



COMPLEX LARGE-SCALE INFRASTRUCTURE DEVELOPMENT IN BUDAPEST: NEW TRAM LINE BETWEEN DISTRICTS INCLUDING AN INTERMODAL JUNCTION AT RÁKOSRENDEZŐ

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Abstract

After four years of preparatory work in decision-making and study planning, Budapest is on the verge of obtaining the necessary permits for a new, large-scale tram network development connecting the 13th and 14th districts. The aim of the project is to reduce the north-south dividing effect of railway lines No. 70, to provide opportunities for better distribution of public transportation, car, pedestrian and bicycle traffic between the affected parts of the city, to improve public transport conditions, and to provide more efficient transfer options. The Buda side of Budapest has extensive experience in improving accessibility, operation, and flexibility by transforming the network into an interconnected one. An important foundation of the current project is the extension of the interconnected tram network of Pest. The need for a new network connection has been around for nearly 60 years. The development has gained new momentum with the ongoing rehabilitation program of Városliget, Budapest's second largest public park, which aims to make it car-free. On the opposite side of the area opened by the development, there is a contiguous rust belt area, the development of which is on the agenda. An essential element of the network development, which is part of this complex urban development project, is a new single-span basket-handle arch bridge that will connect Béke Square and Kassai Square via a previously unexplored route. The railway and underground stations will have direct access from the bridge, which is provided in an unusual way by a pair of stops located in the middle of the bridge. In addition to serve urban planning and landscape architecture considerations, the development also includes further tram network development elements to help the efficient route network organized between the surrounding tram network elements to be connected, with new tram turning and junction options.

Keywords: integrated transport development, strategic and sustainable planning, tram network, urban & complex infrastructure, overpass

1 Introduction

The situation analysis carried out at the beginning of the planning process identified a number of critical areas for development. Apart from the Hungária körút – Róbert Károly körút line, only the Szentmihályi út – Árpád út axis serves as a main road network element within Budapest, which is located approximately 5 km from the axis under investigation. There is currently no direct connection between the district centres, and a lack of ring-shaped transport network can be identified. Ring road and tramline connections are incomplete. The existing part of it, in its current state, the Ógyalla Street overpass meets the assumptions of the structural calculations without speed, traffic, or load restrictions. Although it is suitable for bearing the design load, it is not suitable for bearing the tram load.

From the perspective of active modes of transport, the pedestrian network in the planning area has been developed within the individual sections cut off from each other by transport elements, and its quality is adequate. The cycling infrastructure is not uniform and in many cases is not connected. Another problem is the quality of the constructed elements and the compromises made in terms of routes and junctions.

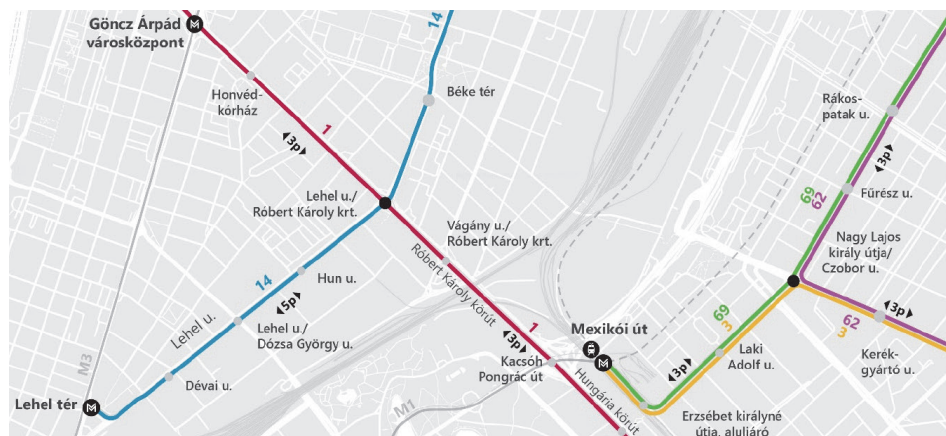


Figure 1 Existing tram network in the project area

The area is therefore delimited as follows, which also identifies the project elements:

- ensuring bicycle access along the Szegedi út-Nagy Lajos király útja axis, based on a functional analysis of the road network
- capacity expansion of Dévényi utca – Vágány utca
- Szőnyi út bicycle development
- Béke tér – Göncz Árpád vpk. & Lehel square tram extension
- junctions affected by significant traffic restructuring in the wider planning area.

