

The viewpoint of clients & operators

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I would like to sum up the point-of-view of the client and the operator in what appears to me to be six particularly important aspects:

THERE SHOULD NOT BE PURELY SECTORAL (E.G. TECHNICAL) SOLUTIONS IN SUBSURFACE CONSTRUCTION.

In concrete terms, this signifies: in tunnelling, from the very outset, the considerations and requirements pertaining to the future utilisation must be taken into account alongside the extremely important issues relating to technological and constructive issues. Purely sectoral solutions, which, for example, are merely aimed at fulfilling construction in an optimal manner, can lead to considerable problems during the subsequent utilisation and often as well to very expensive solutions.

Let us turn to some examples: At one time, it was customary to lay bored tunnels, as far as possible in layers of ground, which were easy to penetrate in order to facilitate the construction of the tunnel in technological terms. However, such layers are often located at a great depth. In the case of road tunnels, such solutions lead to costly and lengthy ramp sections and also to considerably higher operating costs on account of the extending of the tunnels section. In the case of underground railway tunnels, major depths compel passengers to overcome substantial differences in elevation, necessitate the installing of long escalators and elevators, cause operational complications and here too, lead to an increase in operating costs. Quite justifiably today, the aspect of making the construction progress as simple as possible has increasingly taken a back seat. Instead comparative considerations are urgently required, for instance, relating to whether it is altogether better to realise a more expensive constructional solution and in turn, arrive at more favourable priced operation or whether the opposite case leads to a better overall result. Whatever the outcome might be, the view of the user and his customer as well as economic criteria are of essential significance. Similar results are arrived at if the effects of the selected tunnelling method on the subsequent operation are included in the considerations. After all, the ground, structure and operation exert a mutual influence on each other, something which must be observed when solutions are being chosen. Let us also take a practical example here: Ground consolidations by means of grouting are in many cases a standard approach in subsurface construction. They are often applied above the tunnel roof when there are bad subsoil conditions and slight overlying ground between the tunnel and the foundations of the buildings. Admittedly settlements on the surface can be avoided in this way, however, at the same time, "sonic bridges" are formed between the tunnel structure and the fundamentals of the building located above the tunnel route. When the tunnel subsequently is in service, local residents are considerably bothered by the structure-borne noise resulting from trains passing through the tunnel. This has to be counteracted by special, sound-insulating superstructures (for example, mass-spring systems) in the tunnel, which cost around 4 times the price of a standard ballast track. In addition, they require more space and as a consequence, make larger tunnel cross-sections necessary. The technical and economic effects resulting from the construction measure are thus considerable.

TUNNELLING IS BECOMING INCREASINGLY AFFECTED BY ITS CONSTRUCTION - AND FOLLOW-UP COSTS

It lies in the very nature of tunnels that they are extremely costly structures both regarding construction and operation. Furthermore, frequently, costs which are substantially in excess of the original estimate occur. This not only leads the calculations tabled during the planning stage ad absurdum, it also gives tunnellers a bad reputation and strengthens the position of those who oppose tunnels. It is thus an imperative need for clients and operators to get tunnelling costs for the decision-taking progress, which are calculated with more accuracy and to which subsequently can be adhered.

Tunnels are being increasingly rejected for cost reasons and above all, on account of the follow-up costs. If for instance, we compare the construction costs for an urban rail line built at grade, elevated or in a tunnel then we come up with a ratio of 1:3:10 to 15. However, an operator is less interested in the more favourable urban planning solution through selecting the tunnel, he is far more concerned with the cost increases, which the tunnel signifies for his company and which affect the budget annually during the service life of the construction. Let us take a few practical examples here as well:

- A surface urban railway stop calls for annual operating cost in Germany of from DM 15,000 to 20,000; an urban railway stop in a tunnel of DM 80,000 to 120,000. The additional costs, for example, for cleaning, energy consumption and maintenance are thus substantial.
- A road tunnel requires annual expenditures of DM300,000 to 400,000 per tube km alone for operating and maintenance costs (for instance, for lighting, ventilation, supervision, cleaning, etc.). In Germany, this up at present to an average annual figure of DM100 million for operating costs. As the overall amount for financing cannot be increased as desired, less money is available for investments (new construction).

