I. INTRODUCTION

The road signs, signals and markings as well as the types of road equipment, facilities and installations described below constitute essential elements in the functioning of the TAH network and have an important impact on fluidity and safety of the traffic as well as on the comfort of road users. Regular checking of the functioning of all such equipment and appropriate maintenance will enable it to ensure maximum efficiency.

II. VERTICAL SIGNS AND ROAD MARKINGS

1. General Characteristics of vertical signs and road markings

Vertical signs and road markings, in accordance with the principles set out in international conventions and agreements, keep road users informed and contribute to their understanding of the road and shall be designed and executed in such a way as to be consistent with each other on the entire TAH Network. The basic prerequisite for signs shall be homogeneity; they are intended for users moving rapidly and shall therefore be visible from an adequate distance by day or by night, and be immediately comprehensible. An effort should be made to generalize the use of non-literal messages, with standardized dimensions, symbols and characters, so as to make them easily comprehensible to road users of any country. Illuminated panels or panels using retro-reflective materials shall be used for signs on roads which are not lit and may also be used on roads which are equipped with permanent lighting. It is recommended that markings on roads without permanent lighting should be executed using retro-reflective materials. It is important to avoid having too many signs.

2. Road markings

Road markings shall be harmonized with vertical signs and the materials used shall have a high skid resistance.

3. Vertical signs

In view of the international nature of the roads under consideration, particular care shall be taken in the use of indicator panels and the use of the “TAH” sign.

The effectiveness, and particularly the comprehensibility and readability of the signs depends on a number of conditions, their dimensions and correct sighting, predominance of international symbols over words, brevity of the message conveyed, use of the same alphabet over the entire international network (other alphabets should be used only in conjunction with Latin characters), appropriate sizes for
symbols and characters and the suitable proportions in relation to their background and the maximum speed of traffic.

4. Road works and emergency signs

For road works, emergencies (accidents) or ongoing operations entailing the closure of carriageways or lanes to traffic, adequate temporary signs shall be installed so as to ensure the safety of users and the personnel involved in such operations. These signs shall be removed once they are no longer required. Within an area of road lighting the signs shall be retro-reflective. Where there is no road lighting the signs shall be retro-reflective and, as far as possible, combined with special illuminating guiding devices. Permanent signs which are in contradiction with the temporary signs shall be removed or concealed.

III. EQUIPMENT AND USER SERVICES

1. Safety fences and barriers

Safety fences and barriers are designed to prevent a vehicle accidentally leaving the carriageway or to limit the consequences of its doing so. The choice of device (guard-rails, crash barriers, safety barriers and fences) and the conditions for their use shall depend on the type of vehicle to be arrested, the cross-section, the possible consequences of vehicles leaving the carriageway, specific problems of visibility and difficulty of maintenance.

Since such devices themselves constitute obstacles, they shall not be installed unless the risk attendant on not doing so justifies them. Such safety devices shall normally be provided on structures and in their approach zones. The use of safety devices on the central reserve depends on a number of factors, the most important of which are the volume of traffic and the width of the central reserve itself.

Safety devices shall be provided on shoulders where protruding non-brittle obstructions are situated too near the carriageway, where the height of embankments or the slope of banks constitutes an obvious hazard, or on sections bordered or crossed by a watercourse, a heavily used road, a railway, etc.

2. Delineators

The installation of delineators (i.e. road studs and hazard marker posts) furnished with retro-reflective devices may considerably improve perception of the alignment.

3. Anti-glare devices

Outside lighted sections, it might be advisable to install an artificial screen or a hedge on the central reserve of motorways and expressways or on the shoulder when another road runs along the TAH road. It is advisable to make sure that such arrangements do not obstruct the visibility for road users and do not reduce the efficiency of traffic safety devices installed nearby.

4. Arrester beds
To ensure the safety of trucks on very long, steep gradients, it may be useful to provide judiciously-placed arrester beds alongside the downhill lane. This facility should, however, be the exception, and be reserved for instances when no other solution can be envisaged.

