SAFE, ENERGY EFFICIENT, AND ENVIRONMENTALLY FRIENDLY METRO TRAINS

It has not been decided yet what kind and make of trains will be running on the new Budapest metro line. This depends on the results of the international tender that will be announced during the construction period. Nonetheless, the characteristics of the new trains are already known. The conditions booklet for the vehicles, which contains all the parameters and technical features that are necessary for the tender process, has already been prepared.

What should the new metro trains be like? If one were to ask the passengers, the majority would probably say that they should be comfortable, fast, safe, and attractive. Were one to ask the operator, the response would be that the trains, in addition to the preceding, should be state-of-the-art, energy-efficient, reliable, and low-maintenance. An investor would also have to take into consideration acquisition costs and longevity as well as the fact that the vehicles should be able to provide high quality transportation for the planned number of passengers. And we have not even mentioned compatibility. That is, the new trains will have the same basic dimensions as the vehicles running on the currently operating lines. This will also make it possible to rely on the chosen basic type when the vehicles of the other metro lines are replaced in the future. Therefore, the designers have put together the conditions booklet, which ensures that the Metro 4 vehicle fleet will maximally satisfy the many expectations and demands.

What will the new vehicles be like?

Sixteen four-car trains will run between the Kelenföldi and the Keleti railway stations. According to the plans, the trains will consist of two two-car units, and only the cars at the two ends of each train will have a driver's cab. Since the entire train will form one space (like articulated trams), the passengers will be able to pass through the cars even while the trains are running.

An automatic coupling, which can be easily disconnected, will ensure the connection between train units. By the coupling located in the driver's cab, only mechanical connection can be created with another train. These have the same design as those on the vehicles running on the currently operating line, and, if necessary, the two couplings can be connected to one another.

The new vehicles have a modern light-structure construction, and they are made out of corrosion-proof materials. All of the materials used in the manufacture of the trains are environmentally friendly, and they produce no toxic materials in the course of normal operation or in the event of fire. Only fire retardant and self-extinguishing materials are used in the trains. Every component is "vandal-proof," and graffiti can be easily removed from the specially treated surfaces.

According to the technical conditions, the vehicles will operate with the most up-to-date technical equipment. The electrical equipment will enable energy-saving operation, since they have been made with a modern three-phase drive system and recuperative brakes. The trains' brake system, which will provide maximum safety, will be in full compliance with the European regulations. A visual and aural passenger information system will be built into the trains. Fans will provide draft-free ventilation in the passenger areas, while the driver's cab will be air-conditioned. Vehicles on the current lines must be inspected daily. Because of the materials and technology used in the new trains (including the self-diagnostic system), they will only have to be removed from service once a month for inspection.

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Main characteristics

Length of vehicle unit (2 cars)	**~ 39 m**
Gauge	**1435 mm**
Line voltage	**750 V third track, upper contact**
Normal acceleration and braking	**0.8-1.1 m/s^2**
Emergency braking	**1.2-1.3 m/s^2**
Permitted track speed	**80 km/h**
Vehicle design speed	**90 km/h**
Noise level at a speed of 60 km/h in the passenger area	**78 dB(A)**
in the driver's cab	**75 dB(A)**
Door clearance	**min. 1300 mm x min. 1950 mm**
Capacity (5 standing passengers/m^2)	**min. 380 passengers/train unit**
Number of doors on each side	**4**
Seating arrangement	**lengthwise**

FIRE SAFETY –THOROUGHLY INSPECTED

How safe are tunnels from the point of view of fire safety? Many people have been asking this old question in connection with the tragic fires that took place in the Mont Blanc and Tauern tunnels. The experts have been looking for a reassuring answer for decades, and they have developed technical and operational systems that reduce the danger to a minimum.

It is commonly known that tunnels are dangerous. There are tremendous differences, however, between tunnels. Owing to the manner in which they are used, their functions as well as their sizes and dimensions differ. While anybody can use road tunnels with almost no restriction, strict regulations govern the use of metro tunnels. The metro does not transport flammable materials, and its fuel is not flammable either. Because of the fixed right-of-way and the central computer control, the probability of collisions is minimalised. As much as possible, nonflammable materials that do not emit smoke or gas are used in the vehicles and the various equipment and mechanisms. Consequently, the factors that cause accidents in road tunnels are not present in the metro.