The conclusion to be reached here is: more than in the past, we must make tunnel solutions cheaper as far as their construction, operating and maintenance costs are concerned. Only by doing so can we hope to continue to convince clients and operators as well as politicians and general public of the advantages of such solutions.

I am most grateful to the ITA that it has looked into the question of the costs and benefits of subsurface structures in a working group and is still continuing to do so. In this connection, both the direct as well as the indirect benefits must be taken into consideration. Even although not all benefits are monetisable, this is important for "tunnel-marketing" purposes.

TUNNELLING MUST OVERCOME THE "IMPRESSION OF CONSTANT IMPROVISATION"

In the case of many tunnelling methods, above all, those accomplished by mining means, the impression still prevails among clients, operators and outsiders (the media) that in such cases the ground sometimes is less mastered by the tunnelling method but by the adoption of "improvising" counter-measures. Above all, grouting is frequently resorted to as the "panacea" for consolidation and sealing measures.

It goes without saying that not everything in tunnelling is predictable and that in some cases such measures are needed. But one thing is certain: We must make subsurface construction "more planable" if we want to ensure that clients and operators believe in us. In this connection, construction methods must be applied or developed, which take the full scale of possibilities of technical progress into consideration. Here, I include:

- The more accurate pre-investigation of obstacles in the subsoil,
- The more comprehensive application of universal fully mechanised and cheaper tunnelling machines (also for mixed soils) and
- The creation and application of tunnel linings via continuous means (at least, as a temporary lining).
- The standardization of cross-sections in order to use TBM on several building sites (important economic viewpoint !) and for shorter tunnel lengths.



By and large, we are already on the right track in this respect, however, it must be pursued even more resolutely and comprehensively. I can only encourage the ITA working groups on "subsurface planning" and "mechanised tunnelling" to forge ahead with the necessary development work as forcibly as possible. The required technical potential is available or can be acquired from other technological fields. However, it is more important than ever to integrate these other sectors and to apply the right ideas in tunnelling as well.

THE NOTION "TUNNELS ARE VIABLE ENVIRONMENTAL PROTECTION" MUST BE MARKETED MORE STRONGLY.

The awareness of the population with respect to all kinds of negative effects on the environment is increasing strongly. Subsurface structures have considerable advantages to offer with respect to environmental protection in comparison to other solutions. However, these must be marketed far more effectively than up till now. Providing that, two factors have to be taken into account:

- The "constructional weak point" which also exists in tunnelling, is the very substantial transporting of soil and material. This must - as far as possible - be solved in an environmental friendly manner via train and/or ship. Such transports call for consistently well planned logistics. The solution found for the tunnelling operations in the central part of Berlin (rail and road tunnels) reveals on the one hand that water and rail transports are technically feasible and on the other, that such solutions receive a highly positive response from the general public. This is ultimately good publicity for tunnelling.
- The "operational weak points" comprising fume emissions (in the case of road tunnels) and noise and vibration emissions (in case of rail tunnels) must be properly taken into consideration and resolved. Here as well, far too much is subsequently corrected instead of being planned



in advance, i.e. protective measures are first undertaken once local residents complain. However, by then, usually only less effective measures are possible and in addition, the essentially positive image of the tunnel solution has fallen in the eyes of the public and is difficult to restore.

The ITA working group "tunnels and environment" has thus the correct and important task of displaying the link between tunnelling and environmental protection and of showing good solutions through case examples.