The main goal of the project was to establish an interweaving tram network, with common sections, longer line routes, fewer transfers, providing a higher level of service compared to a fragmented network.



Figure 2 The project is a complex intervention to the urban fabric

2 Decision preparation

The design task began with complex decision-making studies, providing realistic answers to the requirements set for the infrastructure to be built. The process was extremely complex and multifaceted, responding to the numerous problems identified and formulating the requirements to be met. Due to the interaction between the different modes of transport, the primary task was to align the concepts, in the following order due to their nature:

- development of a public transport network (focusing on tram)
- examination of road function options
- examination of bridge structures

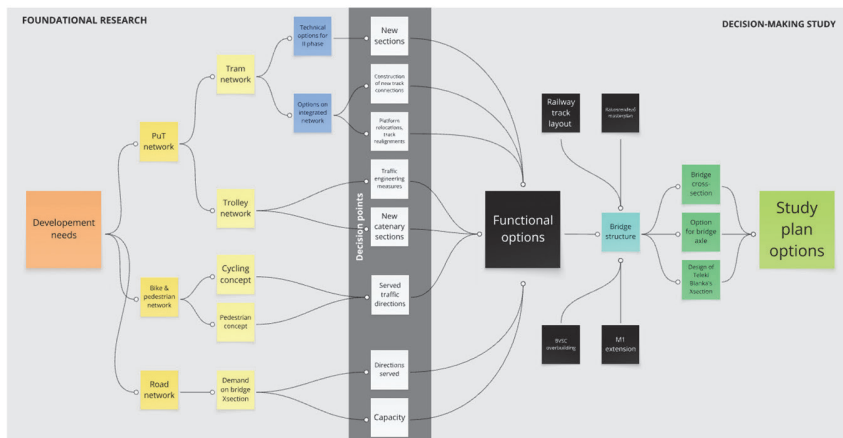


Figure 3 Decision methodology applied

The process was supplemented by elements not covered by the option analysis, such as the trolleybus network and the pedestrian and bicycle networks. For first, development needs were shaped by the city's conceptual goals and local interests. The city's goals are outlined in a settlement development document. Local interests were assessed using a questionnaire prepared by the Client and a public site visit. The data was analysed by the Client and taken into account when developing the options. We have identified development opportunities that mainly depend on the interdependence of parallel projects.



Figure 4 New tramline over the M3 Highway connected to Szegedi út

At the beginning of the design process, we examined the points where the new infrastructure could be connected to the existing one. At these points, we examined the technical feasibility (level 1 option analysis) and its alternatives. Once physical feasibility had been established, we identified network options (level 2 option analysis) based on demand and realistic technical feasibility. We examined the elements of the developed option structure using a traffic model. The creation of network options makes it possible to determine the basic information necessary for more detailed planning, such as track connections, turning capacities, traffic engineering measures, and basic data necessary for the design of engineering structures.

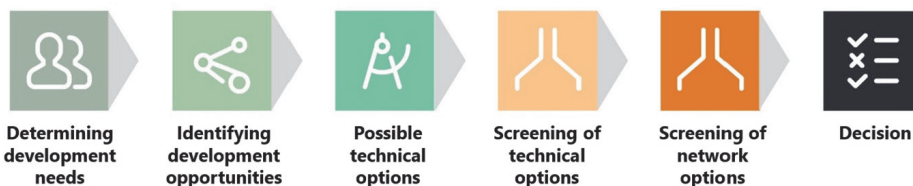


Figure 5 Examination process

General criteria were as follows:

- disposition criteria
- compliance with long-term goals
- compliance with local needs, inter-district relations
- technical considerations
- network connections
- schedulability
- environmental considerations
- cityscape considerations
- feasibility considerations.

When defining and evaluating the options, we examined them in detail not only from a transport perspective, but also in terms of urban development, environmental protection, sustainability, technical operation, and investment costs. Once the main decisions had been made, detailed planning could begin, which involved preparing study plan options for the functional design of the infrastructure. The approval plans could then be prepared.

3 New tram link

The new tram connection between Districts XIII and XIV goes beyond the extension of the existing tram line, representing a renewal of the complex transport system in northern Budapest, integrating existing modes of transport into a single system and creating opportunities for the efficient development of currently brownfield areas. The integration of tram network elements already presents in the two districts concerned offered numerous possibilities. The selection of the most socially efficient option was achieved by examining a large number of options using macro-modelling, and the most efficient option was selected using a multi-criteria analysis method. In addition to the circular tram line 3, the new connection will also allow for additional radial connections as part of the future coherent Pest tram network.

