, closure of stops and stations, etc., which reflect the changing transport requirements, but represents a setback for the development of the rail transport in Bulgaria.

To date, the city of Ruse is one of the largest Bulgarian cities with a population of over 100,000, who use a variety of modes of transport within the settlement. Important road, rail, water, and air connections pass through the city. There is a public transport system including buses and trolleybuses, which provides partial service. For intra-city movements, road transport is the most widely used.

This is the reason why motor vehicles are the main source of air pollution. Thus, the green system of the city of Ruse becomes a vital urban component that reduces

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<http://doi.org/10.7546/EngSci.LXII.25.03.07>

both air and noise pollution caused by traffic. In the urbanised area of the city of Ruse, public green areas total 1,208 ha, with 679 ha of parks alone. A characteristic feature of the green system of the city is its uneven distribution [2]. Structurally, the green system consists of core and complementary landscapes that offer ecosystem services and ecological benefits to the city's residents.

Against the backdrop of the major elements of the transport services listed, in 2020, the National Company "Railway Infrastructure" considered the possibility of developing a project proposal for part of the Ninth Railway running through the city, to use it as an urban railway. Urban rail is an environmentally friendly alternative for getting around in urban areas, significantly reducing air emissions. The route of the historic railway line in Ruse allows for the construction of this type of urban transport, thus serving a larger part of the city.

## 2. HISTORY

The beginning of the railway network in Bulgaria was set on 1 September 1861 with the start of the construction of the first railway line between Ruse and Varna. This important transport link was built under the direction of an English company owned by the brothers Trevor and Henry Berkeley. The original idea was that building the new railway link would improve communication within the Ottoman Empire and connect London with Constantinople. After its completion in 1866, the Rousse-Varna railway became an important part of the Paris-Constantinople international route, which also carried the famous Orient Express from 1883 to 1885 [10, 3].

The establishment of the Ruse (Ruse-East) station accompanied the opening of the Ruse-Varna railway line in 1866. It marked the beginning of the construction of additional stations, such as the Ruse-Halta station and the Port station [3].

Despite the impossibility of implementing the original project, within the newly liberated Bulgarian state, the enormous importance of the railway network was understood, and in 1885, a law was passed by which the state management of the railway infrastructure was carried out by the Bulgarian State Railways. After the adoption of the law and its entry into force, the Ruse-Varna line was bought out by the Bulgarian government and became the exclusive property of the state [2, 3].

Over the years, Bulgaria continued to develop its railway network, building new lines and purchasing more and new locomotives and train sets.

During the 20th century, the country made significant progress with the electrification of rail transport.

To date, despite the political and financial changes in Bulgaria over the last few decades, rail transport remains key to the country's economic development and its connection to the European Economic Area.

### **3. PROPOSAL FOR AN URBAN RAILWAY NETWORK IN THE CITY OF RUSE**

#### **3.1 Some urban planning problems of the City of Ruse**

The transport infrastructure of Ruse includes roads, railways, water, and air transport [2].

The city faces problems such as air pollution, noise, and a lack of sufficient recreational and sports areas that negatively affect the quality of life of its inhabitants. To improve the living environment, sustainable planning and transportation solutions, and pollution control are needed.

#### **3.2 Urban transport in Ruse**

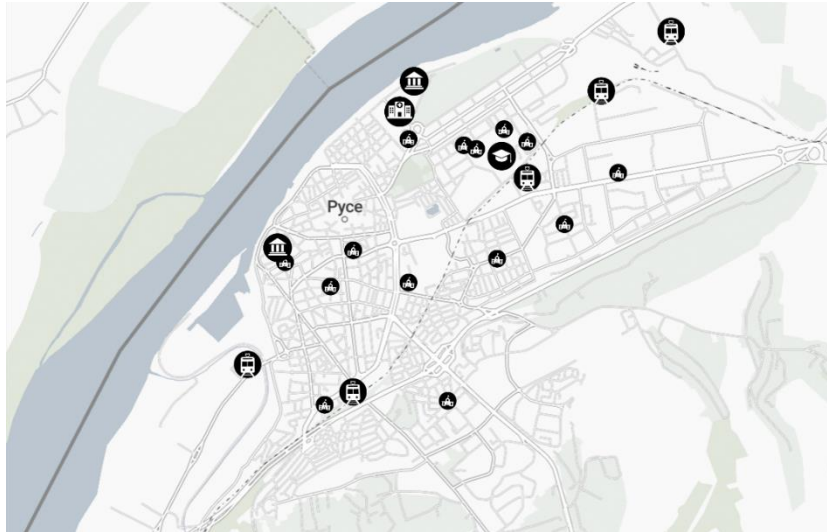
The mass urban public transport (MUPT) system in Ruse includes bus and trolley-bus lines [2]. Based on a social survey conducted during personal short-term visits, it was observed that citizens are not satisfied with the transport services provided. The main problems mentioned were irregular timetables and old vehicles prone to breakdowns. Many areas, especially on the periphery, are not well connected to the rest of the city. This leads to poor air quality and public health, with many citizens preferring to use private cars.

