

## QUALITY AND CAPACITY

The Millennium Underground Railway was, at the turn of the century, still viewed by contemporary city-dwellers with some fear mixed with pride. By now, however, the metro has become a natural part of our daily experience. Without it, the citizens of Budapest would be almost unable to imagine their everyday lives. The plans for Metro Line No. 4 have been prepared with a view to incorporate all the experience accumulated since the turn of the century and also all the engineering advances offered by modern technology.

The urban traveller of our time will opt for mass transit on three conditions: if it is fast, comfortable, and safe. In the densely populated metropolises of today, we know of only one form of transport that meets these demands, and that's the metro. Yet there are differences between different metros. It is sufficient to consider the three different metro lines in Budapest. Their final shape and outlook was formed by the ideas and technology of different eras. The fundamental principles behind the plans of Metro Line No. 4 may be summed up in two words: quality and capacity. In other words, it should provide the highest quality service possible for the highest number of passengers possible. The transport service provided by a metro is best when the trains follow each other fast and with complete safety, and the passengers have convenient access to the platforms which are not too far below the surface, and the other mass transport facilities are also within easy reach of the metro stations. These were the criteria along which the construction techniques were selected, the control and safety systems were designed, and the surface plans were made by our expert consultants.

### Stations built from the surface: convenient and economical

Two basic construction methods will be used for Metro Line No. 4: the tunnels will be built using the self-contained method of the shield-tunnelling and shotcrete, while most of the stations will be built from the surface. This up-to-date tunnelling technology to be employed allows for building both the lines and the stations at relatively small depths below the surface. As a result, the platforms will be easier for the passengers to reach. Out of the ten stations to be built along the new metro line, eight can be built in the above manner, i.e. from the surface, according to the plans. This construction method also helps reduce building costs.

The plans also call for centrally placed platforms in all the stations, with spacious interiors. There will be escalators for the traveller's' convenience. The stations will also have a novel feature: elevators. These will primarily be for the handicapped, but they will also be freely available to anyone else. Every station will have at least two elevators for five to ten passengers each. The elevators at Rákóczi tér will be larger still: they will carry up to 25 people each on the market-hall side of the station. In fact, this side of the station is planned to have no escalator, at all. Wherever conditions permit, the elevators will take the passengers directly up to street level. However, there will be a few stations where two elevators will have to be used to go reach the surface.

The construction work of any one station is a gigantic project, which may take up to two years to finish. The job is about the magnitude of the building of a shopping mall. As construction will be done from the surface, the first stages will necessarily involve significant interference with surface traffic. However, as soon as the retaining walls around station are erected and excavation reaches a depth of a few meters, the final roof may be put in place

and surface traffic may renew. During the rest of the project, work can be carried on under the roof, and the interference with surface traffic will be reduced to the minimum (see illustration).

### **Platforms of 80 meters are sufficient**

One of the most basic calculations to be made at the construction of a metro is how many passengers need to be carried in a given length of time, and how long the trains have to be to accomplish that task. In the case of Metro No. 4, allowing for the greater frequency of trains permitted by the modern control systems, the above calculation formula shows that 80-meter-long trains are capable of handling traffic foreseeable even in the long term. Which also means that platforms of a length of 80 meters are perfectly sufficient. This circumstance is particularly favorable, in that platforms of this size - and the stations - are not larger than almost any of the squares involved, so it is possible to build them from the surface.

The trains running on the existing lines are 120 meters long and run every 4 to 6 minutes, on the average, or every 15 minutes at night. The time between two trains cannot be less than two minutes and a quarter. On the new line, thanks to the advanced control technology employed, it will be possible to have the trains, which will be shorter, run at a much greater frequency. The trains can follow each other at every 90 seconds, and even that delay may be reduced to 75 seconds in future. So the time spent on waiting for a train will also be considerable reduced for travellers. Although each train will carry fewer passengers, still, due to the greater frequency of trains, the new metro line will have a large capacity of transit. After the commissioning of the new line, at first trains will run at every 2 to 2.5 minutes in the rush-hour, at a speed of up to 80 km/h. They will cover the distance between the two terminals in barely 12 minutes.