IV. TRAFFIC CONTROL AND USER INFORMATION

1. Traffic light signals

Traffic light signals shall be used in accordance with the international conventions and agreements in force. Flashing amber lights may be used to indicate a particular hazard (road works, toll gates, pedestrian crossings, etc.), thus encouraging users to pay more attention and reduce their speed. Temporary traffic light signals may be provided in some exceptional cases (e.g. alternating traffic as a result of road works or accidents).

2. Variable traffic signs

Variable traffic signs shall be as comprehensible as static road signs, and be legible by day and night to drivers in all lanes.

3. Emergency communication systems

The provision of emergency telephone or other communication posts, indicated by specific signs, linked to a center operating 24 hours a day is recommended on all types of international roads. Such call-points would be installed along the road on the outer verge away from structures, regularly spaced and at reasonably frequent intervals. On motorways an interval of 2 km is recommended. An emergency communication system should include signs (or panels) indicating the direction and distance to the nearest call-point.

Where a special road emergency communication system does not exist on express roads and ordinary roads the general telephone system can be utilized and signs indicating the position of the nearest public telephone would be helpful. Special allowance can be made for long bridges and tunnels. The operation of call-points shall be simple, easy for users to understand and preferably explained by symbols or ideograms.

4. User information

Up-to-date information on road and traffic conditions should be transmitted to road users by appropriate means. Possibility of receiving such information in tunnels is advisable.

V. ROAD LIGHTING

Lighting is desirable at some special areas such as frontier posts, tunnels, adjoining areas, interchanges with other TAH roads, toll areas, etc. When the volume of traffic justifies its installation and operation, homogeneous and adequate road lighting may
also be advisable if the road crosses or borders an area in which the lighting may inconvenience traffic on the international road (airports, industrial or heavily built-up areas, etc.).

VI. AUXILIARY FACILITIES INSTALLATION

1. Safety of pedestrians and cyclists

The utmost attention shall be paid to crossings for two-wheeled vehicles and pedestrians, especially at junctions, including by building special paths for pedestrians and cyclists. Pedestrian safety should be given an important role in the national and regional road safety policies so that that measures concerning pedestrian safety are given due weight in relevant legislation, regulations. For example, during construction of new roads and when improving existing ones careful consideration should be given to such aspects as the choice of road surfacing materials, provision of public lighting, particularly in urban areas, at pedestrian crossings, heavily trafficked urban roads, rural intersections and other hazardous (high-risk) locations. Footbridges and subways must be properly maintained and accessible to all users, including those with reduced mobility.

2. Traffic calming measures

At higher speeds it takes longer for drivers to stop at a safe distance from potential hazard. This increased stopping distance makes it harder to avoid crashes. In addition, higher speeds result in more severe crashes. Pedestrians are particularly susceptible to increases in the severity of crashes. Traffic calming reduces speeds and improves the safety and comfort level of all users: pedestrians, cyclists, motorists and residents, by making physical changes to the highway network. Schemes are designed to be self-enforcing, although the effectiveness of this varies according to the measures employed. These include but are not limited to road humps, rumble strips, staggered junctions etc.

3. Protection of disabled persons

Users, whether passengers or drivers, for whom travel is difficult or who are not able to provide for their own immediate needs unaided, shall also be able to use the road with ease. It is necessary in any case to ensure that the constraints imposed on users, particularly in rest and service areas, are compatible with their capabilities. The design of the road and its equipment must thus be such as to minimize the critical situations in which such users may find themselves.

4. Protection from and of animals

In order to protect users from animals, adequate fencing shall be provided wherever the topography indicates a risk of animals crossing. Protective measures must also be taken for the animals themselves, such as over- or under- passes of suitable size and shape.

VII. SERVICE FACILITIES
Depending on the characteristics of their operation, separate rest areas, service areas, frontier posts, etc., shall be provided along international roads.

