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METRÓ 4

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DBR METRO

Metro 4 is among the best in an international comparison!

The operation of the new metro line in Budapest will be up-to-date and price efficient. The technology selected will enable the most important objective to be reached: to provide the highest possible number of passengers with a public transport as fast, comfortable and safe as possible. In parallel to all these also to cope with all economical requirements.

Concept of the designers and the BKV, as future operator, is to adopt the latest technological solutions in implementing the new metro line. At the same time, only the technological solutions with due references are acceptable, i.e. they had been judged as reliable by the operating companies in foreign cities. This is indispensable, not only out of safety viewpoint, but also out of considerations of the price efficiency. Price efficiency supposes the harmony of two factors: what the actual purchase price of the installation concerned is, and how high its operation costs are.

And that under Hungarian conditions and on a long term. Since the lifetime of metro lines is extremely high – let us take the example of the Millenium underground railway. Consequently, only such solutions can be accepted which are both durable and up-to-date on a long term.

But what “under Hungarian conditions” means? We could list several examples when methods well proved in some other regions of the World were merely transplanted into our conditions and they did not work quite well. This can be true also for metro lines.

INVESTMENT COSTS		
City	Notes	1 km invest. costs (USDm / km)
London	Extension of Jubilee Line	290
Los Angeles		190
Athens	2 new lines	170
Munich	Line U1	115
Lisbon	Network extension	101
Munich	Line U2	98
Prague	Line IVB	98
Buenos Aires	Extension of line H	80
Munich	Line U6	76
Budapest	Phase I of Metro 4	56
Madrid	A new network of 33 km, partly on surface	40

Since as many requirements as cities... However, this does not mean that the experience obtained by others cannot be useful for us. In preparing the construction of Metro 4 the designers contacted almost all the European and several off shore metro companies. They investigated their operation, equipment and the operating technology selected out of very different viewpoints. All these investigations assisted in selecting the best possible, most reliable and economical solutions. The design of the Metro line 4, which can be constructed and operated in optimal manner under Hungarian conditions, was developed as the synergy of the experience mentioned.

As revoked above, metro parameters can be identified as a function of the requirements, features, possibilities of the city concerned. That’s why the difference between the investment costs can be even 5 to 6 times between the metro networks constructed in various regions of the World despite of the same or similar transport capacity achieved. In other words, there is no “World standard” of the metro construction. Accordingly, metro construction costs can vary between USD 50 and 290 million per 1 km line.

In summary, we can confirm that the new metro line in Budapest will provide a high service level even on World standards and will be constructed in a more economical manner than many existing lines. For illustration we attached some proving data: investment costs in several European and American cities. Of course, in the course of such a comparison the technical level of the various metro lines should be considered, as well.

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Safe metro operation

The licensing plan for railway authorities prepared and submitted for authorisation at the Transport Inspectorate of the Capital City contains all the operation technological plans for the Phase I of the DBR Metro. However, the authorisation of railway safety systems occurs within another licensing procedure. The issue of the license by railway authorities is conditioned by the submittal and acceptance of an Annex Paper comprising detailed parameters of such safety equipment.

DBR metro will be equipped with an automatic operation system providing maximum safety, the most traffic service and requiring a minimum human intervention. However, domestic regulations do not comprise any requirements of application for such standards, thus, all the requirements not ruled had to be summarised in an Annex Paper. In compiling this documentation the Consultant of the Project Management considered some relevant suggestions of the International Railway Union (UIC). Compilation of the Annex Paper was necessary because in case of certain purchases highly dependent on the technology, products of manufacturing companies the designer did not – and due to the openness of tender even could not – prepare any detailed plans. Thus, also the relevant parameters are to be found in the description of the system of conditions.

In the earlier issues of our "Hírlevél" we had presented the train control and safety systems of the metro. Here are several technical details, as well, discussing some problematic issues.