#### **3.3 The Urban Railway Transit**

In Bulgaria, the development of urban rail transit is mainly concentrated in Sofia, where trams and metropolitan railways are used. The reason is that rail transport is mainly built in cities with a population of over a million people, while urban railways are typical for megacities with a population of over three million.

In Ruse, there is a 26-kilometre-long internal rail network, which is important for passenger and freight transport and connects different parts of the city.

According to the analysis in [11], the city's rail network supports the local economy by providing reliable transport for industry, reducing congestion, and offering an environmentally friendly alternative to road transport. This would contribute to the development of a multimodal transport system. Combining modes of transport is part of a sustainable strategy for the development of transport schemes in European cities, and in this case, the rail infrastructure built in the city is a solid basis for achieving an excellent result in projects in this direction - Fig. 1.



**Fig. 1.** Infrastructure services based on the railway network of Ruse [based on Google maps]

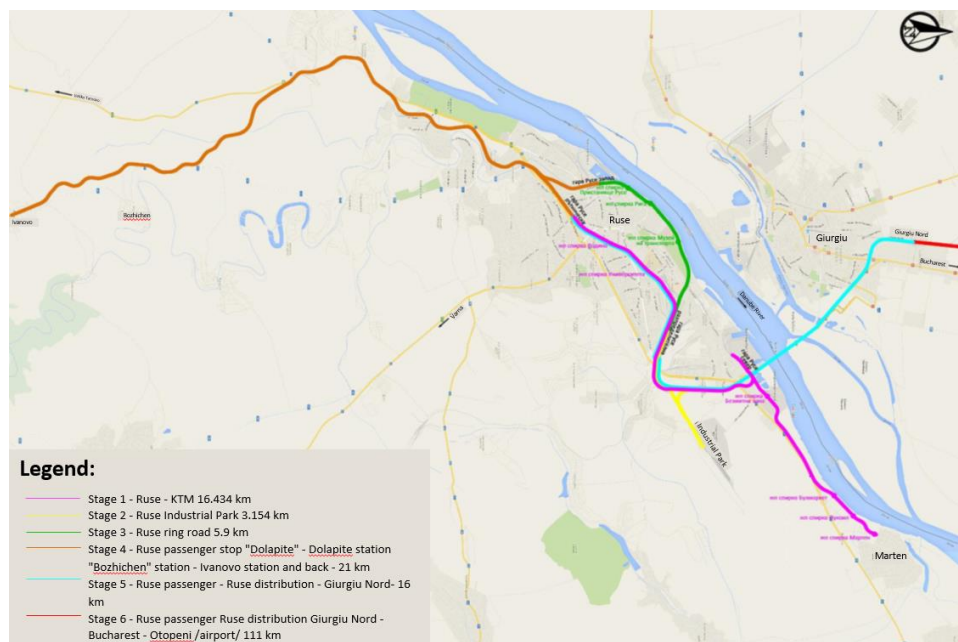
### **3.4 Improvement of transport connectivity of the town. Ruse through the construction of an urban railway - project analysis 2020 [12]**

The concept of adapting Ruse's existing railway infrastructure for urban rail systems has attracted the interest of specialists in the field. The first big step in this direction was made in 2020 by the National Company "Railway Infrastructure" (NRIC). The project is still at the stage of pre-investment studies, due to several objective reasons that hold up its progress. The necessary information from [12] was provided by Assoc. Prof. Eng. Mario Galabov (see Fig. 2 and Fig. 3 of [12]).

