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Group of Experts on Safety in Tunnels
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INTERIM REPORT OF THE TUNNEL TASK FORCE

Transmitted by the Federal Road Bureau (OFROU) of Switzerland

This document contains a summary of the interim report of the Task Force responsible for the consideration of safety aspects in the Gothard and San Bernadino Tunnels.

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CHAPTER A

SUMMARY/BASIC MATERIAL

This summary gives only part of the information contained in the interim report and is no substitute for reading the report in full.

On 24 March 1999 a lorry carrying margarine and flour caught fire in the Mont Blanc road tunnel. The fire spread rapidly to other vehicles. Thirty-nine people lost their lives as a result of the intense smoke and heat.

This event led the Director of the Swiss Federal Road Bureau (OFROU) to establish a Task Force to consider safety aspects in the Gothard and San Bernardino road tunnels.

Following the accident in the Tauern Tunnel on 29 May 1999, the study was extended to all tunnels more than 600 m long in the national road network.

With the establishment of the Task Force, OFROU has intensified and concentrated its efforts to achieve and guarantee optimum safety in road tunnels on a sustainable basis. Following an initial intensive phase, the Task Force's activities will ultimately be incorporated into the organization of OFROU.

The Task Force is made up of OFROU staff under Michel Egger, Deputy Director of the Infrastructure Division of OFROU. In order to ensure broad-based acceptance of the Force's analysis and proposals, a steering committee has been set up comprising experts from other federal offices, the cantons, the police, the fire brigades, the Federal Institutes of Technology and the private sector.

The Task Force is responsible for a very wide-ranging area of activity relating to safety in road tunnels:

- It temporarily has a leading role as regards all matters relating to safety in road tunnels.

- It checks all aspects of safety and where necessary orders measures applying to road-users, operation, infrastructure or vehicles.

- It issues guidelines concerning new facilities as well as modifications of existing tunnels, whether in relation to construction or operation.

- It ensures contacts and exchange of information with neighbouring countries.

- It intensifies public relations activities.

In this interim report, the Task Force provides information on work carried out to date, the results obtained and future steps scheduled. It takes a stand on various proposals submitted by associations and private individuals.

After consultation with the steering committee, it submits proposals relating technically to the achievement of optimum safety in tunnels on a sustainable basis.

The measures proposed have been divided into three categories, namely:

- Proposals to be implemented
- Proposals to be considered
- Proposals to be rejected

At 1 January 1999, 188 tunnels were in service in the Swiss road network. In 2015, when the network has been completed in accordance with the plans adopted to date, there will be 265.

	Tunnels at 01.01.1999		Tunnels in 2015	
	Number	Km	Number	Km
Single-bore tunnels	91	90.5	118	138.9
Double-bore tunnels	97	78.7	147	141.1
Total	188	169.2	265	280.0
Main roads in service		1 638		1 856

The building of main roads can no longer be envisaged without tunnels, as the above table shows. Of the 218 km still required to make up the network, 111 km will be tunnel sections.

The number of accidents and fires is increasing as the volume of traffic rises; traffic is measured as ADT (average daily traffic). The following table shows that the ADT in the transalpine tunnels is well below that of tunnels in the plain.

Tunnel	Location	Number Bores	Lanes	Length (km)	ADT (thousands)	HV (%)
Gothard	TI/UR	1	2	16.9	18.3	21
Seelisberg	UR/NW	2	2+2	9.2	20.0	16
San Bernardino	GR	1	2	6.6	5.9	9
Great St. Bernard	I/CH	1	2	5.9	1.5	11
Gubrist	ZH	2	2+2	3.2	81.0	9
Beichen	BL/SO	2	2+2	3.2	37.7	17
Baregg	AG	2	2+2	1.1	88.1	10
Schweizer-halle	BL	2	3+3	1.0	103.4	12

Key:

ADT: Average daily traffic 1998

HV: Percentage of heavy vehicles in average traffic on working days according to the Swiss road traffic census of 1995

SAFETY IN ROAD TUNNELS: OBJECTIVES AND FACTORS OF INFLUENCE

Objectives

In order to ensure an optimum level of safety in road tunnels the following objectives must be achieved:

- As a matter of priority, the prevention of critical accidents endangering human life, the environment and material structures.