Full automatic control system

Thanks to the up-to-date train control system, there will be no trainmaster on the train in a traditional sense of the word. There will be just a train surveyor. Train traffic will be controlled by the traffic control dispatcher centre and the computer installed on the line through a continuous communication line with the train computers. Continuous information exchange between line computers and central computers will occur through a data transmission system consisted of some optical cables of annular configuration running in the tunnel. This automatic system will be able to process even schedule divergences without any human intervention. A central computer can process any schedule change with adjustment to traffic demands.

But the trainmaster can postpone train starting for the situations that the getting in and getting out of passengers in stations were not completed within schedule. This system enable the trainmaster to postpone train starting up to 5 seconds.

The experts' suggestion is to operate the trains with a trainmaster on following their putting into operation in compliance with domestic expectations. It is in discussion whether the trains should anyhow be operated without any trainmaster on board in a later period.

Outside of their operating time the trains will wait on the stand by tracks of the vehicle shed. Both stand by tracks and the tracks enabling network access will be of automatic operation. On any other tracks of the vehicle shed the trains will be moved in manual operation mode. For the operation of night service trains – in order to assist the manual operation mode – two position optical signs will be installed at each switch connection.

Safe solutions for emergency cases

In addition to the establishment of the daily requirements of a normal operation, the designers has dealt with possible emergency situations, as well. In case of failure of the full system the trainmaster can take over train control in manual operation mode and operate the train in this mode. In all such situations the basic target is to drive to the nearest station and enabling the passengers to get out.

As far as possible it should be avoided to evacuate passengers from tunnels. But Metro 4, in opposition to Metro 2 and Metro 3, will have an escape sidewalk in each of its tunnels.

As far as information exchange between the centre and the line computers was in failure, then the evacuation of vehicles would occur in automatic mode of operation, according to the last schedule. Following the evacuation of passengers, the train in failure will leave the track network in manual operation mode.

A special domain of the safe operation is the protection of the passengers waiting on platforms. One of the elements of this system is represented by the building out of a manual and automatic current cut off installation. The track sections near platforms is monitored by automatic installations and supply voltage cut off whenever the falling in of an object of critical dimension is noticed, simultaneously transmitting a stop command to the train arriving. The same system can be operated in manual operation mode by the train supervisors, by the passengers waiting in the station and noticing any kind of emergency, as well as dispatcher centres monitoring passenger areas by means of closed circuit television system.

In respect of its operation concept and configuration, the line control system of Metro 4 is an integrated one. The abbreviation of this system, DBR–ATC (Automatic Train Control), is an allusion to the location of application and to the degree of automatism. This DBR–ATC system is an integral part of the central control system of the new metro line carrying out passenger monitoring, energy supply control and the survey of other technical installations in stations. ■

MAIN PARAMETERS OF THE DBR–ATC SYSTEM	
Minimum train spacing	90 seconds
Average travelling speed	Not less than 30 km/h
Maximum instantaneous train speed	80 km/h
Stopping time in stations	20 to 30 seconds
Safety level	In compliance with the maximum allowed in international standards, grade 4
Availability	≥99.96%

No danger for medicinal waters

Animated discussions have been carried for several months in relation with the section under the Danube of the new metro line. The investigations performed persuaded us to a maximum extent that the metro tunnel has no danger whatsoever on the thermal waters of Budapest. We do trust that such professional surveys exempt of political interests, considering exclusively the viewpoints of environment protection, succeeded to convince even the sceptics that Metro 4 will jeopardise our medicinal waters of European fame neither in the period of construction nor in operation.

Metro 4 will pass under the Danube southwards from Szabadság bridge, between the Chair of Chemistry of the Technical University and the building of the University of Economics. The south-west end of this tunnel section under the Danube will be closed by the station in Szent Gellért tér and the north-east end by the station in Fővám tér, respectively. Both stations will be constructed in complexes of medium Oligocene. The construction technology selected in accordance to the soil conditions available is a guarantee to not to damage the environment of stations in the period of their construction.