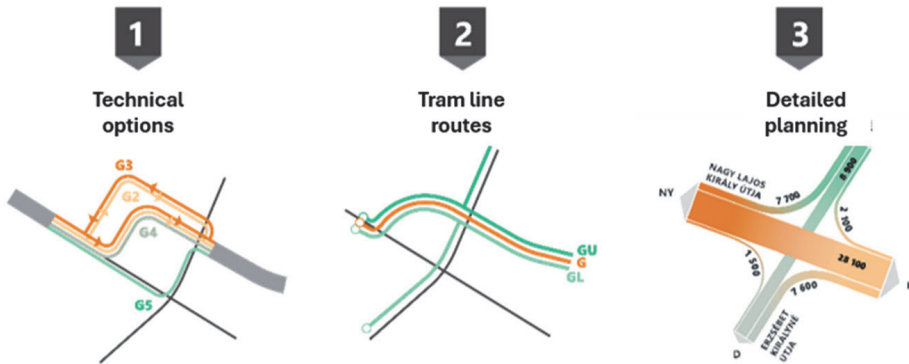


Figure 6 3-step option analysis of the tram network

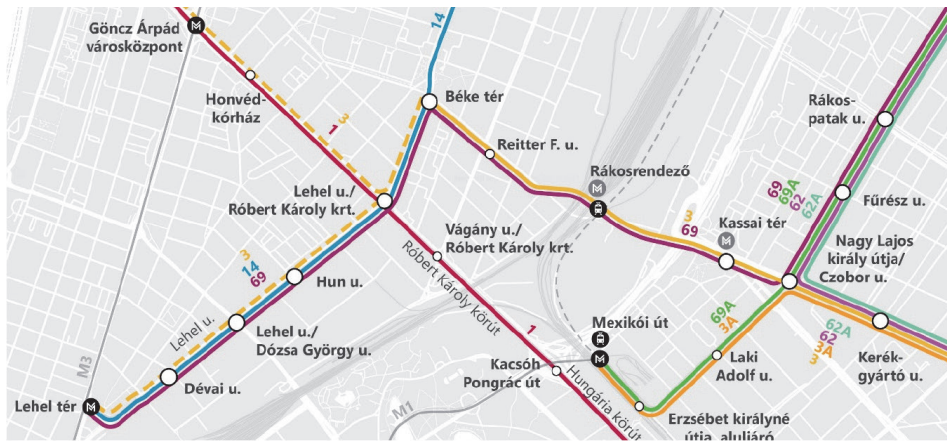


Figure 7 Proposed integration of tramline 3 to the existing network

Studies have shown that it would be desirable to serve the western areas beyond Béke Square with trams, but this would involve significant additional investment costs and affect green areas, which the local government does not support. Due to the interweaving, it has become necessary to plan further localized interventions on the existing network, including at the Göncz Árpád city centre, Lehel Square, and the Róbert Károly Boulevard junction on the west.

4 Rákospatak – New intermodal hub

The focus of the design area and also the tram network was on a new transport link spanning the railway, which had to meet the needs of road, public transport, cyclists and pedestrians alike. A new tram stop is planned on the new connection spanning the railway, thus creating a complex transport hub together with the existing railway station and the planned extension of the M1 metro line, which will also be able to actively serve local demands. There were several options for locating the tram stop on the bridge, and the proposed version was chosen based on the calculated expected passenger traffic and the optimization of the location of modes of transport. This is how the stop ended up in the geometric centre of the bridge, minimizing the transfer time for passengers turning around here. The newly created transport hub is expected to handle 50, 000 passengers per day overall. The new hub planned to build closed to the overpass.