### **Up-to-date controls, perfect safety**

To ensure safe travel, our engineers have used the most advanced control systems available today. The system, which is run by a computer and is completely automated, monitors the locations of all the trains at any one moment, and controls both their speed and their relative positions. Any possible emergency situations are also handled and resolved by the computer. The opening and closing of doors is also controlled centrally. The job of the train personnel is confined to verifying that everything is working in order. If the train should spend more time than planned at a station, for whatever reason, this modern control system is also capable of adjusting the speed of the train between the stations in order to make up for lost time.

At the end-stations the trains automatically turn around. This results in considerable savings in time compared to the present system, where at each terminus the train goes to the turning tracks, the driver gets out, walks back to the front of the train, gets in and conducts the train back to the station. In the new system, the driver needs not to leave the train. He can walk to the other control cabin while the train is being turned.

With the new technology to be employed, the same system will control the trains and monitor operation's safety. The surveillance of passenger areas and reaching passengers through PA systems are of course part of operation of the current metro lines, too. These will not change in principle, only the technical equipment used will be more extensive and more advanced. The new metro line will also be surveyed from the operations control centre in Szabó Ervin tér. The closed-circuit TV network will be linked up to the control centre, so all that goes on at the new stations may also be monitored here, as well. Thanks to the system of high-level, multi-directional communication, travel safety will increase, any potential emergency situations may be handled and resolved swiftly.

### Plans for above-ground, too

An important part of the metro construction project is the rehabilitation of the areas around the new stations. The mistakes committed in the construction of the earlier lines must not be made again. Back then, the planners were content to build a station for the purpose of leaving the metro, but the physical surroundings of the station were not dealt with. Let us think of Moszkva tér, where the construction of the metro was not followed by any reorganisation of surface conditions, so a badly organised, chaotic situation has been inherited by us.

The basic principle behind the plans for the surface areas was to make travel more convenient and the neighbourhood more pleasant for residents. It was an important consideration that the metro and surface transport should be suitably connected, that transfers from one line to another should be convenient. Another major consideration was to increase green area wherever possible.

Several alternative plans were prepared for each particular square. Before the final decision on surface arrangements, it will be indispensable to consult all the parties concerned, including the local councils, their appropriate committees, as well as the local residents.

The metro plans were prepared with due regard to urban and traffic development plans. Since in the case of many of the areas concerned there are no concrete development plans which include the new metro line, these plans are being prepared by the DBR Metro Project Directorate of the BKV Rt. in close cooperation with the public authorities of the Capital City and the Districts concerned.

## ACTUALITIES

In our permanent column, we provide our readers with information on the events of the period since the publication of our last newsletter. We hope that this column helps everyone to keep up-to-date on the many-sided proceedings of the metro project.

### The Preliminary Plan for the Railway Authority and the Railway Authority Design

Obtaining a Railway Authority permit is a fundamental prerequisite to the construction of any new railway line, and the granting of this permit in the case of Metro Line No. 4 is the jurisdiction of the Capital City Traffic Supervisory Board (Fővárosi Közlekedési Felügyelet). The package of plan documentation, prepared by the consortium led by Főmterv, was submitted by BKV first in January, 1999, then - after effecting the requested changes and additions to first version of the plans - on June 11, 1999. The main contractor is in permanent contact with the authorities, all the arising problems or questions are discussed, and the plans are continuously adjusted to fit requirements.

The authorization proceedings involve several different public bodies whose consent is required for the permit. Particularly important among these are the opinions of the fire-protection authorities, environment protection authorities and the civil defence authorities.

### Surface reconstruction

The building of Metro No. 4 entails the reconstruction and rehabilitation of the surroundings of the metro stations, involving some of the major public squares of the capital city. The reconstruction plans (previously known as detailed regulatory plans) for the Etele

tér/Órmező area have been prepared earlier and are currently before the municipal council, awaiting approval.

