

Working Group n°13
« Direct and Indirect Advantages of Underground Structures »
GENERAL REPORT

FOREWORD

In the late 1980s, the ITA decided to go more thoroughly into the issues concerning the numerous advantages of underground structures. This has always been a concern of the association and Working Group Number 4 on “Subsurface planning” had been set up from the origin of the association in 1974. This working group exchanged information on successful examples of underground planning and underground structures over its 27-year life. It published many articles and papers and several reports on general topics concerning underground planning or on famous examples of underground structures. In order to appreciate the very important work achieved by this group, one can refer to the excellent report established by Annica Nordmark (Sweden), who ran this group during its last nine years.

On the occasion of the ITA General Assembly in Brighton (1982), Working group Number 10 was set up with the general topic “*Cost-Benefit of Underground Urban Transportation*”. Under the animateurship of Dr. F. Blennemann (STUVA, Germany), this Working Group published the following reports:

- “*Examples of Benefits of Underground Urban Public Transportation systems*” (TUST, Vol.2 No.1, 1987).
- “*Cost-Benefits Methods for Underground Urban Public Transportation Systems*” (TUST, Vol.5, No.1/2, 1990).

CREATION OF THE WORKING GROUP NR. 13 ON “DIRECT AND INDIRECT ADVANTAGES OF UNDERGROUND STRUCTURES”

Working Group Number 13 was set up during the ITA General Assembly held in Toronto (Canada) in 1989. **Jean Paul Godard** (France) was appointed as animateur.

Through the creation of this working group, the ITA was interested in generalizing the study of the advantages of the underground structures rather than focusing on individual examples. Six countries participated in the first meeting in **Toronto (1989)**: Belgium, France, Italy, Japan, South Africa and Czechoslovakia.

The first statement issued at the creation of the group was as follows:



“This new working group has been set up to deal with subsurface use costs and benefits. Among its tasks, a thorough look at construction cost evolution and the determination of indirect advantages of the main types of underground facilities will be priorities in the near future. Due to the wide range of fields and specialities it embraces, reaching well beyond the technical domain, a step-by-step approach will be adopted, starting with a questionnaire to be sent to all national ITA representatives, and preliminary contacts to be made with other international

associations dealing with some of the related fields.”

IN SEARCH OF A METHOD FOR THE WORK

The year following the Toronto meetings was devoted to the preparation of documents dealing with the general approach of the topics to be treated. At the **Chengdu meetings (1990)**, the Animateur presented a set of documents for discussion. These documents covered the following topics:

- a) A note concerning the methodology aspects related to the scope of study. This document stressed particularly that the advantages of underground structures should be appraised with respect to the socio-economic environment of a structure;
- b) The relevant list of the various expectations and requirements from the socio-economic environment of a structure;
- c) A list of the structures to be taken into account in the study;
- d) A glossary of the specific terms used in the study;
- e) A preliminary questionnaire to be filled in by each country. The purposes of this questionnaire were:
 - i) A general inventory of different types of underground structures implemented in each country;
 - ii) A rough identification of the reasons justifying the underground solution, for the main types of structures;
 - iii) An inventory of the fields to study closely, in order to highlight the specific advantages of underground structures.

QUESTIONNAIRE SURVEY OF THE ITA MEMBER NATIONS

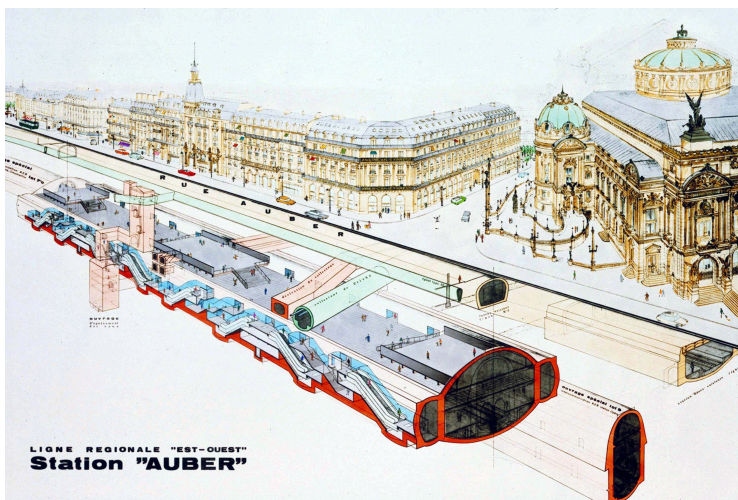
After the Chengdu meetings, this set of documents was sent to the 37 ITA Member Nations. Eleven Member Nations answered the questionnaire: Australia, Belgium, Brazil, Finland, France, Japan, India, Czechoslovakia, South Africa, Switzerland, and USA. The content of these replies were discussed at the **London meetings (1991)**, where **Raymond L. Sterling** (USA) was appointed as Vice-animateur. Considering the extensive mandate of the Group and the necessity to avoid any uncertainty in the analysis of this complex topic, the Group adopted two main resolutions:

- First, to express questions in such a way that they can receive the same interpretation in all countries, independently of their state of development;
- Second, to send a reminder to those ITA Member Nations which had not yet replied to the questionnaire, in order to allow for an exhaustive survey of needs in the field of underground structures.