Minimal Danger

Statistics show that the danger of fire occurring in metro tunnels is significantly smaller than it is in road tunnels. Only 0.5% of the small number of fatal accidents that occur in metros are due to fire. One of the last serious accidents occurred in the London Metro in 1987. A wooden escalator that caught fire caused the catastrophe. This source of danger has since been eliminated, and metal escalators are now being used throughout the world. Although there is an extraordinary small chance that someone traveling on the metro will die in an accident caused by fire, designers and operators must prepare for such an eventuality.

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Since the regulations pertaining to the metro's construction and structural materials strictly limit the use of flammable and smoke-emitting materials, electrical fires must be the primary focus of attention in the course of designing the metro. In addition to possible electrical fires, there is also the possibility of intentional arson.

With all of this in mind, well-tried and extremely effective technical safety regulations and organization have been created to deal with the possibility of fire on the Metro 4 line.

But what if …

Heat sensors that will automatically signal a fire have been placed at many points in the metro cars and stations. Each individual fire signal goes to the control center, where the necessary measures will be taken immediately (fans are put into operation, the necessary directions for escape are issued, etc.).

It is most properly regulated ventilation, both on the trains and in the stations, that guarantees that fires on trains will be handled and passengers will escape through smokeless areas. Water sprinklers are an important aspect of protection in the stations.

Ventilation equipment is located at the stations or is connected to them. The ventilation equipment operates in various modes. The designers have also allowed for the "piston effect" normally produced by the trains, since this, in and of itself, can provide ventilation. If necessary, the fans in the stations that provide air for the train tunnel and the station ventilation system can be put into operation. All of this can be done from the control center.

In addition to the built-in equipment and the fire-safety and ventilation systems, there is a need for a detailed firefighting and rescue plan in case of fire. This plan contains the alarm chains, detailed descriptions of the tasks involved in firefighting and rescue, precise escape routes, and the amount of time needed for these. Everyone involved will master this extraordinarily complex chain of actions at a high level at the time of start up, and the activities are recorded in the operating regulations.

ACTUALITIES

In our permanent column, we inform our readers about what has happened since the appearance of the previous issue of our newsletter. We hope that everybody is able to keep abreast of the multifaceted process of metro investment on a daily basis with the help of our column.

MTESZ Environmental Protection Committee Meeting on Metro 4

The Central Environmental Protection Committee of the Federation of Technological and Natural Science Associations (MTESZ) held an expanded meeting on February 3, 2000. The purpose of the meeting, which was held under the title of "The Problems Involved in Managing Metro Lines in Budapest's Mass Transit, an Impact Analysis," was to help formulate the standpoint of the engineers' community.

Two presentations opened the meeting. The first concerned desirable solutions to transportation problems in big cities, and the second was about the history of the development of the Budapest metro system and current plans concerning it. The participants agreed that there is a need for the coordinated development of rapid rail and surface mass transit in Budapest. Several people addressed the crossing under the Danube as a particular concern among the environmental risks of the planned Metro 4. All of them shared the opinion that it is of the utmost importance to deal with the risks in the area of the river.

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Local Plans for the Environments of the Stations

Preparation of the local plans for the station environments began in October 1999, after the tender procedures. The client received the local plan survey and program for the Tétényi út station and the Bocskai út and Móricz Zsigmond körtér station at the beginning of this year. The plans were evaluated by the relevant officials in the metropolitan government (Architectural Office and the Transportation Department) and by the chief architects of the districts. After the evaluation, the local government assemblies approved the local plans. The program for the other stations will probably be ready by June. As it is known, the plans for the Etele Square – Őrmező area have already been prepared.

Public Forum on Metro 4

The Hungarian Transportation Club organized a public forum for the residents in the Villányi út conference center on March 6, 2000. The forum discussed the current state of Bartók Béla út and its neighborhood, the area's mass transportation situation, and Metro 4.

The BKV Rt. representative introduced the plans for the new metro. He mentioned that the development of bus and tram transportation would only provide a partial solution to the transportation problems of South Buda. A designer involved in drafting the local plan and a representative of the Hungarian Transportation Club also expressed their opinions on the reorganization of the area and the solution of transportation problems.

