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Road quality service levels and innovations to meet user expectations

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ABSTRACT

This national report covers the most significant experiments and innovations recently carried out in Spain n the field of road technology related to the subjects included under ST1 Strategic Session. They can be summarised as follows:

a) New approaches to maintaining serviceability in adverse weather conditions (winter serviceability)

The quality of service provided by the road maintenance teams is gauged by the degree to which a previously established winter serviceability operational plan is implemented as a function of the means employed, section characteristics and predictable situations. The content of these operational plans and the work and coordination protocols amongst the different Authorities involved are also described. These and other improvements made in the management of winter serviceability (installation of anti-avalanche instruments, weather stations, de-ícer sprinklers and GPS devices, etc.) have allowed the procedures and efficiency of the measures involved to be optimised.

b) Technological innovations incorporated into tunnel design and facilities to increase their quality of operation and improve the safety conditions for driving through them

The report details the recommendations recently made in respect of the minimum facilities required that should be made available in existing tunnels as a function of their features (length, one-way or two-way traffic, urban or interurban location and traffic density involved), operating manuals (content, standard attendance records, etc.) and coordination protocols, in addition to the hand-out to tunnel users of explanatory leaflets on the behaviour to adopt in the face of risk situations. The report includes examples where these improvements have been implemented both in tunnels under operation and still being built, and which are well in excess of minimum standards (the 8.6-km long Somport Tunnel and Piedrafita Tunnel).

c) Latest experiments on outsourcing of road maintenance through contracts based on indicators of the road condition and quality of service provided and evaluation of the degree of compliance achieved with a set of defined standards.

Two pilot schemes are described which started in 2002 and consist of indicator-based maintenance contracts. The first scheme is for a shadow toll motorway concession (where Public Administration pays the concessionaire a set rate for the traffic using the motorway), in which a system of incentives and sanctions has been set up depending on the values achieved in certain service indicators (accident rate and impaired capacity owing to lane closures). The second scheme involves contracts for road sections in which varying pre-set amounts are paid for each of the indicators established, in respect of both road condition and service level, with a view to a number of thresholds being achieved and maintained. Sanctions and repair deadlines are imposed if these levels are not met.

This report aims to give account of the most significant innovations that have been developed over the past four years in Spain in respect of the subthemes included in this ST1 Session.

It specifically reports on matters related to capacity improvement, the inclusion of indicators for evaluating services or user satisfaction levels and the input of equipment and techniques for serviceability monitoring and control.

The following inputs are therefore analysed:

a) New Approach to Winter Serviceability Work on the Spanish Road Network

b) Improved Equipment and Attention to Serviceability Levels in Tunnels in the Spanish Road Network

c) Indicator-based Maintenance Contracts. Pilot Scheme on Roads in Álava Province.

d) Inclusion of Indicators in the Concession for the M 45 in Madrid.

New Approach to Winter Serviceability Work on the Spanish Road Network

The State Road Network in Spain is run by Central Administration with powers spread over three Authorities - Traffic, Civic Protection and Roads, the first two of which belong to the Department of the Interior and the last to the Ministry for Development.

A protocol was drawn up in November, 1998 between the three Central Authorities In order to prevent any lack of coordination and it was expanded to cover the corresponding Regional Authorities in each province.

The system in place until that time in this context consisted of setting desirable levels of service as a function of the category of road involved and defined by a maximum number of hours' work per section closed to traffic or where chains were needed for vehicles. Unlike this, a new procedure was introduced to rate the quality of service being provided by the maintenance teams.

This new system stems from the premise that it is not strictly correct to impute the results of the Winter Serviceability Campaign to the Maintenance Services, making them specifically accountable for the time during which a particular section under their responsibility was closed to traffic or required the use of chains as many other external factors affect winter serviceability, such as constraints by Traffic and Civic Protection Authorities and actual road users not complying with orders to use chains or stop driving, etc.

As a result, since November, 2000 an Operational Plan has been drawn up for each of the 156 sectors into which the Road Network is subdivided. This plan takes into individual account all the likely situations that might arise and the way of arranging the means for tackling them with a view to keeping traffic disturbance below the maximum appearing in a table in which each section is given values as a function of its category.