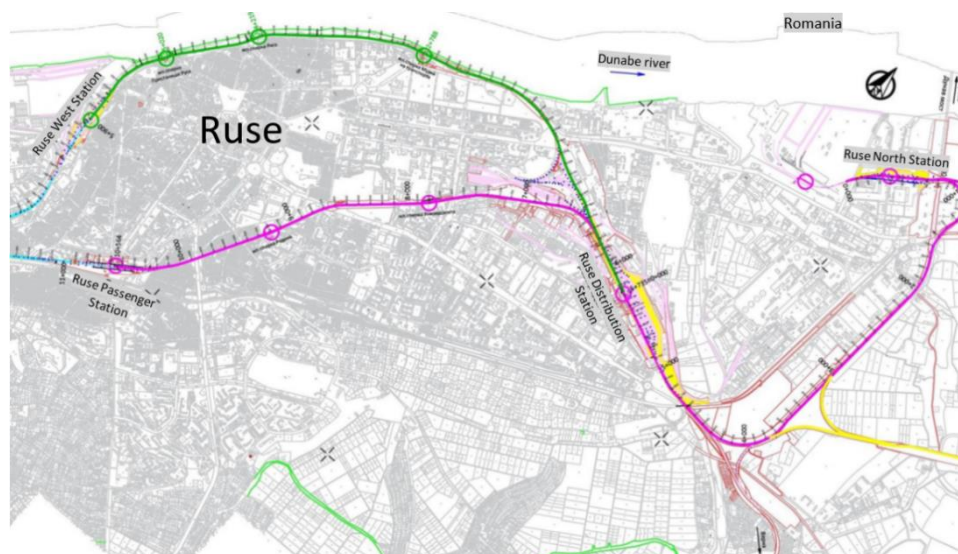
The feasibility study outlines a six-phase project to enhance connectivity between urbanized areas of Ruse and nearby settlements through an integrated rail-based transit system.

The initial three phases focus on establishing routes within the city, specifically Ruse 1 KTM "Marten," Ruse 2 Industrial Park, and Ruse 3 Ring Road. The third phase proposes a 5.9-km route with key stops, including the Port of Ruse and Transport Museum, as depicted in Figs. 1 and 2 from [12].

This initiative aims to introduce a modernized rail-based urban transit network in Ruse, leveraging historic infrastructure alongside contemporary solutions for the creation of a cohesive system. The project is expected to boost public interest in transit infrastructure and enhance urban connectivity. A key advantage of the plan is its reliance on existing resources, which helps minimize investment costs. Moreover, by linking with the national rail network, major investments will primarily focus on the construction of new stops, ensuring efficient and cost-effective development.



**Fig. 2.** General scheme of the future development of the Ruse urban railway [12]



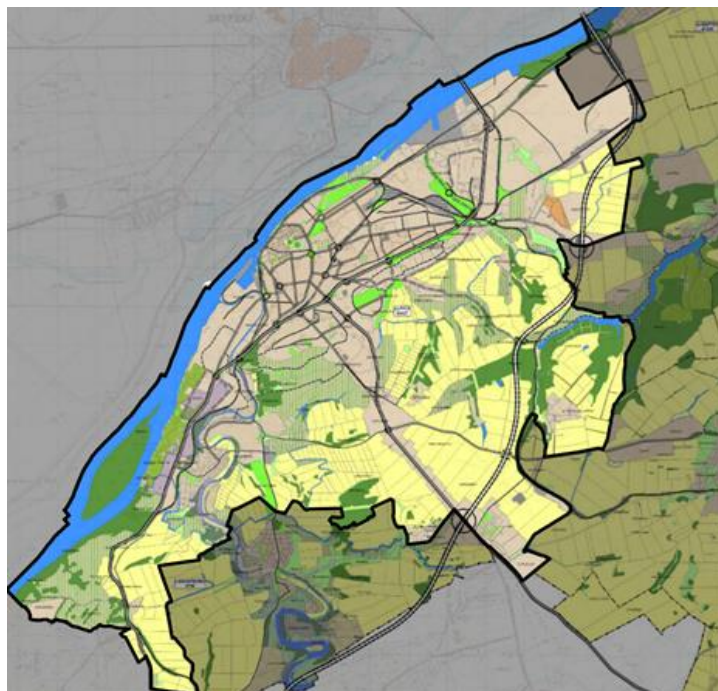
**Fig. 3.** Stages 1 (purple), 2 (yellow), and 3 (green) according to Figure 12 [12]

#### 4. ASSESSMENT OF THE NEED FOR A LANDSCAPE SOLUTION

The urban green system plays a key role in improving the quality of life by connecting people to nature and providing ecosystem services. It reduces noise pollution through sound absorption and reflection, as well as the psychological perception of lower noise levels. In addition, green spaces support biodiversity, making them an essential component of urban and suburban planning for living environment needs [3, 4, 5].