The alignment under the Danube was selected by designers as the most proper one among several possible versions. Despite of research reports, technical plans and construction technologies guaranteeing full safety, one of the authorities is of the opinion that this alignment of the running tunnel can damage the karst water reservoir in rocks both in quantitative and qualitative respect. On the basis of many investigations carried out by experts in the recent years we definitely confirm that this danger does not exist, Metro 4 does not endanger our thermal waters of European fame. In the following, we would like to summarise the geological and hydrological characteristics of the site, supporting our statements by the presentation of research results.

The following considerations are based on the researches investigating the safe routing of Metro 2 under the Danube. According to a declaration of the Hungarian Geological Services, the researches are of proper extent on the basis of "considered possibilities and expectations". Hydro-geological section of the research completed complies with the importance of this issue, with details and correctness adjusted to the preliminary phase.

Geological and hydro-geological characteristics of the area

Both hydro-logical surveys and the digital model prepared by the University in Miskolc reveal that the hills and mountains from the Székesfehérvár–Mór trench to the Danube form a continuous karst water reservoir. The housekeeping of this reservoir is positive, i.e. any rainwater flowing into the karst will generate a higher water level and higher pressure than the underground waters and inter-layer waters in the surrounding area. The superfluous quantity in this housekeeping leaves the reservoir in the form of thermal springs. Some of these springs are erupting on the dry land, but some of them in the river bed of the Danube, in the form of fugitive springs (the so called Schafarzik springs, Névtelen spring, Vitális Sándor spring). Budapest can thank its thermal waters of medicinal capacity to the brow springs risen along the Danube embankment.

The water of these medicinal waters is originated in two domains. The rainwater falling on the Buda hills will flow down through the karst ducts of the mountain. This is the cool–tepid component of the medicinal water. When this water flowing downwards meets an impermeable layer, it will descend to lower layers of the earth, where it is warmed up and complying with the rules of physics it looks for any escape upwards. (This process is referred to as "understreaming".) Thanks to the east-west to south-east fall systems, the rainwater fallen on the Bakony and Vértes mountains will look for upwards ducts at the meeting of the Pest plain and the Buda hills – along the Danube line. This is the moment of the mixing up of warm component with cool component, and spring temperature is a function of this mixing ratio. The springs have the temperature of 22°C at Budakalász, initially 63°C at the Lukács bath and 41 to 42°C at the Gellért bath.

The nature takes care of the safety of medicinal waters

As mentioned, the pressure of karst waters is higher than that of other waters in the area, including Danube water. It remains higher even if the Danube water raised because of abundant rainwater. This is because the rainwater fallen produces the same effect in the karst housekeeping, as well, and the pressure difference remains positive to the advantage of the karst water. This means that the river water cannot penetrate into the thermal water ducts, since the basic nature of fluids enables flow from a higher pressure space towards a lower pressure one.

This status could be affected not even by the exaggerating thermal water production of the last century. Although the water flow rate currently won is definitely above the total flow rate of initial natural springs, the operating pressure of this system hardly fell by one meter during the last hundred years.

Metro construction means no danger

In the knowledge of these antecedents let us overview the risks related to the section under the Danube.

Flowing Off

There are fears that the quantity of thermal waters can be reduced because of tunnel construction. As a matter of fact, the medicinal water possibly penetrated into the tunnel will cause no noticeable alteration whatsoever in the reservoir. Today, the daily production of medicinal waters amounts to about 5,600 m^3. Supposing a tunnel completely filled out with medicinal water – which is excluded by technology – it would accept about 3000 m^3. In addition, in case of a very intensive water inrush – say 1 m^3/minute – it would need two days to completely inundate the tunnel section. However, it is to be emphasised that the technology adopted for tunnel construction – closed front shielding – excludes any karst water inrush into the tunnel.