Each plan at least includes the following components:

- personnel, snowclearing vehicles, self-propelling machines, 4WD vehicles and the other equipment for maintaining serviceability on the roads in the Sector, chemical de-icer spreading systems (dry, humidified and wet methods, etc.), whether auxiliary motors are available for the spreaders, etc.

- silos and deposits of chemical de-icers existing in the Sector and their proximity, indicating storage capacity for each type, machinery for loading the de-icers, location, accesses, etc.

- brine production centres, with their output capacity and location, etc.

- Calcium Chloride deposits with the volume estimated to be available throughout the campaign

- systems for communicating with the bases and between vehicles and to receive meteorological data or other information and how to organise transmission, which must be in real time, of reports on sections closed to traffic, requiring the use of chains or subject to any other type of traffic restriction, reporting in addition on any other type of incidence, stating both the time it started and ended

- organisation of preventive action (vehicles involved, routes, schedules and inspections, especially during the night-time, etc.)

- availability of facilities when snow is forecast (location of snowploughs, possibilities for channelling traffic into contraflow or diverting it onto frontage roads on expressways or alternative routes on regular roads). The different spots where roads can be closed will be studied and how to plan moving snowploughs to the area which requires analysing the movements possible at each junction. In some cases this analysis will involve mobilising snowploughs on a subsection basis although clearly they should never be considered independent areas. Special attention must be given to shady areas, snowdrift formation spots, viaducts, areas with changes of gradient and bends and high humidity spots (at the foot of dams for instance) and from another point of view access routes to important built up localities.

Service quality is measured by the degree to which the plan laid out is fulfilled, as a result this must cover all the scenarios that are reasonably likely to occur.

Implementation of this approach called for a very considerable increase in facilities, doubling the number of snowclearing machines to 511 and increasing the deposits and silos of chemical de-icers until 45,000 tons were stored ready for use, installing GPS devices in vehicles and weather stations and sprinklers along roads.

IMPROVED EQUIPMENT AND ATTENTION TO SERVICEABILITY LEVELS IN TUNNELS IN THE SPANISH ROAD NETWORK

The extremely serious fires that broke out in Alpine tunnels and the experience gained on the particular characteristics involved in tunnel driving and the types of incidents and accidents occurring in recent years in the 272 tunnels on the State-run Road Network in Spain gave rise to a study on their existing equipment. The study recommends that this equipment should be increased, specifications improved and also in some cases standardised. It also recommends the equipment that needs to be installed in new tunnels.

Two tables attached summarise the study report, listing the minimum equipment required as a function of the following four variables: whether the tunnel is one-way or two-way, urban or interurban, tunnel length and average daily traffic (ADT). The report is virtually complete, pending only a small number of official verifications and analyses.

As a result, the new tunnels under construction or at the planning stage have been provided not only with equipment that is more state-of-the-art and therefore better quality, similar to that in other European tunnels being built, but also with refuges and parking areas. Examples of this can be seen in the new tunnels in Piedrafita in Lugo Province, in Malaga and especially in the Somport Tunnel in Huesca Province.

From the start the 8.6-km long, two-way Somport Tunnel was designed to cater for evacuation possibilities through galleries connecting it every 400 m to the old rail tunnel. Traffic regulation through the tunnel operates on a traffic light system which diverts HCVs carrying dangerous goods before they reach the tunnel mouth to a special parking area where the temperature of the basic components is automatically detected. Depending on this measurement and other load checks, they will either be allowed to drive through the tunnel, have to wait, be escorted through if necessary or even may be refused the right to access.

Finally, because it is essential that users are made aware of certain features of the tunnel in order to prevent accidents or incidents, an explanatory leaflet will be printed and given out in filling stations within a radius of 100 km from the tunnel and at the Fusiliers' Tower, a restored XIX Century building standing in the immediate surroundings of the Spanish mouth.

This approach has been applied for the first time in the Somport Tunnel but is planned to be extended to all the other tunnels existing in the State-run Network.