The Spatial Planning Act categorizes green spaces into core areas, such as parks and gardens, and additional areas that meet specific needs. Parks and gardens, which are the backbone of this system, provide significant environmental benefits to city residents – Fig. 3 [11].

In Ruse, due to limited financial resources, green spaces are concentrated mainly in central areas, resulting in uneven distribution. As stated in [2], the green systems of the city that are designated as parks are only half of all green areas, which highlights the need for strategic planning and improvement of the spatial distribution of green areas.



**Fig. 4.** Landscape types within the territory of the City of Ruse [11, Green system]

#### 4.1 Acoustic environment

According to [2], the measured equivalent noise levels at points on Unification, Bulgaria, Lipnik, and 93 Tsar Osvoboditel boulevards and Skobelev, Borisova, Khan Krum, and Tulcha streets significantly exceed the permissible standards for residential areas, ranging between 69.2 and 79.2 dB(A). A serious source of negative noise impact on residential areas is the railway transport carried out on the two main railway lines in the urban environment.

In urbanised regions with a population of more than 100,000, such as Ruse with 124,787 inhabitants (according to the 2021 census), noise pollution has a serious negative impact on the acoustic environment.

The significantly deteriorated acoustic environment can also be judged from the graphs in [6] - Fig. 5.

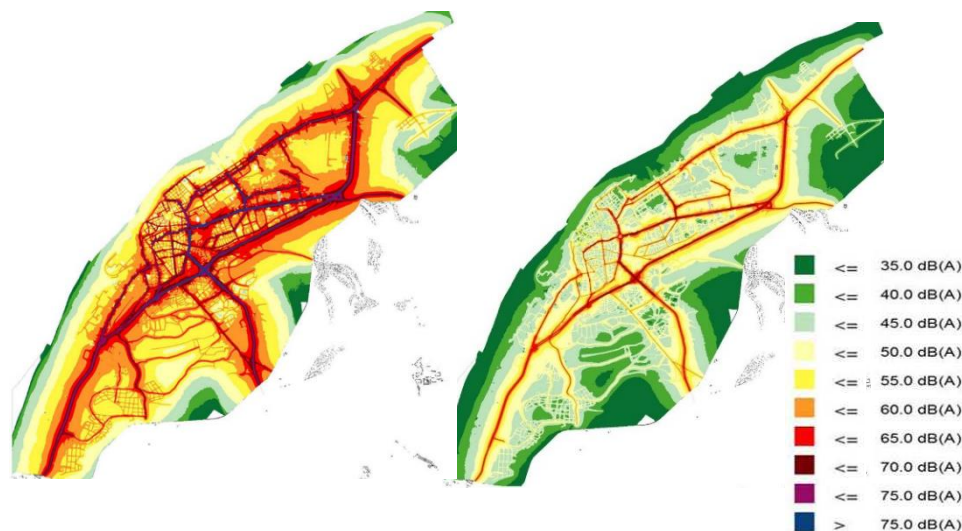


Fig. 5. Ruse day and night polygonal graph [6]

#### 4.2 Protection against traffic noise

There are a number of recommendations in various sources and documents. Effective strategies to reduce transport noise are divided into active and passive measures.

Active measures aim to limit noise generation at its sources and reduce its emissions. These include improving vehicle design, optimising traffic flow by redirecting heavy transport, maintaining roads, creating quiet zones for pedestrians, and coordinating traffic lights to create 'green waves'.