Pollution

There are some concerns that the quality of medicinal waters will be affected by metro construction. In our opinion, this can happen in three modes. One of the possibilities is the thermal water penetration into the tunnel, then the recycling of this water to the karst system together with possible impurities. But this case can be excluded on the basis of physical rules. Since the pressure existing in the tunnel will always be lower than that of the karst system, and a possible water inrush cannot be reversed. In addition, any penetrated water will be pumped away without delay.

Another assumption is the mixing up of thermal water springs with the Danube water. This is excluded both by the construction technology and the natural processes. However, in case of a series of multiple human omissions the water penetrated will be pumped away. Nevertheless, any water penetrated from the Danube into the tunnel is so insignificant with respect to the water quantity in the karst system that it could not produce any qualitative alteration even supposing a mixing up.

In addition, such a mixing up is impossible since the water pressure arriving from the Danube is lower than the pressure of karst waters. All these assumptions are just theoretical, since the Danube water could only penetrate into the tunnel through a crack in which karst water is not present, i.e. it has no connection with the thermal water reservoir.

In compliance with international practise, a detailed research operation on the section under the Danube will take place simultaneously and harmonised to construction. It is possible that such researches will confirm the necessity of cement injection, taking care that injection pressure not exceeds a pressure of 50 cm above the prevailing pressure of Danube waters. This is for not to inject the material into the high pressure karst waters of the Buda side, and only accidentally into the Danube or the fugitive Vitális Sándor spring of lower pressure.

Situation of karst waters in the period of operation

The running tunnel – thanks to its impermeable insulation – can alter neither the quality nor the quantity of karst waters in the period of operation. The tunnel cannot have any impact on the temperature relations of the karst water reservoir neither, since the influence of the warm component arriving from depth is superior to the cooling effect of the tunnel by several orders of magnitude.

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Actualities

In our permanent rubric we would like to inform our kind readers on the events emerged since the appearance of our first issue. We trust that our rubric will assist you in monitoring the versatile implementation of the metro project in an "updated" manner.

Preliminary Environment Impact Study and purchase of the license of the environment protection authority

In our days, a condition preliminary to any project is the license of the environment protection authority. This license is issued by the competent authority on the basis of a Preliminary Environment Impact Study. Such an impact study in relation with Metro 2 had been prepared by Mélyépterv Kultúrmérnöki Kft.

This Impact Study was submitted late in 1998. Since then further geological, hydrological and other complementary investigations were developed. A summary of the results – the so called Complementary Volume – will be submitted at the competent office in December this year.

Surface arrangements

It is known that a plan of development for the area Etele tér – Őrmező is completed. The evaluation phase for the development of the environment of the resting 9 stations is closed. The contracts has been signed, thus, the planning of surface development of each stations is under way.

Owners' contribution

We have dispatched invitation letters to the owners of the estates concerned requesting their contribution. Some of them had already confirmed their contribution, although they asked for a more detailed information on the extent of utilisation of those areas. We have also dispatched the supplements requested.