For its application to the tunnels in operation an individualised plan was drawn up for each tunnel, involving an overall budget of approximately 150 million euros. The first of these to be studied were the fairly long tunnels handling the highest traffic densities corresponding to the provinces of Madrid, Barcelona, Malaga and Orense. By the end of 2001, 19.64 million euros had been invested in this upgrading work and will continue on the remaining tunnels until all the necessary improvements are in place.

One important aspect of these improvements is the ventilation system with smoke and fume extraction designed to operate in the presence of a standard fire, taken to be sourced by a 30-MW HCV producing fumes at the rate of 120 m^3/s, for the purpose of selecting or checking the type of ventilation system installed and its capacity for ventilating and extracting fumes, in addition to the construction of evacuation galleries every 350 m between tunnel tubes (and in certain cases every 400 m). Emergency exits for two-way tunnels have generally been designed across the overburdon or laterally depending on the contour conditions involved.

For exceptional cases such as the Viella Tunnel in Lérida Province, Catalonia, where the geometrical conditions existing prevent the proposed equipment being installed (which tends to coincide with the forthcoming construction of an alternative tunnel), user safety is essentially based on traffic regulation, particularly in respect of HCVs and especially those transporting dangerous goods.

This approach was completed by the drawing up of Coordination Protocols between the Traffic and Civic Protection Authorities in addition to the updating of operating manuals.

INDICATOR-BASED MAINTENANCE CONTRACTS

Spain has consolidated substantial experience with government-managed road maintenance outsourcing with private firms, known as “Integral Maintenance”. This system already incorporates indicators in respect of the state of maintenance of road components and of the service provided as a tool for contract monitoring and management, where only a few service indicators are linked to payment of the corresponding items.

Progress has recently been made in this context in the form of pilot schemes for indicator-based maintenance contracting, understood as a payment and sanction system in respect of specified sums depending on the levels reached for these indicators, which are evaluated by regular inspections.

PILOT SCHEME ON ROADS IN ALAVA PROVINCE

CONTRACT CHARACTERISTICS

The pilot schemes for Integral Maintenance run in Alava Province including payments and sanctions in respect of indicator levels began to operate in February, 2002 and affect all roads run by the Alava Provincial Authorities.

The length of roadway to be maintained is 1164 km.

Investment per kilometre and year is approximately 4000 euros.

1. CONTRACT CHARACTERISTICS

- The Technical Terms of Reference for the contract contain a set of indicators for a specific number of maintenance tasks in respect of both service levels and condition of road components, which must keep up certain minimum levels at all times.

- Payment to the contractor for these tasks is based on meeting these indicator levels (a set monthly amount per indicator) and different sanctions are levied for failure to deliver depending on the level of non-fulfilment involved.

- The indicator levels are evaluated by scheduled inspections, although the Authorities are also entitled to run random inspections which can also give rise to sanctions for failure to meet indicator levels at the particular time.

- The indicators only regulate a specific set of maintenance tasks. Other types of maintenance work (winter serviceability and slope conservation, etc.) are not regulated by a specific level of service or condition indicator being accomplished.

The following table lays out these indicators, their definitions and mandatory levels, deadlines for correction and the sanctions applied for failure to meet levels.

CONDITION AND SERVICE INDICATORS IN THE ALAVA PILOT CONTRACTS

INDICATOR	DEFINITION AND LEVEL REQUIRED	CORRECTION DEADLINE	SANCTION FOR ANY INDICATOR
Attending to emergencies and incidences	Percentage attended to within one hour of awareness of same must equal 100%	None. Must be fully complied with at all times	Minor: three requirement notices to correct shortcomings Indicator level and correction deadline per section and month not met Sanction: value of the action concerned. Serious: repetition of three minor sanctions. Failure to attend to service permanently Sanction: double the amount for correcting the shortcoming in the first case. 10,000 € in the second case. Gross: repetition of three serious sanctions. Sanction: termination of contract.
Installations. Installation maintenance.	Percentage in correct working order must equal 100% at all times	Depending on priority area (*)	
Pavement cleaning	No residue or foreign bodies on carriageway at any time	Depending on priority area (*)	
Gutter and ditch cleaning out	No obstacles or silting up at any time	Depending on priority area (*)	
Drain cleaning out	No obstacles reducing section by more than 10% at any time	Depending on priority area (*)	
Bank mowing	Height of plants below 30 cm at all times	Depending on priority area (*)	
Pavement evenness	IRI no higher than 120% of the initial value for a primary network road at any time	One month	
Pavement adhesion	TRC not less than 45 at any time	One month	
Road marking reflection level	Greater than 100 mcd/l x m^2	Depending on priority area (*)	