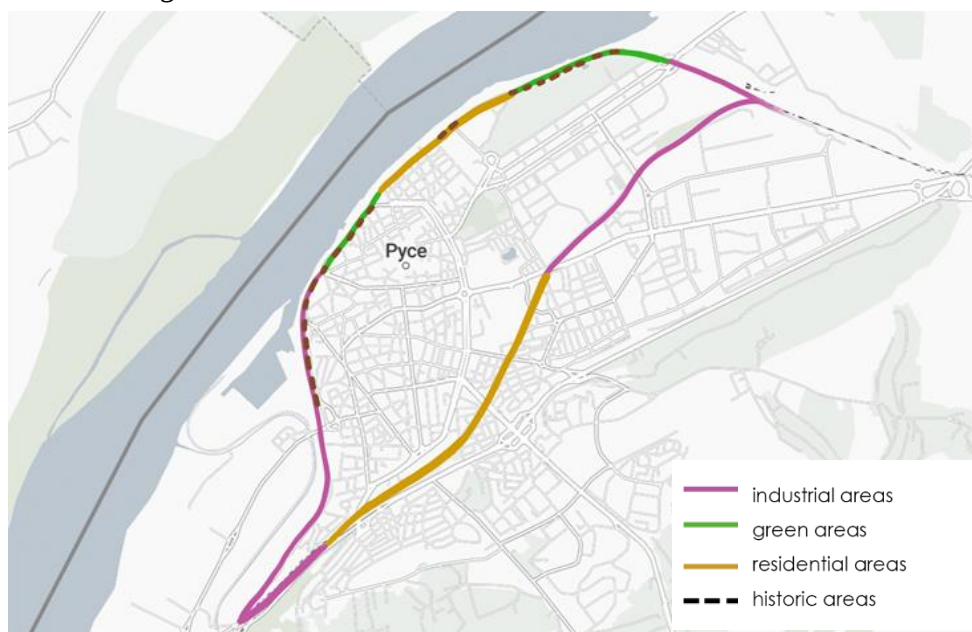
Passive measures to protect against traffic noise include the application of sound-proofing or sound-absorbing materials; the installation of sound-reflective, sound-

absorbing, or combined screens outside the roadway or at the centerline; use of vegetation as a natural sound barrier; and the construction of earth berms to absorb and deflect noise [7, 8, 9].

To achieve a sustainable solution, it is advisable to implement a combination of active and passive strategies tailored to the unique characteristics of the urban environment.

## 5. CONCEPT OF THE LANDSCAPE SOLUTION

Considering the case study and the existing situation, the conceptual design to provide noise insulation from the urban railway involves the use of acoustic "sandwich" type panels. These panels will be designed and implemented within the overall noise barrier design solution, and are available in four sub-variants, each optimised to meet the particularities of the different types of areas without compromising the acoustic reduction sought.



**Fig. 6.** Zoning of areas where acoustic environmental improvement options are suggested

### 5.1 Industrial areas

The panels for industrial areas will be durable and compliant with regulatory requirements to resist environmental impact and effectively reduce noise. The design will combine transparent and solid panels in different colours for a dynamic visual

effect, making journeys more enjoyable. Installation will take place in industrial sections of the railway. They will incorporate sound reflective and sound absorbing materials.

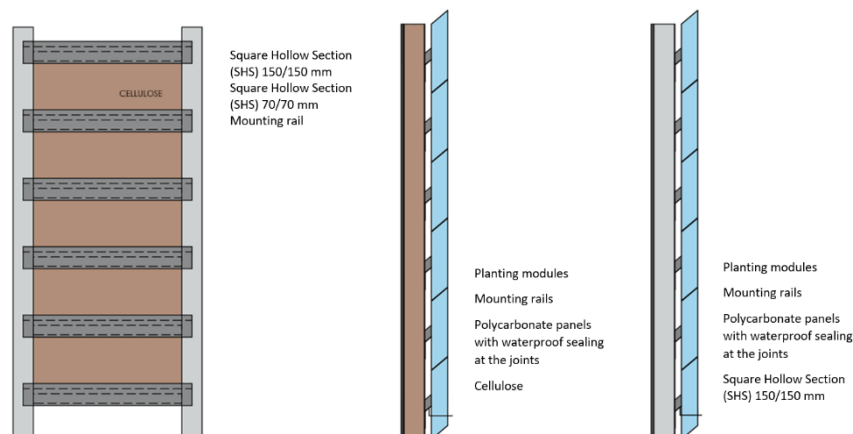
The sandwich panels have a core of mineral wool or dense foam and outer layers of impact-resistant polycarbonate coated to resist weathering and UV radiation. Translucent panels are made of plexiglass, which provides durability, sound insulation, and minimal maintenance.



