NEW METRO LINE D IN PRAGUE – DESIGN PREPARATION

David Krasa, Vaclav Vales

METROPROJEKT Praha a. s., Prague, I.P.Pavlova 2, 120 00, Czech Republic

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INTRODUCTION

The operational section I of the new Line D contains 10 stations and the total length amounts to 10,6 km. The horizontal alignment and locations of stations fully respect the allotted space which is specified in the current zoning and planning documents. It runs along a corridor starting at Náměstí Míru station on the Line A (transfer station), continues across the districts of Nusle and Pankrác (transfer station to line C) to the south to the districts of Nové Dvory and Libuš and further to Písnice, where it is terminated by a new depot.
The entire metro line is drawn up as an open system allowing the extensions to run both northward (beyond Náměstí Míru station) and southward (beyond Depo Písnice station allowing the the development to the region), as well as in the abovementioned direction of the branch to Modřany, splitting from the track beyond Nové Dvory station.
The valid Prague Master Plan considers the Line D to be developed between the Písnice Depot and Náměstí Míru Square, with a reserve area available for future extension to the city centre (a possibility of an interchange to the Line B and Náměstí Republiky station) or to the area of the district of Žižkov. The development of the Prague metro network in a medium-term outlook is presented in Fig. 1.

MAIN SUBJECT MATTER

Horizontal And Vertical Alignment
In general, it is possible to state that the horizontal alignment design is based on previously prepared documents and analyses, which are relevantly updated and complemented in relation to new input requirements of the City and new information about the systems. The operational section I. of the metro line D being described in this paper is part of the whole line D, which is incorporated into the overall concept of the development of the Prague metro network. The horizontal alignment provides 10-minute walking distance around individual stations.
The vertical alignment of the metro line is synoptically obvious from the longitudinal section (see Fig. 2). The entire metro line, with the exception of short sections, runs underground; the depth of stations (the depth of platforms) is significantly affected by the relatively complicated vertical dissection of the heavy settled area, because the route in the city crosses two valleys – the Botič Brook valley (the Nusle valley) and the Kunratice Brook valley (the Krč valley).

Time, Funding, Construction Technique And Equipment
The construction techniques to be used will apply the experience gathered till now during the work on the Prague metro, first of all the recent experience gained on the construction of the metro section from Dejvická station to Motol station on the Line A. It will therefore be the experience from mined largevolume single-span stations, driving singletrack running tunnels using earth-pressure balance shields (EPBS), and double-track tunnels using the NATM (the New Austrian

Tunnelling Method), which has been the method prevailing in the construction of underground sections of metro in Prague during the past 20 years. As far as the structural design (tunnels and stations) is concerned, the authors strive for designing modern, effective construction methods and attractive architectural solutions which will be amiable for both the passengers and the operating personnel. Nevertheless, progress in the structural solution does not advance so fast as that in the equipment. On this project, state-of the art technologies will allow us to design solutions more economic in terms of the space, first of all in the operational hinterland of stations compared with the recently completed extension of the Line C to Letňany and the extension of the Line A to Motol, which is under construction.