- In second place, in the case of events such as accidents or fires:

  - restriction of the extent of the damage

  - saving of persons

  - response by the emergency services

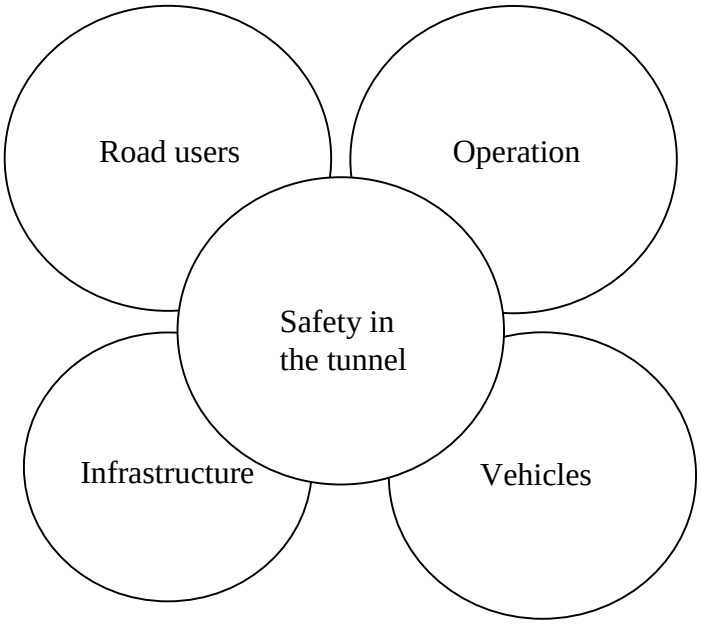
  - protection of the environment

  - limitation of material damage

Factors of influence

Overview

Safety in road tunnels is influenced by various factors, set out below in four main groups:



Conclusion

The vast majority of road tunnels and their facilities present a high level of safety. This is the current result of a review of tunnels in the Swiss road network. It may be observed that Swiss safety standards and the recommendations of the World Road Association (PIARC) have been systematically applied.

Measures need to be taken, however, on the one hand because some tunnels and facilities should undergo more detailed inspection, and on the other because safety in tunnels does not depend only on the infrastructure but also on other factors such as the behaviour of road users and the state of their vehicles. Safety in tunnels is a very complex question which is still going to need additional efforts. This is why some of the measures required have already been implemented; the rest will be implemented in the medium term.

Measures

The measures and proposals of the Task Force are divided among the four main factors influencing safety in road tunnels: road users, operation, infrastructure and vehicles.

1. Proposed measures for road users

Measure 1.01: An information campaign should be prepared and conducted in collaboration with the main partners.

The information campaign will essentially concern behaviour before and after entering a tunnel, particularly if there is a bottleneck or a fire. Inside the tunnel the same rules of the road should be observed as for open sections of road (sufficient distance between vehicles, observance of maximum speed limits and maximum weights permitted, safety of load and traffic safety in the event of a breakdown).

A press release of 9 July 1999 gave details of what to do in the event of a bottleneck or a fire in a tunnel:

What to do in the event of a fire in a tunnel

- Stop on the side
- Turn off the engine immediately
- Leave the vehicle and the site of the fire immediately

Important: U-turns and reversing strictly prohibited!

What to do in the event of a bottleneck in a tunnel

- Stop on the side
- Turn off the engine immediately
- Do not leave the vehicle
- Turn on the radio

Important: U-turns and reversing strictly prohibited!

Measure 1.02: Specific questions on what to do in the event of a bottleneck or a fire in a tunnel should be included in the driving test.

During the mandatory driving lessons, learner drivers are taught to drive responsibly and on the defensive. At the same time they learn how to react correctly in special situations such as bottlenecks, fires or in tunnels.

Measure 1.03: There should be reinforced inspections of heavy vehicles and the transport of dangerous goods. The necessary credits need to be released.

This measure does, however, represent an additional financial burden for the cantons. In connection with the agreement on transport by land, the Federal Council has requested an amendment of the federal act on the mileage-related heavy vehicle tax (RPLP). The revenue from this tax should permit a financial contribution to be made available to the cantons most affected in order to enable them to finance these inspections. Parliament has approved the amendment which will be endorsed at the autumn session.

Measure 1.04: Specific questions concerning conduct in road tunnels should be included in the training for drivers of vehicles carrying dangerous goods.

All drivers of vehicles carrying dangerous goods should receive special training sanctioned by an examination and the issue of an SDR/ADR certificate. Every five years they should take a refresher course and an examination in order to continue to hold the certificate.

Measure 1.05: The recommendation to leave the tunnel insofar as it is possible when a vehicle catches fire should be reconsidered.

When a vehicle catches fire, drivers cannot be required to leave the tunnel. Doing so would also endanger oncoming vehicles.

However, advising drivers to leave the tunnel in the event of a vehicle fire insofar as it is possible should be regarded as a useful recommendation.

Measure 1.06: Possibilities should be considered for reinforcing requirements concerning the carriage of dangerous goods over the Alps.