Public purchase tenders

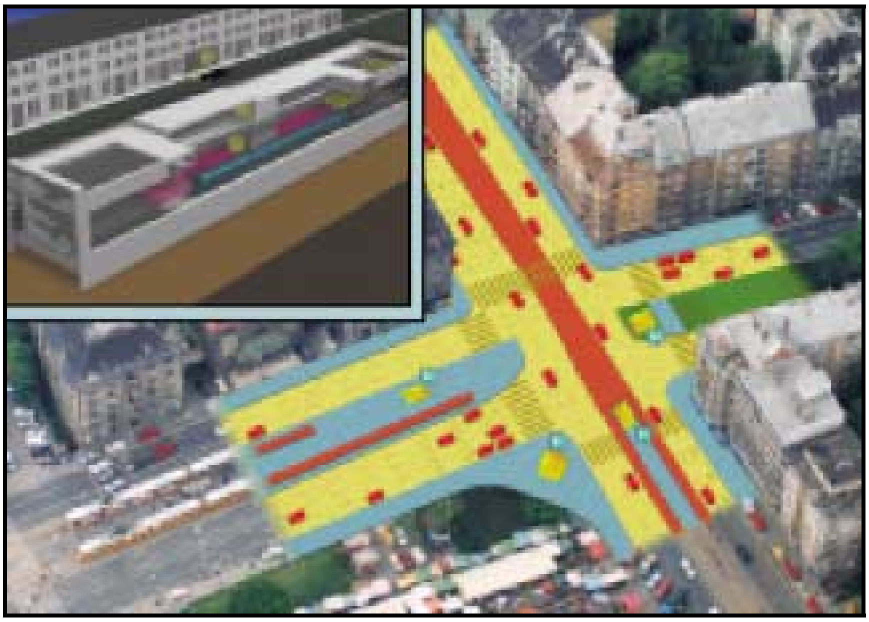
One of the last two tenders related to the new metro line is entitled "Complementary Geological Surveys and Expertise Because of Alignment Modification". The publication of results for this tender occurred in September. The tender winner delivered the completed expertise late in November. The other tender is the "Preparation of a Summarising Geotechnical Report", the bidding phase of which has also been closed. Currently, the collection and sorting of the data needed to such a study takes place, as well as the processing of expertise studies. The winner of both tenders is Geovil Kft.

Annex Papers

An Annex Paper compiled on railway safety installations has been prepared and submitted. The authority has inspected the description of the system of conditions. On the basis of their comment the experts have inspected the supplements required.

Ten Squares – Ten Stations

Among the overview pictures prepared on the basis of the Licensing Plan of Railway Authorities we are presenting hereunder the surface development of Móricz Zsigmond körtér, as well as the configuration of stations. We would like to underline that they are just plans, projections, and consultations are carried in this respect with the authorities concerned and competent local governments.



Bocskai út

Environment of the Skála business house in Buda is already a commercial and official centre, but the new Metro line may give a special swing to it. Such investments can be implemented, which were inconceivable without any high level transport. Estates of the area would be re-evaluated, and new office buildings and service facilities could appear.

The metro station will be located on the southern side of the junction. From the subway to be constructed staircases will lead to the surface in several directions. Thanks to the subway, pedestrian traffic will be safer and faster, and the surface will be ordered.

In implementing the metro station in Bocskai út an important viewpoint was the possibility of a later branching towards Budafok. The tracks of this station are 15.5 m deep under the surface. Four moving staircases and 2+2 elevators are available for passengers.

The station will have two exits, one of them connected with the moving staircase, the other one with the elevator, respectively. Designers reckon with 32 thousand getting in and 39 thousand getting out passengers every day.

Móricz Zsigmond körtér

Metro will transform the image of this square to a considerable extent. The designers' suggestion includes a 3 or 4 times increase of the green area. Road function will decrease, but the place available for passengers will be larger. By reducing the number of tram stations the inhabitants can enjoy a well arranged and more friendly square. Following the putting into operation of the metro, the route of trams in this area will be different, consequently, the location of tracks, too: the tracks will run from Villányi út to Fehérvári út. The metro station will be installed on the southern side, thus, all surface public transport vehicles can easily be accessed. In parallel to metro construction it will be possible to resume the development of Bartók Béla út, which was postponed so many times. Among others, aged utilities, obsolete tram tracks and road pavement will be replaced.