General Assembly Decision on Owner's Approval

Prior owner's approval for use of the privately owned properties affected by Metro 4 was given at the February 24 session of the Municipal Assembly. At the same session, the changes to the Metropolitan Master Plan (FSZKT) also received support, through which it became possible to get approval of the Etele Square – Őrmező area local plan related to the metro.

ENVIRONMENTAL PROTECTION CRITERIA: FULFILLED

Impact on soil, water, and air. Noise and vibration levels. Impact on the natural and artificial environment. Their common feature is that the Preliminary Environmental Impact Study has examined each of these in connection with the preparation of Metro 4.

No significant infrastructure project can begin in Hungary without the preparation of a professional environmental impact study. No factory, sewage treatment plant, shopping center, or highway can be built without one. In accordance with the law that came into force in 1995, preparing an environmental impact study is an important aspect of the authorization process of Metro 4. The successful tenderer, the Mélyépterv Kultúrmérnöki Kft. prepared the summary by the end of 1999. The study prepared with great professional thoroughness examined the planned metro line in terms of every environmental consideration.

Based on the present situation, the analysis examined three future states. It examined the impact of metro construction on the environment. It also examined what can be expected during construction and what can be expected if the metro is not built and the affected area's traffic problems are resolved in a different way. By comparing the favorable and unfavorable effects, the metro's benefits, according to the conclusion of the analysis, far outweigh its potential disadvantages in terms of efficiency, environmental protection, and traffic. What this really means can be seen by a closer look at the findings of some of the environmental studies.

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Soil

The construction and operation of the metro will not have a significant impact on the soil in the affected area. The soil that will be excavated during construction will be used in a manner appropriate to its composition or will be stored at a designated location that will be examined in terms of environmental protection. Chemical pollution (paint, oil, etc.) can only occur at the vehicle depot when the metro is in operation, but it can be avoided by fulfilling the technological requirements. Ecologically active soil – suitable for planting flowers and trees – can replace the previously polluted soil in the station areas when the terrain is being landscaped. The most favorable impact of the landscaping, however, will be an improvement in ecological conditions, not soil conditions.

Water

There will be no danger of water pollution in case of normal operation. The protection of the *karst* waters that flow beneath the Danube is the most important water protection issue in connection with the metro tunnels. The drilling in the Danube's bed verifies that the tunnel's route is optimal. The chosen construction method (closed shield boring) and strict compliance with the technological requirements completely exclude the possibility of polluting or lowering the yield of the thermal waters that are famous throughout Europe.

Air Quality

It is difficult to summarize briefly the findings of the analysis in terms of air quality, since the impact on those who live in the immediate vicinity of the stations, on those who live in the impact area, and on the users of the metro will be different. Once the metro is operating, we can expect an improvement in air quality everywhere where surface traffic will be reduced due to metro use. Therefore, we can expect positive effects in the vicinity of the downtown stations. However, traffic will increase at those places along the metro line where people will arrive by car. This will probably have a negative impact on air quality.

Noise and Vibration

Metro 4 will be very important in terms of noise protection, since conditions will improve in the densely built-up areas with a high noise load once the metro opens. There will be a definite reduction in noise load as a result of the elimination or reduction of tram traffic in the Károly körút – Szent Gellért tér section. A similar positive impact can be expected as a consequence of the general reduction in and restructuring of traffic as well as the road improvements in the affected area.

The metro will also bring positive changes in terms of vibration in the affected area, especially in those areas in which trams 47 and 49 will stop running. Since the metro traffic will partly neutralize the positive effects of the removal of tram traffic, the impact will be felt further away from the metro stations and not in their immediate vicinity.

Health Impact

350,000-400,000 people are estimated to live in the affected area; these people are currently subject to air pollution. Although pollution due to transportation will decline before 2010 regardless of the metro project, the construction of Metro 4 will reduce the danger for approximately 100,000-150,000 people. The new metro line, therefore, will unquestionably create better conditions in terms of public health. We can expect positive effects primarily in terms of respiratory diseases, but the beneficial impact of reducing the noise level is not negligible at all.

Public Safety

The implementation of the planned metro line will affect public safety in the area in two ways. On the one hand, it is expected that the kind of crime typically found in pedestrian

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underpasses will appear in those parts of the city that previously had no metro stations. On the other hand, the metro will also provide a kind of control because of the more intensive presence of the police. The use of security cameras in metro stations for police surveillance is very important for public safety.