A number of restrictions do exist as regards the carriage of dangerous goods. In view of the freedom of choice of the most appropriate transport mode, the traffic of vehicles carrying dangerous goods over the Alps cannot be prohibited entirely. It should, however, be possible to check possibilities of further reinforcing existing restrictions.

Measure 1.07: Possibilities should be investigated of imposing restrictions, making up convoys and ensuring escorts for (dangerous) goods-carrying vehicles.

A time limit on the traffic of vehicles carrying dangerous goods, the making up of convoys and vehicle escorts are all measures which will aid the intervention of the police and the emergency services. It will thus be possible to limit risks and the adverse consequences of accidents.

Making up convoys, however, implies that enough room will be available for waiting vehicles.

Measure 1.08: The prohibition on overtaking by heavy vehicles in some tunnels should be reconsidered.

In two-way two-lane tunnels, the law in force for all vehicles strictly prohibits overtaking. However, in multi-lane tunnels, prohibiting overtaking by heavy vehicles in some cases could improve traffic safety, for example, in tunnels with a gradient of more than 3 per cent. Road signs could be used to announce the prohibition.

Since a general prohibition on overtaking would not achieve the desired results, it should be abandoned.

Measures to be rejected

Measure 1.09: The proposal requiring a distance of 100 m to be kept between heavy vehicles in tunnels should be rejected.

The consequence of this requirement would be that vehicles observing a distance of 45 m would be forced to reduce speed drastically on entering the tunnel so as to maintain a distance of 100 m. Their slowing down would force other vehicles to reduce speed still further (bunching) and would ultimately create a bottleneck which has definite disadvantages for road safety and the protection of the environment. It is also a fact that in tunnels with several lanes in the same direction, light vehicles would fill up the 100 m gaps between two lorries. This safety distance would then serve no purpose and there would be an even greater risk of collision.

Measure 1.10: The proposal to restrict the maximum speed of heavy vehicles to 60 km/h should be rejected.

In accordance with the law in force, the maximum speed of heavy vehicles on motorways and semi-motorways is restricted to 80 km/h. A reduction of this maximum speed in tunnels would have the same effect as increasing the safety distance insofar as all vehicles would have to adapt to the speed of slower-moving heavy vehicles in two-way tunnels (risk of congestion). In the case of one-way multi-lane tunnels, a maximum speed of 60 km/h would not make for greater safety.

2. Proposed operational measures

Measure 2.01: OFROU should look at contingency plans (operation, emergency services), access routes for the emergency services and evacuation routes and emergency exits for road users in the event of an incident in all tunnels more than 300 m long.

In the event of bottlenecks, oncoming traffic or other adverse situations, the planned means of access and emergency exits may no longer be accessible. It is therefore important to ensure that these means of access and emergency exits remain usable even in a major adverse situation.

Measure 2.02: A safety officer should be appointed for all tunnels more than 600 m long.

He would have the following competencies and tasks:

- Planning of organization and response plans;
- Planning, implementation and assessment of emergency drills;
- Participation in decision-making when safety plans and infrastructure installations are defined (new constructions and transformation);
- Training of operations centres personnel, police and emergency services;
- Participation in the acceptance of structures.

Measure 2.03: Requirements should be issued for live periodic fire control and rescue drills in tunnels.

- The scenario of the drill should be realistic and correspond to one of the cases defined;
- The drills should produce measurable results;
- The planning should be carried out in collaboration with the maintenance services and the police so as to prevent any deterioration of the structure and keep hindrances to traffic to a minimum.

Measure 2.04: A tunnel should be built or made available – outside the road system – intended exclusively for drills and tests by the emergency services.

More attention should be given to rescue operations on roads and in tunnels. In situ training possibilities are genuinely lacking because as a general rule tunnels can never be closed for rescue or fire control drills.

Measure 2.05: All fires breaking out in tunnels should be listed and assessed.

There is a current lack of a systematic registration of all fires. It would enable particularly useful conclusions to be drawn regarding safety measures to be implemented.

Measure 2.06: Consideration should be given to setting up a (Swiss) national coordination centre for incident control.

It would have the following competencies and tasks:

- Control of the organization, response plans, training and the equipment of the emergency services in collaboration with the safety officers;

- Introduction of requirements for safety officers;

- Competence to decide to close a tunnel so as to permit the emergency services to carry out drills or perform fire tests.

3. Proposed measures relating to infrastructure

Measure 3.01: The necessary improvements to be made to structures should be discussed with the cantons and carried out rapidly.

The equipment to be examined should be rapidly assessed with the cantons. As regards ventilation and safety equipment, the cantons have received a checklist to be completed as soon as possible.

They were also required to assess the existence and check the working of available equipment in the following areas: energy, lighting, ventilation, road signs and signals, measuring and monitoring equipment, centralized facilities (maintenance/police centre) and related installations.

