

Guidelines for Good Tunnelling Practice: Summary of the ITA Working Group Report

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Abstract—This paper summarizes the contents of the ITA's Guidelines for Good Tunnelling Practice, which were compiled by the ITA Working Group on Health and Safety in Works. The guidelines deal with the following major aspects of health and safety in tunnelling: hygiene and safety planning, underground traffic and movements in shafts, ventilation, illumination, drilling and blasting, occupational health, underground electrical installations, the use of compressed air as a power source, and tunnelling with compressed air.

Résumé—Cet article résume le contenu du Guide pour une bonne pratique de l'art de percer des tunnels de l'AITES qui contient les résultats du groupe d'étude de l'AITES sur la santé et la sécurité lors des travaux. Le guide traite des aspects les plus importants en ce qui concerne la santé et la sécurité dans les tunnels: l'hygiène et la sécurité, le trafic en sous-sol et les mouvements dans les conduits, la ventilation, l'éclairage, le percage et l'explosion, les problèmes de santé des aux travaux, les installations électriques en sous-sol, l'utilisation du compresseur en tant que source de courant, et le percement des tunnels au compresseur.

The ITA Working Group on Health and Safety in Works was formally established by the ITA at its second general assembly, held in London in February 1976. The participating nations were the United States, United Kingdom, Japan, Australia, Italy, France, Finland and South Africa.

The group set as its initial task the production of Safety Codes that would prescribe procedures that would then, it was hoped, be adopted throughout the world with a minimum of local amendment. The group was to confine itself to the topic of safety during underground construction.

It was anticipated that during the preparation of the Safety Code, it would be possible to issue a series of recommendations on specific subjects. In this regard, it was felt that a single standard for safety signs could be formulated at a fairly early stage.

Initially the working group set about the preparation of an index of national legal and administrative regulations. For this purpose, the members of the working group obtained a great deal of information regarding standards and codes relevant to safety in tunnelling used in member countries.

It soon became apparent that the preparation of an index as originally proposed would prove to be a monumental task, and the real value of the index was questioned. As a result, the

group began to concentrate on formulating a single standard for safety signs. This study led to the ITA's acceptance and publication in 1981 of a number of standard safety signs for use during underground construction.

During 1980 the working group determined a new objective: the preparation of guidelines for safe working conditions in the areas of traffic, ventilation, illumination, and drilling and blasting. In 1984 the ITA published the first edition of the document entitled *Guidelines for Good Tunnelling Practice*. In addition to the aforementioned subjects, this edition includes recommendations for a hygiene and safety plan, and for occupational health in tunnelling.

A second edition of the guidelines has since been adopted and includes additional chapters on electrical installations, the use of compressed air, and working with compressed air. The group is currently considering proposals on the use of tunnel boring machines and roadheaders, dealing with water, and underground communication.

The guidelines are not intended to constitute a Code of Practice; nor are they intended to replace any existing local regulations. Rather, they are meant to aid tunnellers in achieving improved working conditions. The guidelines could be of special benefit to developing countries where detailed regulations to cover all aspects of underground construction may not exist. It is to be hoped that member countries of the ITA will encourage the use of these guidelines in an endeavor to attain safer underground construction conditions.

Summary of Recommendations

The first chapter of the guidelines, *Hygiene and Safety Plan*, identifies the main risks in underground construction, such as overturning of machines, falling rock, explosives, dust and noxious gases, noise and fire. The chapter also indicates what steps should be taken in the event that one of these risks should occur.

The second chapter, referred to as Section A, deals with *Underground Traffic and Movements in Shafts*. It is recommended that pedestrians be allowed to walk on only one side of the tunnel, which should be clearly indicated; and that each pedestrian or group of pedestrians should have a light, since they must be seen as well as be able to see. Where railed equipment is used, groups should be transported in specially equipped units.

It is recommended that training of personnel should receive high priority, as it is vital to the safety of the work. With regard to the movement in shafts, detailed recommendations for the lowering and hoisting of personnel are given. A signal code is included as an appendix to the guidelines.

Section B, dealing with *Ventilation*, recommends that the average flow of air in the tunnel or shaft should be between 10 m per min and 45 m per min. The minimum quantity of air for personnel should be 3 m³ per min per person.

The next section, on *Illumination*, recommends that all headings in which work is being performed or which are used as normal access to a working area be illuminated at all times throughout their length, at intervals not exceeding

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20m, and that 100W incandescent lamps should be used.

Section D, on *Drilling and Blasting*, makes extensive recommendations on the use of drilling machines and the use of explosives. Drilling machines should be properly designed to undertake underground work. With regard to the use of explosives, it is recommended that only water-resistant explosives be used and that firing lines be installed on opposite sides from powerlines or other conductors such as waterlines. Explosives are to be transported in vehicles specially designed for the purpose and clearly marked. It is imperative that adequate ventilation be provided to ensure the removal of all noxious gases before re-entry to the working face after blast.

Section E, dealing with *Occupational Health in Tunnelling*, states that the main dangers to health in tunnelling are dust, noxious gases, noise, heat and humidity.

To reduce the incidence of dust, it is recommended that wet blasting be used during drilling and that adequate ventilation be provided. Because of the large emission of CO and of nitrous

fumes, petrol-driven combustion engines should not be used underground. The guidelines recommend that only diesel engines or electrically driven or rechargeable battery-operated motors be used.

Tunnelling is one of the noisiest occupations. Various noise reducing measures are recommended, including reduction of machine noise, improved design of equipment, and personal protection. With regard to the latter, it is recommended that protection be provided where a noise level equal to or larger than 90 dB (A) exists.

Section F deals extensively with *Underground Electrical Installations*, including matters such as voltage, cables, switchgear, grounding and transformers. It is recommended that for underground lighting, voltage should not exceed 50V. Electric cables should be constructed of materials that will not emit toxic gases when they burn; and, where high voltage cables are used i.e. in excess of 1000V, very high standards of protection--especially against mechanical damage--are necessary. It is also necessary to provide adequate grounding and bonding for all electrical installa-

tions and equipment. Only transformers with air-cooling or with non-flammable coolants should be used underground, and transformers should be sited to minimize the risk of damage.

Section G, *Use of Compressed Air as a Source of Power*, states that proper maintenance of compressors and air-powered equipment is vital to their continued safe operation. With regard to air lines, it is recommended that for the main supply, quick coupling metal pipes be used, and that shut-off valves be installed in all main supply lines at a maximum space of 500 m.

Section H, which deals with *Tunnelling with Compressed Air*, includes various recommendations about medical examinations, safety measures to be taken before work starts, precautions to be taken during construction operations, and precautions to be taken after work.

Copies of the complete guidelines may be obtained from the ITA Secretariat for FF 50 plus mailing cost. Contact: ITA Secretariat, 109 Avenue S. Allende, 69500 Bron, France. Tel.: 78.26.01.55. Telex: 370008.

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