1. **Rest areas**

Highway authorities should provide safe parking facilities for long distance drivers to comply with rest hour regulations. Rest areas away from interchanges enable users to stop in an environment which provides a break from the monotony of traffic; in such cases landscaping is of great importance. These should be provided at appropriate intervals; a sign indicating the approach to a rest area should also indicate the distance to the next rest or service area. Water points, tables, shelters and toilets with easy access for physically disabled persons are desirable.

2. **Accident and emergency response facilities**

There are many actions that can be taken to stabilize road traffic accident/incident to minimize potential damage. The actions taken in the initial minutes of an emergency are critical. Highway Authorities should develop accident and emergency response plans. Highway Authorities should establish emergency accident and response centres along the TAH at a minimum interval distance.

3. **Axle load control and Enforcement**

Overweight trucks and buses are dangerous from a road safety point of view and will cause premature damage to roads, infrastructure such as bridges and buildings. This in turn increases Road Agency Costs, such as Construction and Development, Rehabilitation and Maintenance. The implementation and management of axle load control programs forms a vital tool in reducing the damage caused by overloaded vehicles. Weighbridge facilities that also contain facilities for limited vehicle roadworthiness inspection exercises should be provided at or near vehicle rest stations.

There are two types of roadworthiness assessments: On-the-spot roadside inspections and periodical checks for which the owner of the vehicle must take to Motor Vehicle inspection centres.

4. **Service areas**

Service areas adapted both to the site and to its users (tourists, truckers, etc.) and away from interchanges shall provide a minimum of services such as parking, telephone, fuel and toilets with easy access for physically disabled persons. These areas should be provided at appropriate intervals, taking into account, among other things, the volume of traffic; a sign indicating the approach to a service area should also indicate the distance to the next service area. All traffic and parking areas shall be separated from the carriageway(s) of the TAH road.

5. **Toll areas**

Toll booths should be situated in open areas. It is not advisable to situate them at the bottom of a descent. Adequate spaces shall be provided outside the control lanes for
the buildings and installations required for collecting tolls, for surveillance and the personnel involved. Toll areas comprise a progressive widening of the carriageway or interchange loops up to and beyond the control lanes. The number of control lanes shall be determined in terms of the volume of traffic anticipated.

6. Frontier posts

The location, dimensions and form of frontier posts, as well as the type and layout of the installations, buildings, parking areas, etc., shall be selected on the basis of the checks anticipated and the traffic passing through such posts. By means of agreements with the neighboring States, joint frontier control installations as well as coordinated control services with sufficient personnel shall be aimed at.

The structure and form of a frontier complex and the internal communications network should, with effective signposting that is coordinated among the neighboring States, make it possible to preselect and separate passenger and goods traffic according to the different kinds of control before they arrive at the buildings and installations. At frontier posts with high truck-traffic peaks, truck reception areas for pre-control or pre-selection according to the kinds of control should be provided for in front of the frontier control installations themselves.

VIII. MANAGEMENT, SAFETY EQUIPMENT AND GENERAL ARRANGEMENTS FOR TUNNELS

1. Traffic management systems

Tunnels with high traffic volume should be equipped with traffic management systems in order to avoid traffic congestion, particularly in the case of an incident. In the case of long or short-term closure of tunnels, the best possible alternative itineraries should be planned and indicated to users at diversion locations situated in advance of the tunnel. In the event of a serious accident, all the affected tubes of the tunnel should immediately be closed to traffic. The traffic should be managed in such a way that unaffected vehicles can quickly leave the tunnel.

2. Control center

A control center should be provided for long tunnels with a heavy volume of traffic. Several tunnels should have its control center. For tunnels starting and ending in different countries or falling under the control of different national regions, one single control center should be designated as being in control at any given time.