DECISION TO FOCUS ON SPECIFIC UNDERGROUND FACILITIES

At the **Acapulco meetings (1992)**, considering that the topic was very broad and quite open-ended, the Working Group decided on two principal approaches:

- To focus on one particular type of facility at a time and develop a report to act as a source book for the preparation of cost-benefit studies of underground solutions for this type of facility;
- To continuously collect basic data and case studies from member countries which help to quantify and illuminate the specific issues involved in the underground placement of various types of facilities.



Thus it was decided that the primary focus for the study would be underground parking facilities. Actually, urban parking was one of the high priority issues arising from the previous questionnaire. In addition, this type of facility appeared as a well-defined and relatively simple type of structure for an initial effort.

During the following years (1992-1993), materials regarding underground parking facilities were received from six countries: general reports from France and Japan, case studies from France, Japan, Sweden and the USA, and other data from the Czech Republic and South Africa.

At the Amsterdam meetings (1993), the group decided to continue data collection by requesting information from major cities in ITA Member Countries.

Regarding cost-benefits associated with relative environment impacts between above and below-ground structures, basic data were collected simultaneously from several countries. For example, the Paris Region prepared several analyses of the financial cost associated with air pollution, congestion, accidents and noise with regard to the various types of transport. This case provides a means of quantifying some indirect benefits of subsurface construction in financial terms. The French data also included information on subsurface easement costs. Data also were compiled from specific communications or previously published papers from the Czech Republic, Sweden, United Kingdom and the USA.

AN IMPORTANT MILESTONE: THE CAIRO MEETINGS (1994)

The Cairo meetings (1994) were especially important regarding the production of the working group, because two draft reports were presented and discussed there.

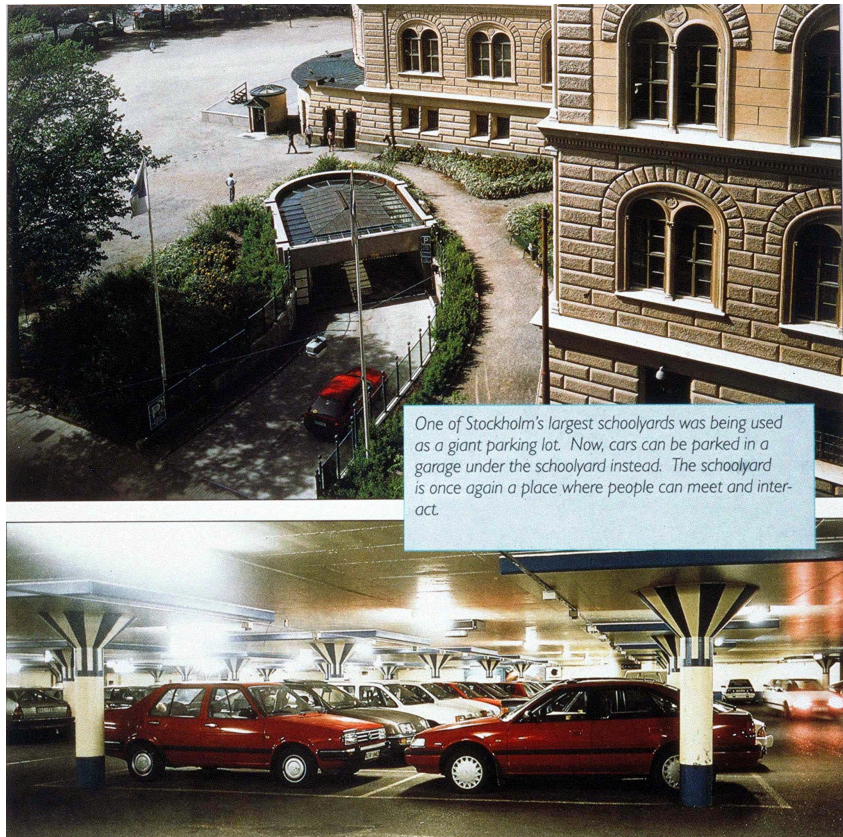
The first report concerned the « *General Considerations about the Assessment of the Advantages in Using Underground Space* », which constituted a general introduction for a series of reports treating several specific uses of underground space. This report covered the following principal issues:

- on what are the advantages of using underground space based?
- who benefits from the advantages of using underground space?
- what factors are to be taken into account to assess the advantages;
- what is the distinction between direct and indirect advantages?
- how to value the advantages?