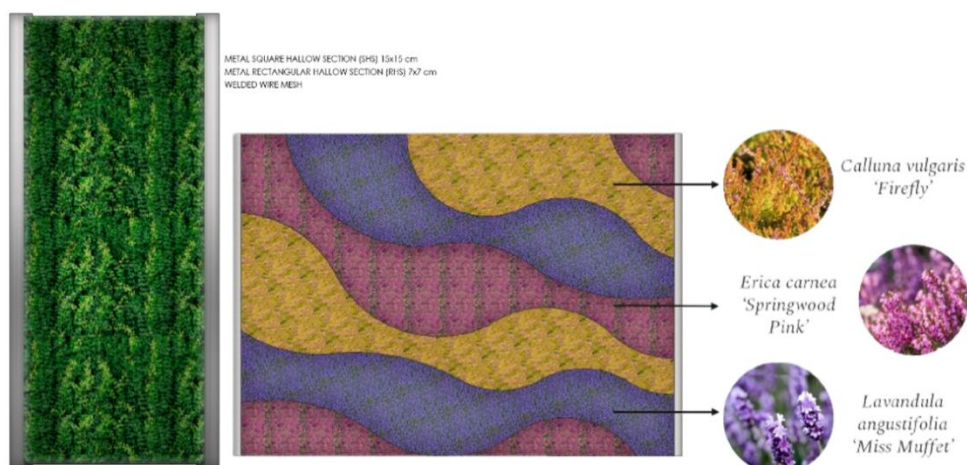
**Fig. 7.** Example of a noise panel for industrial areas [16]

## **5.2 Green areas**

Panels in green spaces will blend in with nature, using environmentally friendly materials and a design that integrates with the landscape, reduces noise, and promotes harmony. Panels will include planting modules supported by a robust metal structure of U-shaped sections. Embedded cellulose will serve as a sound-absorbing material, reducing noise by 22 dB, and an additional 15 dB reduction will be provided by the sealing polycarbonate panels. The panels will be ornamental and strategically placed in parks and gardens, with plant species provided to add aesthetics and practical benefits such as mosquito prevention.



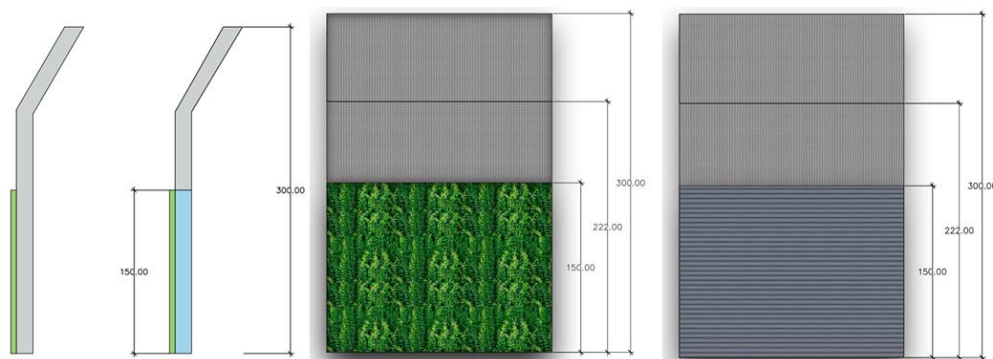
**Fig. 8.** Longitudinal and transverse sections of noise panels in green areas



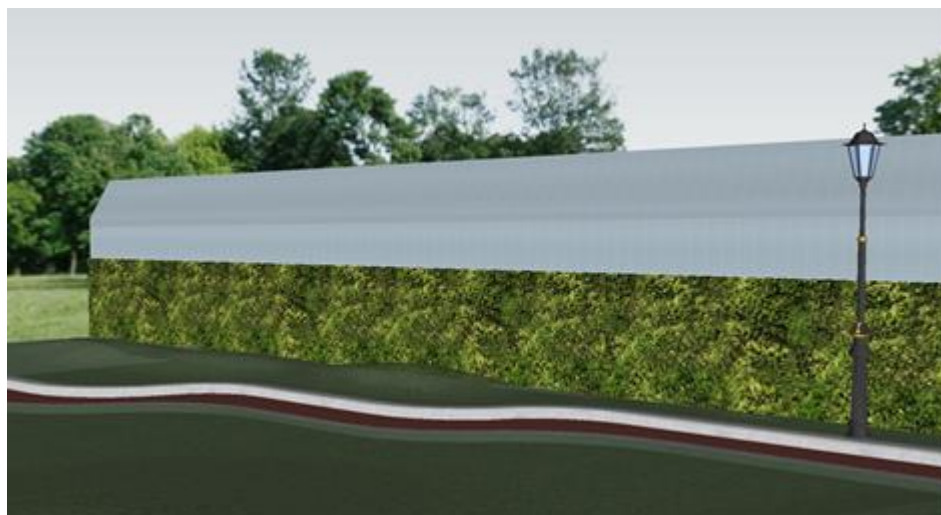
**Fig. 9.** Exemplary landscaping of noise panels in green areas