CRIME AND VANDALISM IN UNDERGROUND STRUCTURES MUST BE EFFECTIVELY PREVENTED

Subsurface facilities (above all, Underground stations) are prone to crime and vandalism more than most other structures. As a result, they are increasingly avoided, especially during the evening hours. This means that the transportation company loses customers and revenues and the value of the facility is considerably reduced. As a consequence, today it is more important than ever before to orientate subsurface facilities from the outset so such aspects. This signifies in concrete terms that:

- No subsurface facilities should be set up with hidden corners and areas; instead they should always easily monitored (for instance, via video) from a central control room;
- High-grade and easily cleaned lining materials should be applied;
- Immediate removal of such contamination directly after they occur, as they otherwise result in further damage (zero tolerance concept);
- Exclusive utilisation of transparent (glass) elevators instead of closed versions whose interiors are not visible;
- Light and friendly design of the facilities with good lightning and high-quality fittings,
- Installation of kiosks, shops or the likes in order to further "liven up" the subsurface facilities.

There have been interesting developments particularly with regard to the last-mentioned point. Berlin has, for example, set up a number of especially outstanding stations in a "public-private partnership programme". This means:

- A private investor is invited to put forward a bid.
- The investor takes over the responsibility for the designing modernisation, cleanliness and repair of the stations and concludes sub-leasing contracts with third parties.
- The Underground station becomes a shopping mall with service and goods of all kinds on offer.

The success of such measures is already evident after a number of the converted stations have gone into service.

Such solutions should essentially be followed up to a greater extent as they make a lasting contribution to ensuring that subterranean stations are cleared of crime and vandalism thus creating clean service facilities, which can act as the operator's "visiting card". The utilisation frequency increases markedly as a result, which in the end effect, represents the most important ultimate goal for the establishment of such subsurface structures.

THE INTER-DISCIPLINARY TASK "TUNNELLING" REQUIRES FAIR PARTNERSHIPS

Tunnelling is an interdisciplinary task more than in the case of other constructions. This can be attributed to the diversity of the task, but also to the fact that in spite of the most careful preparations, not everything in tunnelling is predictable. As a consequence, this means that geologists, civil engineers, mechanical engineers, electrical engineers, clients and operators - and sometimes even lawyers - must work closely together during the planning phase as well as during the execution of the project in order to come up with a balanced and high-quality solution in both constructional and operational terms. This applies first and foremost, to a clear demarcation of responsibilities as well as to a fair distribution of the unavoidable risks. In this conjunction, all those involved must depend on trustful collaboration. Clients and operators deserve to obtain a high-quality and reasonable priced structure in conformity with the submitted bids. On the other hand, it is equally essential that the contractors also do not find themselves unilaterally burdened with all non-calculable risks - above all, for instance, the subsoil risk - and in turn, the effects on the costs. It goes without saying that legal assistance is in some case necessary for both sides, during the formulating of the contract as well as subsequently interpreting its contents; however, "assistance" should be the key work, which fairly reflects marginal conditions which might have changed rather than juristically one-sided contractual interpretations. It cannot be in the client's interest to ruin tunnelling contractors, for future structures must also be built with their involvement.

It appears to me that a shadow has fallen on the subject of trustful collaboration among all those involved in tunnelling during the last years. This is something, however, which our branch must comply with very carefully, for essentially, it leads to

- saving at places, where it does not apply
- lower quality
- demotivation of those involved in the project
- higher contracting risks (safety !) and in turn, to
- inferior constructional solutions.

Corrections are urgently called for here, which - in order to make this quite evident - is no call for currying favours and inappropriate advantage but clearly for fair partnership between clients and operators on the one hand and contractors on the other.

SUMMARY

The above-mentioned rules clearly do not represent a definitive catalogue. However, they are of elementary importance for the future of the tunneller. It is imperative that the "pent-up demand" on this sector is recognised not simply by clients and operators, but also by tunnelling engineers instead of getting wrapped up in their technical solutions only. For one thing can safely be predicted: Tunnelling's problems will increasingly revolve around the future approval of major projects.