(*) Priority 1: for immediate execution. Roads belonging to primary and basic networks
Priority 2: for execution within 48 hours. Provincial network roads
Priority 3: for execution within one week. Local network roads

INCLUSION OF INDICATORS IN THE CONCESSION FOR THE M45 EXPRESSWAY IN MADRID

1 Road Specifications

In 2002 the Directorate General for Roads of the Madrid Regional Government opened the newly constructed M45. This 36-km long dual carriageway is an urban expressway with local feeders and fully controlled accesses making up a partial bypass for Madrid. It is expected to carry high traffic densities.

The private sector was involved in the funding for this highway, whereby an administrative concession was awarded for construction, operation and maintenance of the road. The total 36 km of expressway were split into three consecutive sections and the concession for each section was granted to a different concessionaire. Payment for construction and maintenance operates under a shadow toll system in which Public Administration, rather than users, is responsible for paying the concessionaire the corresponding tariff based on the volume of traffic carried by the road.

Over the concession period Public Administration pays each concessionaire a sum resulting from multiplying the number of vehicles·km recorded on the expressway by the tariff laid down in the concession contract. This tariff is not a standardised one but is defined in three traffic bands. These bands have tariffs on a sliding scale so that the higher the traffic volume, the lower the price to be paid per vehicle·km.

Over the operation and maintenance period for the expressway, the terms of reference for the concession contract include a system of incentives and sanctions depending on whether or not the service provided for the road meets user demands in three aspects:

- the state of maintenance of the road
- a rise or drop in the Hazard Index
- impaired road capacity as a result of lane closures throughout the year or of stretches having to be closed to traffic or sections requiring the use of chains during winter serviceability.

2 Road Maintenance

Longitudinal evenness, transverse friction and retroreflection levels for road markings are monitored by regular inspection by the concessionaire itself, which is forced to correct any values that fail to meet mandatory levels by work at its own expense.

Deadlines or regular schedules are fixed for routine maintenance and serviceability work and sanctions are imposed if these are not met.

3 Accident Rate

The Hazard Index (HI) must be calculated on an annual basis. It is defined as:

$$HI = N \cdot 10^8 / (L \cdot 365 \cdot ADT)$$

where

N = number of accidents involving casualties in a section
L = length in km of the section
ADT = average daily traffic on the section.

Any variation in this index above or below 10% in comparison to the previous year's index will give rise to an incentive (or sanction) in the form of increasing or decreasing the tariff paid by as many percentage points as the HI variation points, with a 5% ceiling for these incentives or sanctions.

4 Impaired Road Capacity

Any reduction of road capacity is sanctioned under the following situations:

Lane Closure

For the different cases provided in the concession contract (closure of a main carriageway lane or of an entry or exit slip road) and based on the counting devices installed for the purpose of determining shadow toll rates, the reduction in traffic rate is calculated by comparing the traffic rate obtained with the lane closure to the traffic rate obtained over the seven days of the week prior to the closure, for the same time of day. The sanction levied on the concessionaire is the result of applying the concession tariff to the volume of traffic lost as a result of the lane closure. An additional sanction is also applied if the lane closure affects adjacent concessions to the stretch where traffic is restricted. This is calculated by the same method.

Road Closure or Use of Chains Owing to Winter Serviceability Conditions

This situation is sanctioned at the rate of 1800 euros for every hour the road is closed to traffic as a result of show or ice, and of 600 euros for every hour in which chains are needed for driving along the expressway.