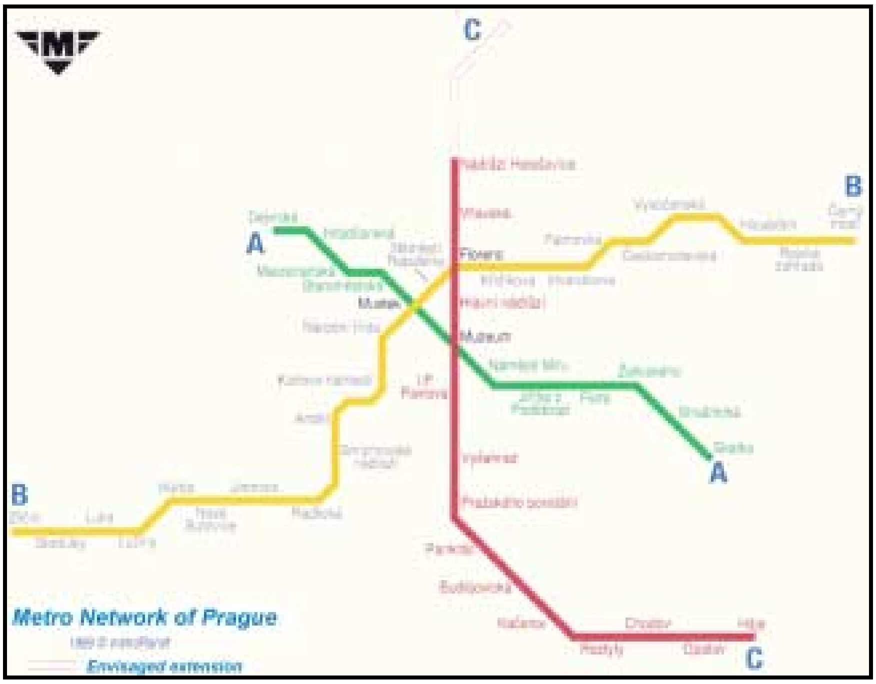
The station is designed to a lengths of 106 m. The tracks will run 23.2 m under the surface. Four moving staircases and 2 elevators are available for passengers. The station will have two exits: one of them connected to the moving staircase, the other one to the elevator. In this station, about 46 thousand getting in and 40 thousand getting out passengers per day are expected.

Prague: Systematic Metro Construction

The metro in Prague plays a decisive role in the public transport of the city. Its continuous extension and technological development is a key element in the transport concept both of Prague and of the Czech Republic. The Government provides not only a theoretical support to it. As we know, Government and city management jointly assumed financing – like in general in the World.

Metro construction in Prague was commenced many decades after the inauguration of the underground railway in Budapest. However, the backlog of more than eight decades was recovered with an incredible speed, moreover, they have left us behind them long ago. In the Czech capital city three metro lines were constructed in about 25 years, amounting to a length of nearly 50 km. Whereas Budapest can be proud of a network of only 33 km. The difference is even more striking in comparing the network to the population number. While 4.1 km metro line per 100 thousand inhabitants are available in Prague (a significant ratio even among European conditions), this ratio in Budapest is hardly 1.3.

The last quarter of century was spent in the Czech capital of 1.2 million inhabitants with the slogan of metro construction. The first metro line was given over to traffic on May 9, 1974: this is line ‘C’ with 7 km section and 9 stations. The new metro connected the southern city side with the city centre. Only four years following the first line a second ‘A’ line with a section of 4.7 km was completed. The network was continuously enriched by the extension of ‘C’ and ‘A’ lines, and in 1985 also the first section of the ‘B’ line was put into operation. New line extensions were carried out following regime change, as well. The last occasion for the inhabitants in Prague was in November of the last year to participate in metro inauguration: an extended section of the ‘B’ line, long of 6.4 km. The work goes on, since they are working on a new north extension of line ‘C’.



In technical respects, the metro in Prague is very similar to ours in Budapest. There is no wonder, since they are based on Soviet metro construction technique and methods. However, the Czech invented some very interesting solutions and succeeded every year to construct attractive stations with unique design and using more and more up-to-date materials.

More than 520 coaches are serving on the metro tracks in Prague. Initially they bought coaches similar to the model “E” in Budapest, but they replaced all of them a few years ago. Later they purchased vehicles of identical model referred to as “black headed” by us. They commenced in 1997 to reconstruct and update these last vehicles of Soviet manufacture. The greatest transformation in the vehicles fleet is about starting: in 1998 they made operation tests with the trains of world standard consisted of 5 coaches and manufactured by the consortium ČKD–Siemens–Adtranz. Within a short time these new trains will represent a quarter of the vehicle fleet.