



LJUBLJANA RAILWAY STATION UPGRADE

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Abstract

Ljubljana railway station, the main railway station in the Slovenian capital, is the most important railway junction in the country and plays an important role in international rail traffic, as it is located at a strategic transit point linking different regions of Europe. However, the existing track infrastructure does not allow the most optimal organization of traffic flow and therefore represents a bottleneck in terms of rail traffic. At the same time, the station does not meet the technical specifications for interoperability of the trans-European transport network. Because of these problems, the upgrade of Ljubljana railway station has been planned for decades. This article presents the existing situation, the planned phases of the Ljubljana railway station upgrade, the challenges faced during the design process, the final situation after the upgrade, the benefits of the upgrade, and an overview of the projects in the design phase that will ensure a periodic timetable for passenger trains and the withdrawal of freight trains from Ljubljana railway station.

Keywords: railway station, junction, transport organization, analysis

1 Introduction

Ljubljana Railway Station, the main railway station in the Slovenian capital, is the most important railway junction in the country. It also plays an important role in international rail transport, as it is located at a strategic transport point connecting different regions of Europe [1]. The station building is located on “Osvobodilna fronta” square at the northern edge of the old town centre. The main bus station is located on the platform in front of it. The station building was built in 1848 according to a standard design for the Austrian Southern Railway [1]. The building is of great architectural value and is protected as a cultural monument. The first train arrived in Ljubljana on 18 August 1849, the 19th birthday of Emperor Franz Joseph. The opening ceremony followed less than a month later, on 16 September 1849, with the official opening of the railway line from Vienna to Ljubljana [1].

The Ljubljana railway station, open for the reception and departure of passengers in domestic and international rail traffic and a transit station for freight traffic, is the junction of several railway lines [1] (Figures 1 and 2): the main lines number 10 state border – Dobova – Ljubljana – Core TEN-T Network, 20 Ljubljana – Jesenice – state border – Comprehensive TEN-T Network, and 50 Ljubljana – Sežana – state border – Core TEN-T Network; regional lines number 11 Ljubljana Zalog – Kajuhova splitting point (P3) – Core TEN-T Network, 12 Ljubljana Zalog – Ljubljana (P4) – Core TEN-T Network, 13 Ljubljana Zalog – Ljubljana (P5) – Core TEN-T Network, and 80 state border – Metlika – Ljubljana. Regional line number 21 Ljubljana Šiška – Kamnik Graben branches off from the nearby Ljubljana Šiška station and has a significant impact on the operation of Ljubljana station.

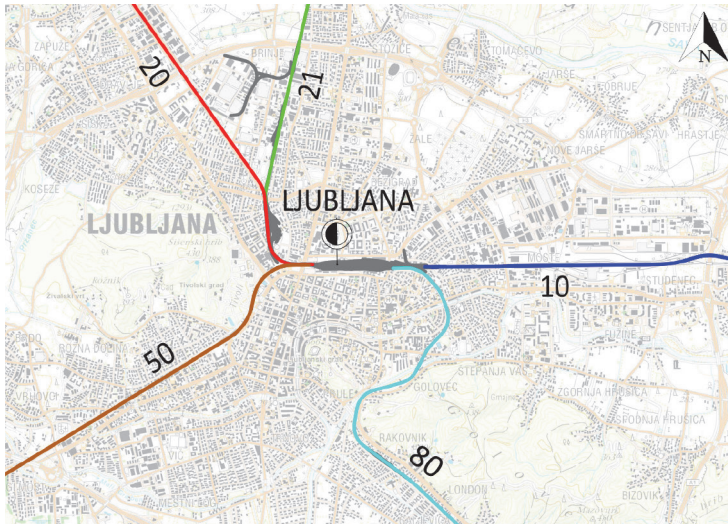


Figure 1 Ljubljana railway junction of lines 10, 20, 21, 50, 80



Figure 2 Ljubljana stations and regional lines 11, 12 and 13 branching from line 10 [2]

The existing track infrastructure does not enable optimal organization of traffic and therefore represents a bottleneck in terms of rail traffic. The essential weaknesses and deficiencies affecting the implementation of technological processes are congestion, insufficient track lengths, low line speed in the station area, the intersection of train paths, simultaneous unrolling and the intersection of train paths and shunting runs, numerous changes of train direction, technically and technologically obsolete signalling systems and telecommunication devices, carrying out “dirty” activities at the station (such as washing and cleaning of wagons and locomotives, fuel pump, etc.), carrying out the manoeuvres of changing the locomotives of freight trains.