Measure 3.02: Existing guidelines for single-bore tunnels should be given consideration.

They define restrictively the conditions in which provision must be made for emergency exits. In single-bore tunnels, the construction of emergency exits or a safety tunnel generates particularly high costs. A detailed check is required as to whether these constructions are genuinely necessary to minimize risks or whether less costly measures exist which would lead to the same result.

The most important criteria are: the volume of traffic, the length of the tunnel and the ventilation system. The new semi-transverse ventilation systems with venting ducts are particularly efficient and prevent the propagation of smoke, so that in most cases the tunnel can be used as an escapeway.

The Great Saint Bernard (VS) and San Bernardino (GR) Tunnels along with the Vue-des-Alpes Tunnel fall within this category; they require special monitoring in this regard.

Measure 3.03: The drafting of new guidelines concerning the calculation of proportions and the operation of ventilation in tunnels should be speeded up.

In accordance with the calendar of 19 July 1999, a first version was to have been completed by the end of October 1999. The draft would be ready for consultation at the end of January 2000. The final draft should, in principle, be completed in May 2000.

Measure 3.04: Guidelines should be prepared on the preparation, implementation and evaluation of fire tests in tunnels.

Pending its publication, fire tests in tunnels are subject to prior authorization by OFROU.

The preparation, implementation and evaluation of fire tests involves very substantial requirements and implies detailed knowledge of the laws of physics in tunnels if the results obtained are to be reliable. This means that costs are high and that there is a major risk of arriving at erroneous interpretations. These tests do, however, provide determining information for calculating the proportions and the proper operation of ventilation systems.

International coordination is therefore required.

Measure 3.05: Guidelines and requirements for tunnel equipment need to be adapted to the most recent technological know-how.

The guidelines establish the criteria to be applied, periods for implementation in existing tunnels and monitoring of serviceability.

These guidelines concern all of the tunnel's facilities, namely electricity supply, lighting, ventilation, signs and signals, central measurement and monitoring installations, communications facilities and computer equipment, cabling, related installations and electromechanical equipment. Monitoring is necessary in view of the new know-how acquired in technological and safety matters.

Measure 3.06: The role of the transverse passages as possibilities for access by the emergency services needs to be examined.

In order to facilitate access by the emergency services (and their vehicles), transverse passages exist every 900 m in double-bore tunnels. In single-bore tunnels, additional access is possible only where a safety tunnel or an escapeway leads to the outside.

Access to portals, passages and – in single-bore tunnels – to the site of the disaster, is ensured by an appropriate traffic management system. It should be checked how far such access is guaranteed.

Measure 3.07: The proposal for a second bore in the Gothard Tunnel for safety reasons should be rejected.

The possibilities for evacuating and rescuing road-users from the Gothard Tunnel are considered to be very satisfactory. A second bore for safety reasons is therefore unnecessary.

Measure 3.08: The proposal to take other criteria than the foreseeable traffic load into account in specifying the number of bores should be rejected.

When the traffic load is light, a single-bore tunnel is adequate; when the traffic load is heavy, a double-bore tunnel should be planned.

The definition of the number of bores in terms of the foreseeable traffic load is completely justified. This is current practice throughout the world.

Measure 3.09: The request to amend present practice concerning double-bore tunnels, whereby the second bore serves as an emergency exit when an accident occurs in the other bore should be rejected.

In double-bore tunnels, the construction of transverse passages permitting escape via the second bore when an incident occurs in the first is a very efficient solution and financially advantageous.

Measure 3.10: The request to install automatic sprinkler systems in tunnels should be rejected for the time being.

To date, these systems do not exist in Switzerland and are only exceptionally permitted in other countries. They are used preventively, i.e. they serve to cool vehicles which have not yet caught fire. In fact, very hot vapour or explosive gases formed by the fusion of the water and the dangerous goods carried may occur in the vicinity of the fire.

4. Proposed measures concerning vehicles

Measure 4.01: The obligation of fitting heavy goods-carrying motor vehicles with an extinguisher or an extinguishing system should be considered.

Extinguishers or extinguishing systems which have proved their worth can be found on the market at advantageous prices. If correctly used, they allow a fire which has just broken out to be brought under control and extinguished.

Follow-up operations

The interim report is a first inventory and shows clearly the direction in which efforts should be pursued if safety in tunnels is to be improved. Since it was not possible to answer all the questions raised, the Task Force will submit a final report next spring.

The permanent response and intensive work of the road administrations, operating companies and the road traffic police are not enough to end breakdowns, accidents and incidents in tunnels completely. In spite of everything a chain of unfortunate circumstances could lead to a catastrophe in our road tunnels similar to the fires in the Mont Blanc or Tauern Tunnels.