### 5.3 Residential areas

Panels for residential areas will have improved sound absorption properties to reduce rail noise. The double-layered structure includes a lower section of sandwich panels on one side and metal mesh and climbing plants on the side facing the residential areas (such as Clematis and Hydrangea) and an upper section of translucent polycarbonate panels. This combination provides effective noise absorption and aesthetics, blending into the residential landscape. The panels will be installed next to the railroad tracks to provide protection and maintain the visual appeal of the neighborhood.



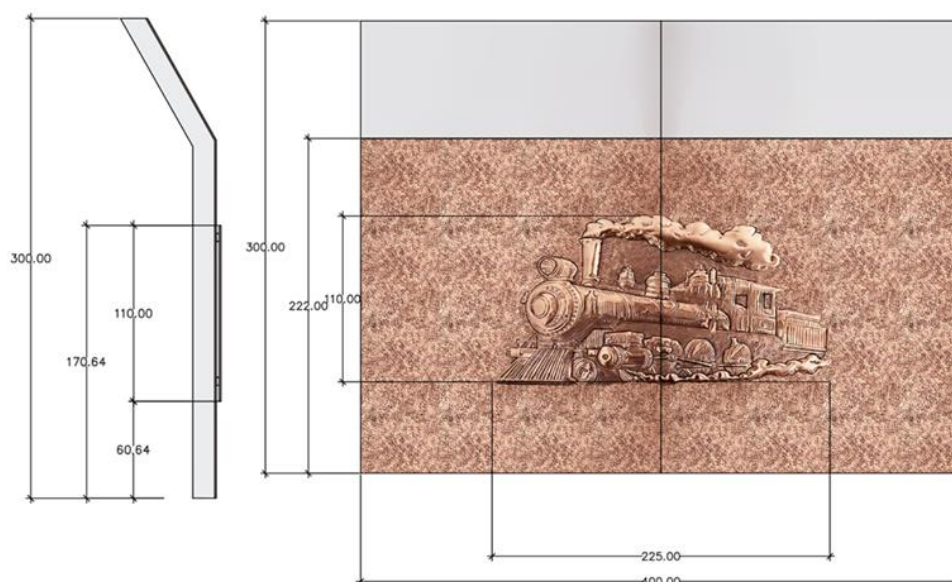
**Fig. 10.** Cross-section, transverse, and longitudinal profiles of noise protection panels in residential areas



**Fig. 11.** 3D Visualisation of noise protection panels in residential areas

#### 5.4 Historic areas

The panels for the historic areas of the city will be designed with an emphasis on the aesthetic integration with the existing historic context around the Regional History Museum and the National Museum of Transportation and Communications. They will be "sandwich" panels with a bronze coating on the lower half, with informational signs and illustrations of the First Bulgarian Railway and clear polycarbonate panels on the upper portion.



**Fig. 12.** Cross section and longitudinal profile of noise protection panels in istriction zones

## 6. CONCLUSION

The landscape renovation project of the historic railway line in Ruse combines modern transport planning and landscape architecture for a more sustainable urban environment. It offers solutions to tackle air and noise pollution and improve transport infrastructure. The modernisation of the Ruse-Varna line and the introduction of urban rail will reduce car traffic and air pollution. Green initiatives will make the city quieter and healthier, preserving its historical heritage. The project will establish Ruse as an example of combining tradition and innovation in urban planning.

## ACKNOWLEDGEMENTS

The authors would like to thank Eng. Mario Alexandrov Galabov, PhD, for the provided materials and moral support for the project idea.

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*Received May 5, 2025*