TEN SQUARES -- TEN METRO STATIONS

The surface arrangement of Szent Gellért tér and Fővám tér and the design of the stations are now shown among the artist's views made on the basis of the Railroad Authority's Authorization Plan. We underline again that the plans and ideas are under discussion with the authorities involved and the respective local governments.

Szent Gellért tér

The entrance to the metro station is planned for the eastern side of the square where the monument used to be. The metro will be able to reduce the square's road traffic function, thus making the area more pleasant. There is even the possibility of closing down the *Szent Gellért tér* entry section of *Budafoki út*. According to the designers' proposal, the location of the tram tracks and stops will be changed. Simultaneously with the construction works, preparations for the extension of the tram running along the riverbank in the direction of the *Petőfi híd* will begin. The tram running along the shore will be extended in the direction of the *Petőfi híd* while the construction is going on. There is also a possibility that the tram traffic on the *Szabadság híd* would be terminated. The future of the hundred-year old bridge is already at stake. The heavy load has seriously damaged the bridge's iron structure. If there is no change, the costs of repairing the bridge will be multiplied.

Owing to the Danube crossing, the station's platforms will be very deep. They will be at a depth of more than 31 meters. Eight escalators and two elevators will carry passengers from the trains to the pedestrian underpass near the surface. One exit will be built for the station. The designers are planning on 21,000 disembarking passengers and an equal number of embarking passengers at *Szent Gellért tér* every day.

Fővám tér

According to plan, the metro exit will be next to the Budapest University of Economic Sciences. The no. 2 tram stop, which will be thoroughly renovated, can be reached from the passenger underpass. The metro exit will be built in a way that both *Váci utca* and the market hall would be easily accessible. Thanks to this, the downtown area will spread further south along the Danube. In addition to the renovated market hall and the university building, several nearby buildings will be overhauled and remodeled. Tram service can cease on *Szabadság híd* and the *Kiskörút*, and the tracks can be removed. Thus, it is possible that, in addition to the remaining four traffic lanes (two in each direction), the sidewalk will be widened and the green area will become larger.

The *Fővám tér* platforms will be at a depth of 27 meters. There will be eight escalators and two elevators serving the passengers. The station will have one exit. The designers reckon on 32,000 disembarking passengers and 33,000 embarking passengers daily.

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MUNICH: SOON OVER 100 KILOMETERS

It has been less than 30 years since traffic started on the first metro line in Munich. The approximately 20 kilometers of metro line that was built with unbelievable speed has since been followed by 65 more kilometers of new metro sections. This is twice as much as was built in Budapest in its more than 100 years of metro construction.

The people of Munich were overjoyed in the middle of the sixties. The city's 1.3 million residents celebrated in unison, since they had won the right to organize the summer Olympics in 1972. Only the transportation specialists were "frustrated," trying to come up with a way to transport the many people who would be flocking to the games safely and quickly between the various locations. In the fifties, they had been thinking of moving some of the downtown tramlines underground. The Olympic games, however, created such an enormous demand for transportation that it could only be resolved by building a "real" metro. Metro construction started in 1965, and the first section was opened in 1971. Work progressed at a rapid pace, and the second section could be opened in 1972.

Thanks to continual development, Munich now has one of the best underground railway networks in Europe. The length of the eight metro lines reached 85 kilometers by the middle of last year, and it will soon reach 108 kilometers as a result of current construction. The majority of the metro system (82.5 kilometers) is underground. P+R parking lots were built next to most of the metro stations, thus taking the load off the city center. There has been a great emphasis on making the metro convenient for handicapped passengers

The metro in Munich operates for more than 21 hours a day. The first train leaves at around 4 a.m., and the last train around 2 a.m. The trains run somewhat less frequently than what we are used to, although the automatic guidance system allows 90-second headways. The trains run with 6 cars during peak hours and 2-4 cars off-peak. The Munich metro currently has two basic train types. Ten of the newest, third-generation trains, which are manufactured by the latest technology, will be put into operation this year.

The urban railway system, the S-Bahn, which is operated by the German railway company, Deutsche Bahn, is definitely worth mentioning in connection with the Munich metro. Downtown, the eight lines of the S-Bahn run in tunnels like the metro. There is a uniform fare system for the metro and the other forms of mass transit serving the suburbs.

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