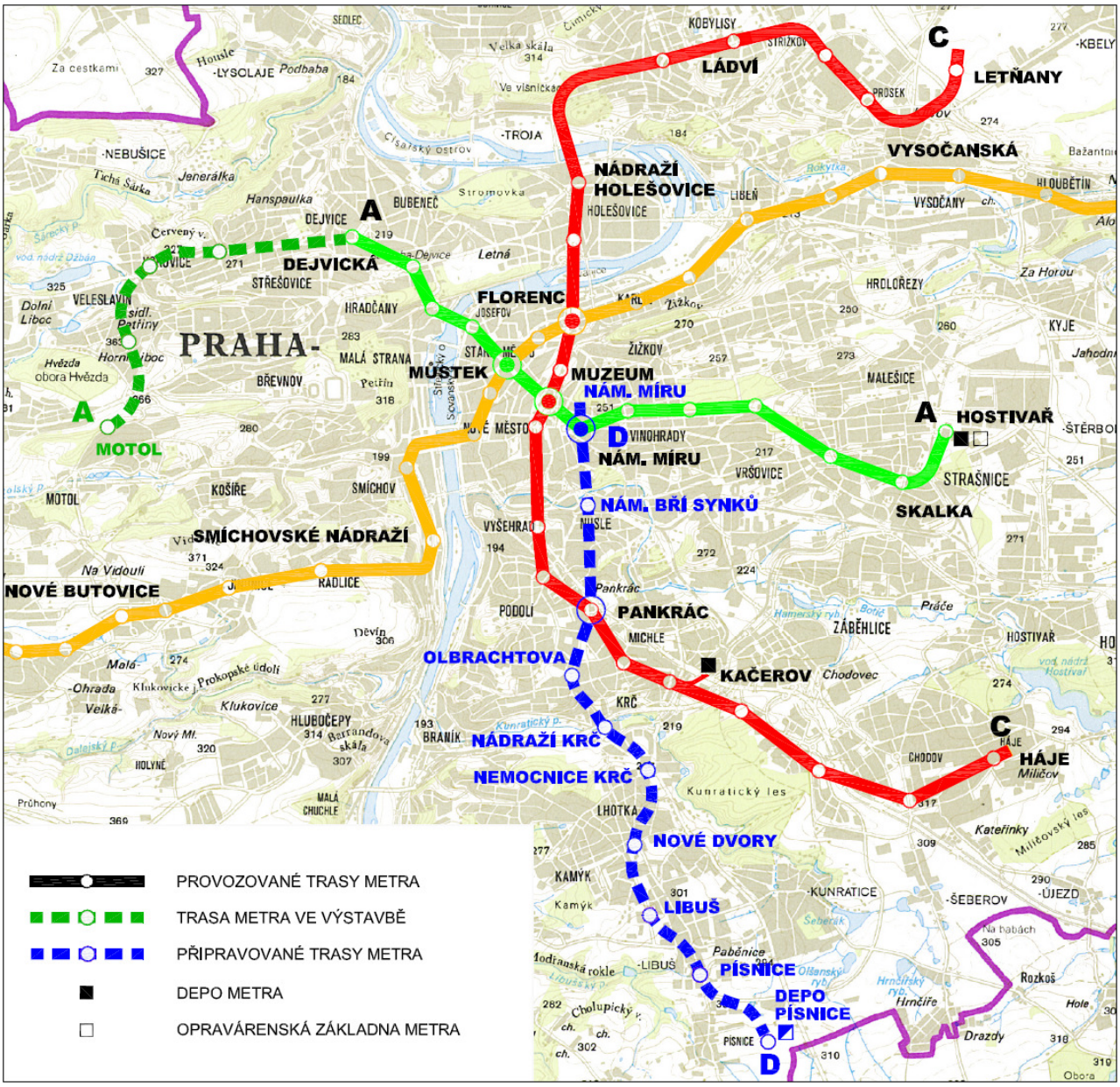

Figure 1 Development of Prague metro net in a medium-term outlook

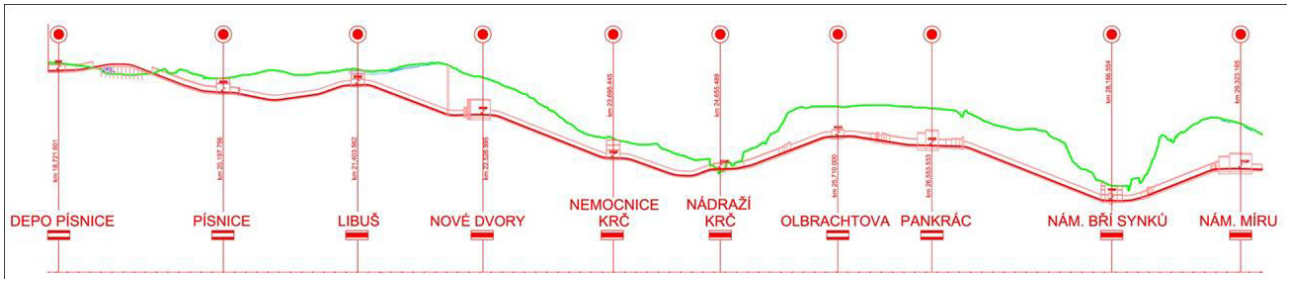

Figure 2 Longitudinal section

New Safety Elements In Prague

Platform-edge doors separating the platform from trains and preventing passengers and objects from falling under trains.

A closed entry system (wicket gates) preventing passengers from entering the metro space without paying the fare.

Emergency call boxes both on platforms and inside carriages connected to the control centre, allowing a passenger to be immediately connected with the control centre in the case of emergency.