The Ljubljana railway station upgrade has been planned for decades. The State, as the owner of the infrastructure, has decided to contract the design documentation and implementation of the upgrade of the Ljubljana railway station. The objectives of the upgrade of Ljubljana railway station were to: (1) design a modern passenger station that will meet the long-term needs of the periodic timetable passenger traffic that will take place at the station after the establishment of double-tracking of all connecting lines, (2) ensure maximum throughput for freight traffic through the station during the transition period (until freight traffic is detoured past Ljubljana passenger station), (3) ensure compliance with the technical specifications for interoperability of the trans-European conventional rail system in the area of the planned

interventions, (4) ensure accessibility of public passenger transport for disabled persons and persons with functional disabilities, (5) provide a modern, orderly and safe passenger centre, (6) establish a multimodal interchange point, which will allow passengers to transfer more quickly between the different means of public passenger transport, (7) provide more user-friendly infrastructure, (8) integrate rail and bus transport in the Ljubljana passenger centre area, (9) provide more efficient management of rail transport, (10) optimize work processes in the Ljubljana passenger centre area, (11) relieve the city and the region of the use of private cars, thus reducing the negative impact on the environment, and (12) increase the level of safety.

A conceptual design plan for obtaining the objectives was prepared, where several options for the upgrade of the Ljubljana railway station were elaborated, illustrated, and presented. The selected variant for the station upgrade meets the requirements of the design brief and additional requirements and suggestions of the Operator and the State, which were given during the preparation of the project documentation. The selected option was also subject to a traffic-technological check with the support of a microscopic railway model. The evaluation aimed to prove that the selected variant of the Ljubljana railway station track layout enables the periodic timetable of passenger trains with a 15-minute tact during peak hours after the establishment of double-tracking of all connecting lines. The new track layout and the traffic technology checks have also been reviewed and validated by a foreign expert participating in the “Jaspers” group. After the selection of the final version in the conceptual design phase, the implementation plan was drawn up.

2 Planned station upgrade

After the upgrade, the tracks in the new station will be upgraded to category D4 (permissible load 22,5 t/axel, 8,0 t/m) and GC loading gauge [1]. All tracks and switches will be placed on concrete sleepers with a 60 E1 rail system with elastic fixing and welded into continuously welded tracks.

The main feature of horizontal geometry entails a minimum radius of curves on the main station tracks and the installation of switches with a minimum radius of $R = 300$ m. This will allow a deviation speed of 50 km/h and 80 km/h for trains that will not stop at the station, which is higher than the current one.

The planned upgrade comprises of: (1) an upgrade of 19 km of the lower and upper track structure, including drainage, (2) the construction of a new overpass with a station hall and a new extended underpass, (3) the construction of 6 tracks over the extended bridge structure of the Dunajska Road and 13 tracks over the new Šmartinska Road bridge structure, (4) the installation of 107 new switches, a completely new overhead contact line network and external lighting, (5) construction 3 new island platforms, 2 island platforms and 2 side platforms equipped with information equipment in line with the overall graphic image of Slovenian Railways and of sufficient width to allow the construction of escalators and lifts from the new overpass and the new and rehabilitated underpass, with new canopies and shelters on the platforms and floor tactile guidance system for the blind and visually impaired, (6) the construction of 12 peronized tracks, with a total length of 3650 m and 2 non-peronized tracks at the station, intended for transit traffic only, (7) preparation for the connection of track 2 from the direction of Novo mesto and the construction of four tracks towards Šiška station, and (8) the construction of service (emergency) crossing with frontal access to the island platform.

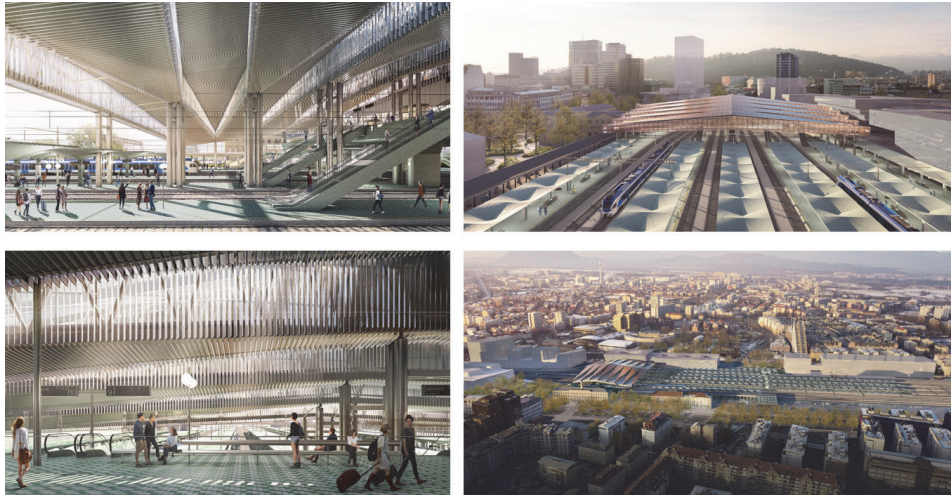


Figure 3 Visualizations of upgraded Ljubljana railway station [3]