As regards the other nine metro stations, six tender invitations have been issued for urban reorganisation plans (with some of these affecting more than one metro station) to eight prominent civil engineering offices specialising in urban planning. The tender calls were prepared jointly by the Chief Architect of the Municipality of Budapest and the DBR Metro Project Directorate, and the closing date is September 15, 1999. The plans will be prepared in two stages, with a more general first version followed by a more definite version containing concrete directions and specifications.

### **Consent from real estate owners**

The list of real estate proprietors affected by the metro project has been compiled. The proprietors concerned have been requested by the chief contractor to grant their consent to the project.

### **Public procurement tenders**

The two last tenders related to the preparation of the alignment of the new metro line concern the preparation of the studies "Preparation of complementary Geotechnical, Engineering-geological and Hydro-geological Works and Report" and "Preparation of a Summary Geotechnical, Engineering-geological and Hydro-geological Report".

The tender calls have been published in the Public Procurement Gazette. As regards the supplementary geological explorations, the tenders have also been opened. The above two studies bring to an end, for all practical purposes, the studies required for the issue of a tender invitation for the execution of the project, and provide for a general compilation of very extensive data collected over several decades.

### **Vibration studies**

The vibration studies conducted in the studios of the Hungarian Radio, aimed at studying the effects of the metro line to be built under the building, have been completed. The evaluation of the results is in progress.

### **Engineering Design Conditions**

In the case of certain purchases which greatly depend on the products and technology of the given manufacturer the planners of the project have not made any plans -- nor would it have been justified to make such plans in view of the tendering process to follow. For this reason, the Project Management Consultant has prepared "Engineering Design Conditions" (describing the required conditions) about the specifications and different conditions concerning the safety equipment, railway tracks, vehicles and different systems. These documents are subject to approval by the Traffic Supervision Board as part of the authorisation process. The Engineering Design Conditions have been completed and submitted to the Board.

### **Experience collected about metro lines in operation**

As member of the Project Management Consultant consortium, Széchenyi István Technical College has collected information regarding engineering, operational, transport, etc.

questions about metro lines in operation around the world, directly from the operators of such metros. The comparison and analysis of these data have now been completed.

### Connecting tunnel

A study has been made with the aim of presenting the advantages and disadvantages - with a view to all possible (engineering, financial, economic, construction, operation) considerations - of a connection at *Fővám tér* between Metro Line 3 and the proposed Line 4, and a connection at the *Keleti pályaudvar* station between Metro Line 2 and the new metro.

## TEN SQUARES -- TEN METRO STATIONS

On the basis of the Preliminary Plan authorised by the Railway Authority, the artist view plans of the stations have been prepared. In the current series of our Newsletter, we shall publish the drawings of the ten metro stations, with a brief summary of their most important characteristics, and shall also present the draftsmen's suggested plans for the surface surroundings of the area.

### Kelenföld Railway Station terminus

The plans for the metro terminus at Kelenföld Railway Station foresee two exits, one in the direction of Etele tér and one in the direction of Órmező. The metro station will be built with provisions for a future extension of the line in the direction of Budaörs. The reconstruction of the bus and tramway terminus of the BKV and the Volán long-distance coach terminus has now been completed on the Etele tér side of the railway station. The metro station will be located to the south of the MÁV railway station. The metro train depot will be located here, too. The train depot will be placed in a trench, according to current plans, so as to protect residents in the neighbourhood from the noise caused by normal operations. There are also plans for the construction of a 1,400-car P+R car park under the BKV bus terminal at the Órmező exit. There will be an underpass leading to the bus terminal, so the buses will be able to reach Budaörsi út without having to cross the roads on the surface. The same underpass will be used by motorists for access to the car park.

With the arrival of the metro, Etele tér will become a major traffic junction point. All forms of public transport will meet here: railway trains, long-distance coaches, metro, tramway, buses. At the same time, thanks to careful planning, the square itself will become much more orderly and the ambience of the as yet neglected neighbourhood will be considerably improved. Etele tér may well become the transport, commercial and service centre for the region.