The second report concerned “*Underground Parking Facilities*”. This report was the first treating a specific use of underground space. It comprised three parts:

- a general overview on “*Underground Car Parks*”;
- a part regarding “*International Case Studies*”;
- and a part concerning “*Underground Car parks in France*”

These two reports were published in *Tunnelling and Underground Space Technology in 1995* (Vol.



TOWARDS A NEW STUDY: “UNDERGROUND URBAN MASS TRANSIT SYSTEMS”

At the same meetings in Cairo, the group decided to choose as its next topic of study “*Underground Urban Mass Transit Systems*”.

At the **Stuttgart meetings (1995)**, the group started the establishment of a scheme for the data collection and presentation regarding case study reports by cities and more general conclusions drawn from them. Following this decision, a questionnaire was sent to all ITA Member Nations at the beginning of 1996. The very first answers received before the **Washington meetings (1996)** were encouraging, since 27 cities from 11 countries had indicated their intention to take part in this study: Belgium, Brazil, France, Hungary, Japan, Norway, Netherlands, Czech Republic, United Kingdom, Sweden, and USA. All Member Nations were requested: (1) to encourage the distribution of the questionnaire to appropriate individuals and organizations for a response, (2) to provide a national synthesis report on the subject.

At the **Vienna meetings (1997)**, the Group discussed the status of the responses to the questionnaire, received from 21 cities from 12 countries. The deadline for further responses was extended to the end of June 1997. In addition, two draft country reports were received from France and Japan. At this same meeting, **Raymond L. Sterling** was appointed as the new Animateur of the Group, in place of Jean Paul Godard who had entered the ITA Executive Council two years previously.



By the **Sao Paulo meetings (1998)**, the total of responses received was 27 from 16 countries. These meetings were mainly dedicated to a preliminary compilation and analysis of the questionnaires received. These responses provided a very useful set of data to underscore the discussion of the choice between above-ground and below-ground systems. Following a discussion of the issues raised, the Group organized itself to prepare a draft of the findings of the study, while requesting additional comments and suggestions from participants and correspondents. At the same meetings, the Group benefited from two presentations:

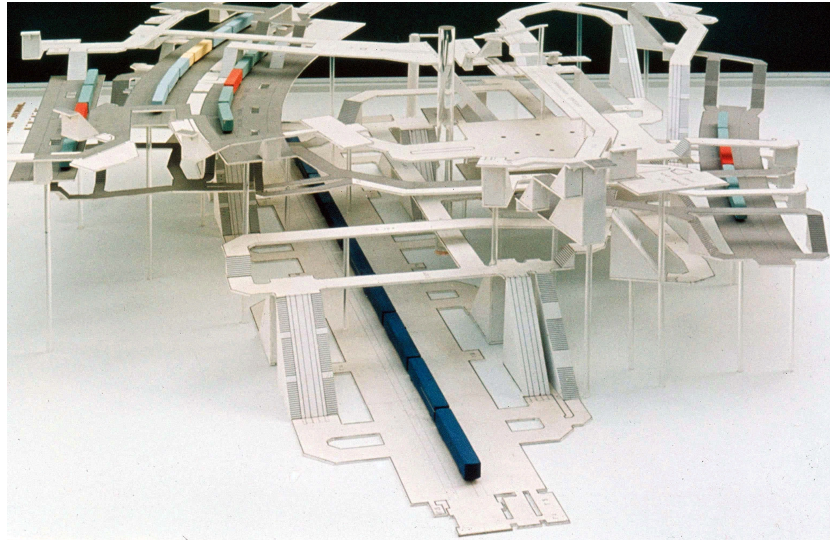
- One on the choice between above-ground and below-ground for the planning of a new line for Sao Paulo Metro;
- Another about the need for consideration of the use of the deep underground for transportation and other uses in Tokyo.

In addition, the Group discussed possible topics which could be treated following the conclusion of the current study. The principal suggestions considered were:

- To examine the question of the value of underground land which also relates strongly to the questions raised in Japan about the use of the deep underground to avoid restrictions placed by surface ownership.
- To go deeper into the question of cut-and-cover versus tunneled solutions for infrastructure facilities.

At its **Oslo meetings (1999)**, the Group continued the analysis of data and the review of contributions for the study between above-ground and below-ground structures for transit systems. A title was then chosen for the report: *“Underground or Aboveground? Making the Choice for Urban Mass Transit Systems”*. A response from Moscow brought the total of questionnaire responses received to 29 from 19 countries.