3 Construction phases

As Ljubljana railway station is the most important railway junction in Slovenia, train traffic must be properly organized during the individual phases of the works, i.e., when the capacity of the station will be lower than usual. Due to the complexity and scope of the planned construction works, the project documentation and implementation of the Ljubljana railway station upgrade is planned in four main phases (Figure 2), divided into individual sub-phases. Phase A of the Ljubljana railway station upgrade comprises the demolition of the existing railway station and the construction of a new bridge over Dunajska Road, with associated track infrastructure. The construction of the new bridge and the upgrading of the tracks will be carried out in several sub-phases, due to the interconnected nature of the traffic routes, which will be temporarily interrupted. During the construction of the bridge, the transportability of two tracks will be ensured. The southern part of the two-track bridge will be demolished and constructed first. Then the northern part of the bridge with the other new tracks will be demolished and constructed. The new bridge over Dunajska Road is planned to have 6 tracks (the existing bridge has 4 tracks): 2 main tracks in the direction Ljubljana - Postojna (line number 50) and 4 tracks towards Šiška station (lines number 20 and 21). The widening of the bridge structure is planned both on the south and on the north side of the existing structure.

Phases B and C include the construction of a new overpass with a station hall, the construction of a new underpass and the rehabilitation of the existing one, the construction of 3 temporary and 7 new platforms with canopies, the upgrade of the tracks and track infrastructure adjacent to the new platforms in the central part of the station, including the upgrade of the signalling systems and telecommunication device installations, the upgrade of the overhead contact line network and the upgrade of the external lighting. In phase B, the northern part of the station will be upgraded, and rail traffic will run through the southern part of the station. In phase C, the southern part of the station will be upgraded, and rail traffic will run through the northern part of the station.

Phase D will upgrade the eastern part of the tracks, the overhead lines, signalling systems, and telecommunication installations, linking to the existing situation and the completed phases A, B and C in the central part of the station. This phase also comprises the construction of a new bridge structure over Potrčeva Street, and the construction of a new structure over Šmartinska Road.

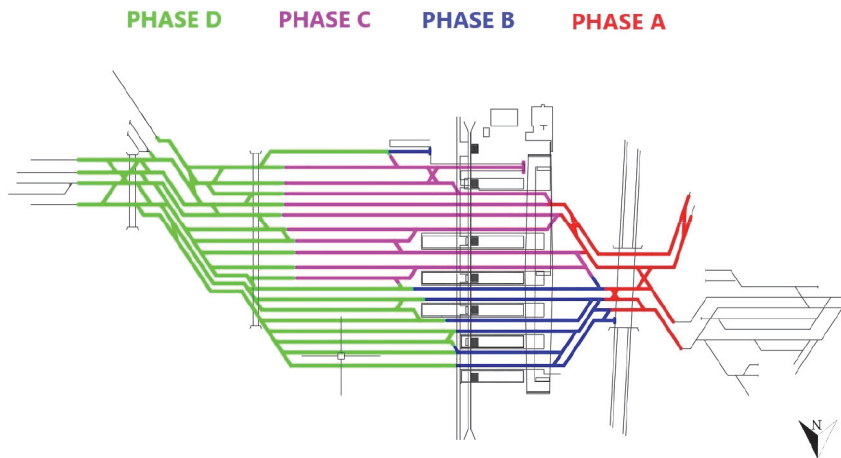


Figure 4 Scheme of the main construction phases

The work will be carried out during a complete closure of traffic on individual tracks, with traffic running on the adjacent tracks. The existing speed through the station for all trains is 40 km/h and the speed of trains passing the construction site will be limited to 30 km/h. The timing of the construction works is planned to minimize disruption of traffic at the station. In parallel with the upgrading of the Ljubljana railway station, a new bus station, residential and commercial complexes as well as the revitalization of the surrounding area are planned in the immediate vicinity.

4 Conclusions

The upgrade of the Ljubljana railway station has been planned for a long time. The station's infrastructure, signalling and telecommunications must be modernized, and relocation of service and manoeuvring operations from the station area is of great importance to increase the capacity and functionality of the station.

This paper has given an overview of the first part of the upgrade of the Ljubljana station railway area which will significantly improve the station's running conditions and capacity. Due to the complexity and scale of the construction work, the work is divided into phases and sub-phases, which are already underway. However, this will not yet achieve the set objectives, which will require the development of the remaining railway area of the Ljubljana stations. This development is already being addressed in another project (currently in the stage of preparation of investment and project documentation) and will focus on the upgrade of railway stations Ljubljana Šiška, Ljubljana Moste, Ljubljana Zalog, Ljubljana Polje and the track sections between them. National spatial plans are also being drawn up, which plan for double tracks on all connecting lines to ensure the periodic timetable for passenger trains. A study of variants for a freight bypass line is also underway, which will allow freight trains to completely bypass the Ljubljana railway station.

It is to be expected that the Ljubljana railway station will finally become a modern multimodal hub after the modernization of the infrastructure, which will enable better integration of public transport and increase interest in it.

References

- [1] Detailed design of upgrading the railway infrastructure in the area of the Ljubljana railway station, Phases A, B, C and D, Tiring d.o.o, 2023.
- [2] Slovenske železnice: Program omrežja 2023, <https://infrastruktura.sz.si>
- [3] Visualizations of upgraded Ljubljana railway station, Sadar+Vuga, Elea iC, 2023.