Video surveillance over platforms and inside carriages, increasing the safety of passengers and discouraging objectionable individuals (pickpockets, vandals etc.) from their activities.

Geological and Hydrogeological Conditions

The entire area of operations is part of the Central Bohemian region, the so-called Barrandean Region. According to the rock types existing in this area it is the so-called Barrandean Proterozoic or Barrandean Lower Palaeozoic formation.

In the direction from Depo Písnice station, i.e. in the direction of the chainage, the proposed route passes through a ground environment formed by the Upper Proterozoic, consisting of compacted up to moderately diagenetically converted shales, silty shales and greywacke. Between Libuš and Nové Dvory stations, the route runs across the Závist Thrust Fault zone. It comprises clayey shales, silty shales, quartzite and sandstone. The route passes approximately laterally across the south-eastern wing of the Barrandean Syncline, where the youngest rock types of the Silurian age are found. They are represented by shales and black limestone. From this place, the route proceeds across the north-western wing of the Barrandean Region, passing again through Ordovician rock types up to Náměstí Míru station.

Surface deposits comprise relics of Pleistocene terraces formed by the Vltava River and their tributaries Brooks, which are abundantly present along the northern half of the route. There are relatively very thick accumulations of Holocene fluvial sediments. In addition, covers consisting of deluvial, deluviofluvial or aeolian sediments were found along the route. Anonnegligible part of the route is covered with anthropogenic fill.

With the exception of the immediate surroundings of the Kunratický and Botič Brooks, ground water forms most frequently aquifers in the fissured environment formed by weathered and slightly weathered bedrock.

Water table level in deposits along the two brooks depends on the level of the water surface in the respective stream. As regards the Pankrác Terrace, the aquifer is supplied with water only by precipitation.

Driving Sigle-Track Running Tunnels using EPBS Technology

The profiles designed for single-track running tunnels for the Line I. D are identical with the profiles of the currently under construction tunnels on the Line V. A (Dejvická station – Motol). The net diameter of the tunnel is 5.3 m, the thickness of the reinforced concrete segmental lining is 0.25 m and the diameter of the cutterhead of the tunnelling machine is 6.06 m.

Two fully mechanised Earth Pressure Balance Shields (EPBS) will be set up. The machines will be assembled in a construction pit behind the southern end of the yard of Nádraží Krč station. This launching pit will be interconnected with the the Krč railway station at-grade metro station, which is located north of.

Driving Tunnels Using The Conventional NATM
Naturally, the NATM will be applied to all mined stations. The 1st stage comprises the following mined stations: Nové Dvory, Olbrachtova, Pankrác and Náměstí Míru station.
The NATM technique will be used for the Line I.D construction even during the construction of mined running tunnels and other underground structures (equipment rooms, interchange galleries, escalator tunnels, lift shafts, ventilation shafts etc.).

Table 1 Lengths of tunnel sections (m)

Description	**Single-track running tunnels EPBS**	**Single-track running tunnels NATM**	**Double-track running tunnels NATM**	**Station Kaverns**
Station Pankrác			200	130
Station Pankrác technological tunnels				120
track section Pankrác - Olbrachtova		625	500	
Station Olbrachtova - 2 station tunnels				2 x 110
track section Olbrachtova – Nádraží Krč		640	413	
track section Nádraží Krč - Nemocnice Krč	2 x 682		85	
track section Nemocnice Krč - Nové Dvory	2 x 999			
Station Nové Dvory				315
IN SUM 1.part I.D	**3362**	**1265**	**1198**	**785**
track section Nové Dvory – Libuš	2 x 729			
track section Libuš – Písnice	2 x 970			
IN SUM 2.part I.D	**3398**			
track section Pankrác – Náměstí bratří Synků	2 x 1270			
Station Náměstí Bratří Synků				35
track section Náměstí Bratří Synků – Náměstí Míru	2 x 175		645	
Station Náměstí Míru		290		267
IN SUM 3.part I.D	**2890**	**290**	**645**	**302**

CONCLUSIONS

The entire first operational section of the Line D (I.D Line section) is a very extensive investment asset in terms of the extent and funds. At the moment the documents required for the issuance of the zoning and planning approval are being prepared. The construction time, first of all construction staging, depend above all on the capability of the project owner to provide funding. It probably will experience numerous changes during the course of the design works.