3. Emergency exits and access for emergency services

The need to provide emergency exits and the distance between them should be decided on the basis of a risk analysis of the tunnel in question. However, in new tunnels, emergency exits should be provided where the traffic volume is higher than an annual daily average of 2000 vehicles per lane. The maximum distance between two emergency exits should not exceed 500 m. Shelters without an exit leading to escape routes to the open air should be avoided in future tunnel construction.
In twin-tube tunnels, in the event of an incident in one tube, the other tube may be used as an escape and rescue route. To this effect, the tubes should be connected at regular intervals by cross-connections for pedestrians and by cross-connections allowing the passage of emergency services. In the absence of these, direct connections with the outside or with an emergency gallery should be provided in each tube. For twin-tube tunnels, wherever geographically possible, crossing of the central reserve (median strip) should be made possible outside each entry and exit allowing the passage of emergency services to gain immediate access to either tube.

4. **Tunnel equipment**

All safety installations or facilities for tunnel users, in particular, emergency telephones, fire extinguishers, emergency exits, lay-bys, or the indication of radio frequencies or use of radio should be signaled by means of fully visible signs and panels. The signs and panels to be used are described in the Vienna Convention on Road Signs and Signals of 1968.

The safety equipment required in tunnels should be defined on the basis of a risk analysis of the tunnel under consideration. A list of such equipment is provided below. Some of this equipment is intended mainly for long tunnels and/or tunnels with heavy traffic.

5. **Lighting devices, power supply and electrical circuits**

i. Normal lighting to ensure appropriate visibility day and night for drivers;

ii. Safety lighting to allow a minimum visibility in the event of a breakdown of the power supply;

iii. Evacuation lighting, such as evacuation marker lights, at a height of no more than 1.5 m to guide tunnel users to evacuate the tunnel on foot, in the event of an emergency;

iv. Emergency power supply capable of ensuring the operation of safety equipment indispensable for the evacuation of users;

v. Design of electrical, measurement and control circuits such that a local failure (such as one due to a fire) does not affect unimpaired circuits.

6. **Emergency provisions**

i. Emergency stations, equipped with at least an emergency telephone and two fire extinguishers, should be installed at the entry and exit of tunnels and inside at regular intervals. These intervals should not exceed 150 m for new tunnels and 250 m for existing tunnels;

ii. In addition, a water supply should be provided for the fire brigade near the tunnel entry and exit and inside at intervals which should not exceed 250 m.

7. **Ventilation systems**

Appropriate ventilation systems should be provided to ensure the control of pollutants emitted by road vehicles under normal conditions and in the event of an incident, and the control of the air and of smoke in the event of a fire. When mechanical ventilation is necessary, the following recommendations should be
observed:

i. In tunnels with congested bidirectional or unidirectional traffic, longitudinal ventilation should be used only if a risk analysis of the tunnel in question shows it is acceptable and/or if appropriate measures are taken;

ii. Transverse or semi-transverse ventilation systems should be used in other cases;

iii. In bidirectional tunnels with transverse or semi-transverse ventilation, equipped with a control center, when justified by the length and the traffic, air and smoke extraction dampers should be installed which can be operated separately or in groups. In addition, the longitudinal air and smoke velocity should be monitored constantly and the steering process of the ventilation system adjusted accordingly;

iv. In twin-tube tunnels, appropriate means should be implemented to stop the propagation of smoke and gases from one tube to the other in the case of fire.

8. Other safety improvement devices and systems

i. Radio broadcast installations that can be used by the emergency services;

ii. Systems for video surveillance and automatic detection of incidents and/or fires;

iii. User information systems (radio, loudspeakers, variable message signs);

iv. Traffic lights, barriers and other equipment to stop vehicles when necessary before the tunnel entrance and, if required, road signs and other appropriate devices within the tunnel;

v. Overheating control systems for heavy goods vehicles (to be installed outside tunnels);

vi. Road signs and/or markings to help drivers to maintain an adequate distance from the vehicle in front;

vii. Automatic systems for detecting violations of traffic regulations particularly regarding speed limits and distance between vehicles.

IX. FIRE RESISTANCE OF THE STRUCTURE

The main structure of tunnels where a local collapse may have catastrophic consequences (for example, an underwater tunnel or a tunnel liable to cause the collapse of large adjoining structures) should ensure a sufficient level of fire resistance.