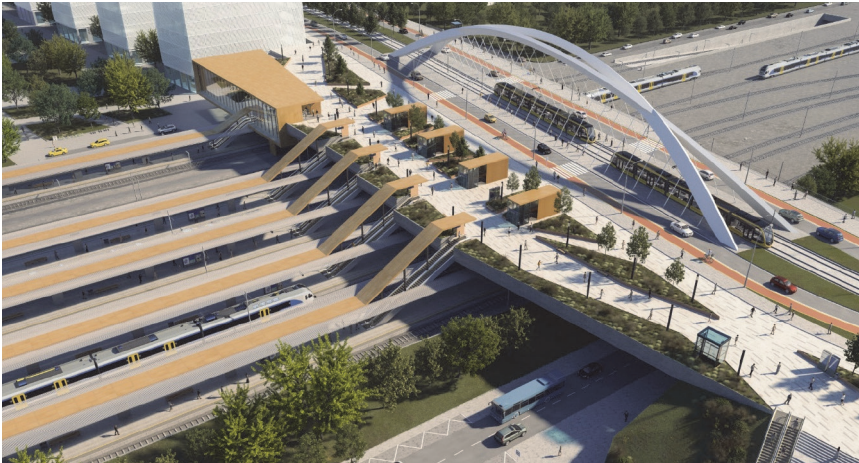


Figure 8 New intermodal node on the tramline in phase 2 of the project, Photo credit: SPECIALTERV/NAUTES [1]

5 The Bridge

During the variant analysis [1], we also examined the possible structural types of the planned overpass. As part of the option analysis, we proposed basic structural solutions - arch bridges, truss girders, and cable-stayed structures. Aesthetics, functionality, and economy were important considerations. Most options used the central “island” to place the supports and span the track zones, but an option with large support spacing was also prepared.

Table 1 Measuring results

Length	Support span	Height	Width	Structural steel
146.00 m	144.00 m	23.08 m	19.54 m	+4,960 tons

After presenting several design options, the client ultimately chose the single-span option based on railway traffic considerations. The development had to ensure the future multifunctional use of the area, so the location of the intermediate supports was not guaranteed from a long-term perspective.

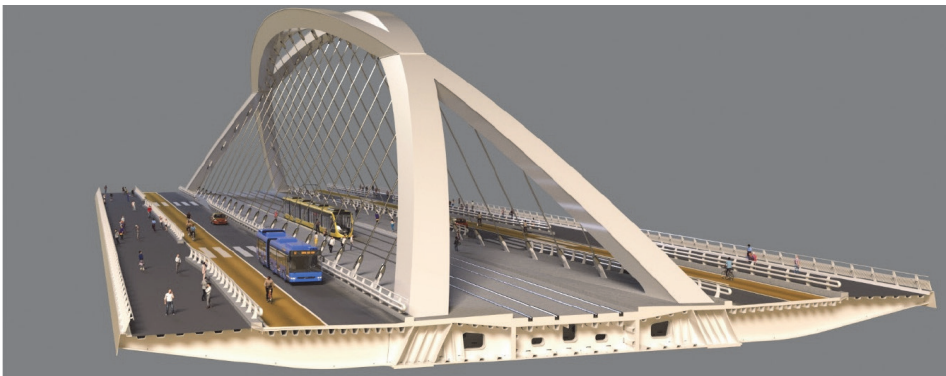


Figure 9 The proposed section of the new bridge accommodates space for pedestrian, cycle, road and tram connections [2]

The selected bridge is a structure without intermediate supports, with a 2 x 1 lane design, directional bicycle infrastructure, a tram stop, and barrier-free pedestrian connections. The single-span basket-handle arch bridge with intersecting arches will be a spectacular feature of its surroundings.

6 Conclusion

A new network element would be built as part of a complex urban development project in Budapest, Hungary, between the 13th and 14th districts. The overpass will connect Béke Square and Kassa Square via a new route, crossing the road and tram traffic on Szegedi Road above railway tracks of the Rákosrendező Railway Station, while also providing bicycle and pedestrian access to the Millennium Underground Railway and traffic over the electrified railway tracks of Rákosrendező, while also providing the opportunity to bridge and accommodate the extension of the Millennium Underground Railway.

In addition to serving urban planning and landscape architecture purposes, a tram stop has also been built on the bridge. Furthermore, both the existing and planned track layouts have been adapted to create a barrier-free connection between the tram stop and the Rákosrendező railway station. In addition to meeting the traffic needs of pedestrians, cyclists, and cars, the pedestrian crossing on the bridge ensures cross-traffic. The long-term goal was to have trolleybus traffic on the bridge, so it was also necessary to design a structure suitable for this purpose. The new transport link will enable the creation of a interweaving tram network in northern Budapest, providing high-quality service to the main rapid transit lines and urban sub-centres.

References

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