A lively discussion was held on many issues regarding the ways in which transit planners and the responsible political decision makers compare long-term environmental benefits with initial cost considerations. It had been hoped to have the final draft report ready for approval at these meetings. However, slow progress in the preparation of some sections of the draft report and a need to discuss the contributions led to the Oslo meetings being needed prior to completing the report. At the same meetings, it was also discussed to some extent what activities should be undertaken by the Group in the future:



- One task that the Group was willing to undertake was the preparation of several short information pieces that could be placed on the ITA website. These information pieces would set out the direct and indirect advantages of underground structures in broad terms and would be directed at policy level decisions on whether an underground alternative should be considered.
- Another task could be focused on a study of the way in which underground projects interact with the value of land both within and adjacent to underground works. Neglecting consideration of the value of underground space occupied by a project could have significant long-term consequences for the development of dense urban areas. Such a topic also relates strongly to questions raised in Japan about the use of the deep underground to avoid restrictions placed by surface ownership. Also, the issue of adjacent land value changes can be one of the most important long-term financial implications between an elevated structure and an underground structure for a road or rail segment.
- And, at its previous meetings, the Group had also discussed the question of cut-and-cover versus tunneled solutions for infrastructure facilities.

In this regard, input was requested from the Executive Council on the choice of the next task(s) for the Working Group.

The **Durban meetings (2000)** were a new turn for the Group with the appointment of **John Reilly** (USA) as the new animateur and **Pal Kocsonya** (Hungary) as Vice-animateur. The Group discussed finalization of the draft report *“Underground or Aboveground? Making the Choice for Urban Mass Transit Systems”*.

The data received in response to the questionnaire were very useful to illustrate the essential characteristics of the cities and transport networks that replied. However, one of tasks of the group was to establish a summary of these in the report and the group's concern rested on the fact that many cities and transport networks did not appear in the data. Furthermore, it was not surprising that the data showed great variations in the characteristics of the various systems and cities. As a consequence, the group decided to end up its work by describing and commenting over the decision process in the considered field, in the spirit of the general topic of the group. It was thus suggested to establish a statement of the essential questions factors criteria and considerations illustrated by concrete cases in

a useful form for the decision-makers, notably the politicians and the people who fix the orientation in this regard: the town-planners, engineers, and infrastructure managers.

In Durban too, some coordination meetings were held with the Animateurs and Tutors of Working Groups Number 4 (“Subsurface planning”) and Number 15 (“Environment”). Actually, the three groups had similar aims in terms of data collection. It was agreed that a cooperation in the collection of data and of concrete cases would lead to better results.

The group devoted its **Milan meetings (2001)** to the finalization of its report for presentation to the ITA Executive Council and publication in TUST. Additionally, as in Durban, coordination activities were continued with the Animateurs and Tutors of Working Groups 4 and 15.

The report “*Underground or Aboveground? Making the Choice for Urban Mass Transit Systems*” was finally submitted for Executive Council review on the occasion of the Sydney meetings (2002). It was accepted in 2003 and published in **TUST Vol.19 (2004)**.

SYDNEY (2002): A NEW START WITH THE WORKING GROUP NUMBER 20 ON “URBAN PROBLEMS, UNDERGROUND SOLUTIONS”

Following the coordination meetings which had been held between the working groups 4, 13 and 15, and considering the critical problems faced by most of cities regarding their development, it was decided to focus on urban areas with the creation of a new working group in charge of demonstrating how some of the main urban problems can or could be solved by a more extensive and rational use of the underground space. Working Group Number 13 then dissolved and its efforts were redirected to the newly formed working group.

EPILOGUE

The task assigned to the working group in 1989 was very important, and perhaps too heavy for a single working group! Actually, apart from the general qualitative considerations that are frequently quoted in papers and communications, it proved to be very difficult to highlight in a quantitatively precise way the advantages of underground structures. In this respect, it is considered that the chosen approach was certainly appropriate but probably many other types of structures deserved to be studied.

Thus, a lot remains to be done regarding the topic! It is hoped that the new ITA Committee on “*Underground space*” (ITACUS) that the ITA set up officially in early 2008 will initiate a new start in developing a broad awareness of the many advantages of the use of underground space.

ACKNOWLEDGMENTS

The important output of the working group would not have been possible without the great interest and involvement of many colleagues from the “ITA Family”. It is difficult to recognize all of them, but it is sure that this short history will raise some good memories.

The ITA Member Nations which regularly participated were: Australia, Belgium, Brazil, Czechoslovakia, Czech Republic, Finland, France, Hungary, India, Italy, Japan, Lesotho, Netherlands, Norway, South Africa, Sweden, Switzerland, United Kingdom, and USA.

A special mention must be made to the colleagues who led the group’s efforts:

- As animateurs, successively: Jean Paul Godard (France), Ray Sterling (USA) and John Reilly (USA)
- As vice-animateurs, successively: Christian Dochy (Belgium) and Pal Kocsonya (Hungary).

Finally, such working group activities changed some initial “colleagues” into very good “friends”. And this is not the smallest merit of the ITA!