Inside the metro terminal, there will be three escalators at both ends of the platform to carry the public up to the level of the underpass. The two elevators, carrying up to twelve people each, will also arrive at this level. There will be three further escalators leading to the surface, in the direction of Órmező. The metro tracks will be 16.8 meters below the surface at the terminal. Estimates foresee 83,000 passengers arriving and 79,000 leaving daily at this terminal in the opening year of the metro line.

### Tétényi út

The escalator will go up from the platforms to the corner of the park, on the north side of the service centre. Passengers will arrive in a small pavilion, designed to fit harmoniously in among the buildings of the vicinity, and which will not encroach on the green area of the square. The station building will provide easy access to the other public transport facilities. The Capital City Council is planning to seek investors for the renovation of the service centre, to be done along with the construction of the metro station. If tenders are received, the plans may be modified to connect the exit of the station with the service centre.

With the opening of this metro station, residents of this populous district will gain a direct and convenient means of access to the central part of the city. This facility will further strengthen the central role of the area, and new commercial and service shops will undoubtedly appear.

At the Tétényi út station there will be four escalators leading from the platform to the surface, to the station building. The two elevators, each carrying up to 13 people, will also arrive here. The metro tracks will be 14.9 meters below the surface. Estimates based on traffic surveys foresee 36,000 passengers leaving and 35,000 arriving daily in the opening year. The station will also have a special feature: the middle part of the platform will receive natural light from above, through a skylight.

## IN VIENNA DEVELOPMENT NEVER HALTS

The Austrian capital, with its population of 1.6 million, has one of the best underground railway systems in Europe. The metro is an integral part of the rapid railway network, which plays an important role in both urban and suburban mass transport.

The first parts of the network were opened in 1898. The trains were pulled by steam locomotives at that time, in line with the technology of the age. The lines, for the most part, ran on the surface in trenches, or were elevated above ground. These early parts now form sections of the U4 and U6 lines. The "city railway" (Stadtbahn) lines were electrified in 1925. In 1966 an underground line, previously used by trams, also became part of the metro network (U2).

The construction of "real" underground metro lines began in 1969. Development has been constant and dynamic ever since then. New lines and extensions are being opened from time to time. The network today comprises five lines, with a total length of 63 kilometres. That means more than three kilometres of metro line for 1.000 residents, compared to Budapest where the same figure is merely 1.3 kilometres. There are 82 stations along the metro lines of the city. The five lines meet at nine stations, and passengers can transfer to the S-Bahn (a rapid suburban railway) in fifteen places. In the Vienna metro the length of the stations is 80 or 115 meters. The trains follow each other at an average interval of five minutes, which is reduced to two to three minutes in the rush-hour. The metro starts up at around 5 am., with the last train leaving at 0:30 am.

The coming decade will see a continuation of the development of the metro. Currently, a 4-kilometer extension of the eastern section of the U3 is under construction. Traffic is expected to begin here in the second half of 2000. After the opening of the new section of the U3, an extension of the U1 line is planned in the northern direction, to be finished by 2006. There are plans for the extension of the U2 line, as well. As the first stage of that

project, this year they will begin the reconstruction of the stations along the section in operation at present.

The trains of the Vienna metro are all modern and of uniform appearance - with the exception of the U6 line, which operates "light rail" type trains, powered from overhead lines. Currently they are working on the prototype of a completely new train, incorporating the most advanced technology of the times. Production of the new trains is expected to begin following the trial runs planned for next year.

The metro lines built in different historical periods all contribute something to the city. The stations, bridges, overpasses built in the early decades of the century are eminent products of the "art nouveau". The recently built underground stations present a modern, friendly appearance, are easily accessible and remarkably clean and tidy.

***Published by: Budapest Transport Ltd. DBR Metro***

***Responsible publisher: László Gulyás project director***

***Prepared in: 1500 copies***

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