OPTIMIZING THE EXISTING INFRASTRUCTURE BY CONTROLING CONGESTION AND TRAFFIC FLOW ON A HEAVY TRAFFIC MOTORWAY: THE SUCCESSFUL CHALLENGE OF ASF

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Traffic volume on the A7 motorway, in the Rhone Valley, keeps on increasing so much that it causes a significant and recurrent worsening of traffic conditions even out of the major summer migrations context. Deterioration in the level of service provided by the A7 motorway is closely linked to the current capacity of the corridor.

Given this situation, and in the face of very few possibilities of widening the motorway, ASF has undertaken to improve its operating methods in order to face the worsening of traffic conditions along this corridor.

To do so, ASF launched in 2003 several prospective studies aimed at setting up innovative road operation devices in order to best manage the highest trafficked areas of its network.

Among these studies, ASF started up some reflections on various matters such as ramp metering, dynamic pricing, ban on overtaking for heavy vehicles and speed control. The A7 motorway, facing more than 75.000 veh/day (AADT) and almost 165.000 veh/day during peak-periods, is a preferential axis for the implementation of such devices.

Thus ASF experimented, as soon as summer 2004, a dynamic speed control device on a 90 km long section of the northbound A7 motorway, being the most sensitive of the axis. After positive evaluation results, it was perpetuated then extended, on summer 2005, to the other direction (equating to 250 km under speed control in total : 160 km southwards and 90 km northwards).

EXPERIMENTAL OBJECTIVES

The objective of the experiment conducted by ASF during summer 2004 was to assess both the performance and feasibility of a life-size speed control system over a heavy traffic section. The goal was to better grasp the impact of this type of system on the flow of traffic and to quantify the gains achieved with respect to capacity, safety and comfort.

With respect to infrastructure capacity, the objective aimed more specifically at delaying the occurrence of congestions on the controlled section by anticipating traffic destabilization regimes. In addition to the speed control system, a campaign to raise drivers' awareness of their speed sought to promote compliance with the speed limits set by the system and thus reinforce the expected effect of the speed control system on the traffic load carrying capacity of the corridor.

With respect to safety, the lower speed limit sought to reduce the speed differentials between the vehicles on the same traffic lanes thus limiting the risk of rear-end collisions. Likewise, standardizing the speeds driven on the different lanes also

aimed at limiting the appeal of the fast lanes, thus reducing accident-causing lane changes during heavy traffic situations. The addition of the awareness-raising information on the speeds in use aimed at reinforcing compliance with the prescribed speeds and thus reducing the number of vehicles driving over the speed limit.

With respect to driver comfort, a more subjective criteria, improved traffic fluidity reduces the “stop and go” effect and the drivers’ driving load. The objective of improving driving conditions was to promote less aggressive driving behavior by reducing the “infrastructure use conflicts”. This was reinforced by the presence of the awareness-raising information on the speeds actually being implemented.

EXPERIMENTAL SETUP

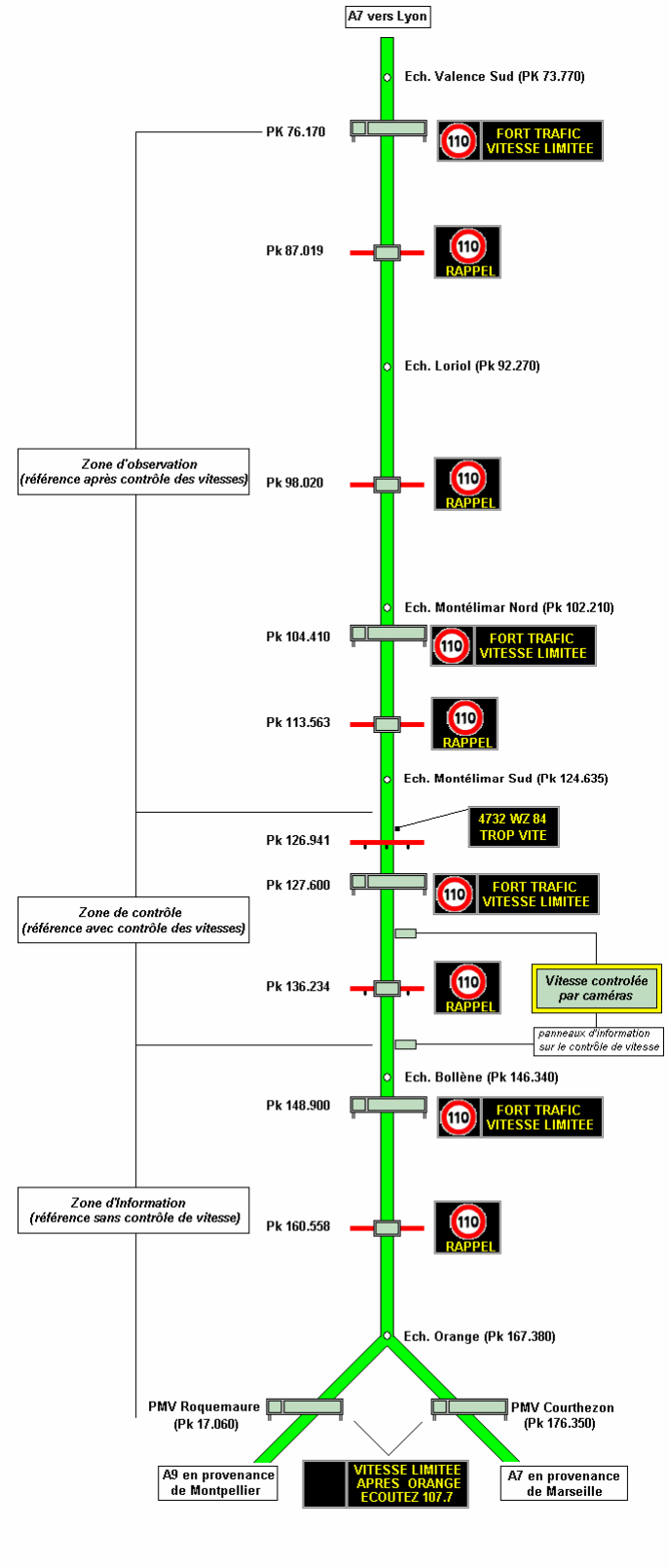
The technical setup used in for this experiment relied on an algorithm specifically developed for the project, which uses “real-time” traffic data (in particular speeds, flow, occupancy rate). This algorithm detects the “risks of destabilization” of the traffic in certain zones during the phases when traffic volume increases.

When a “destabilization risk” alarm appears and is validated by ASF managers, their traffic control centers (TCC) launch a complete information message for customers driving on the corridor.

Drivers are thus given real-time information about the speed limit they must comply with on the experimental corridor. This speed limit changes dynamically by increments and ranges between 110, 90 and 70 km/h, the speed limit normally in force being 130 km/h. For increased effect, the control strategy defined with the public authorities within the context of this experiment was based on implementing speed limits and not on recommending speeds intended to improve traffic conditions.

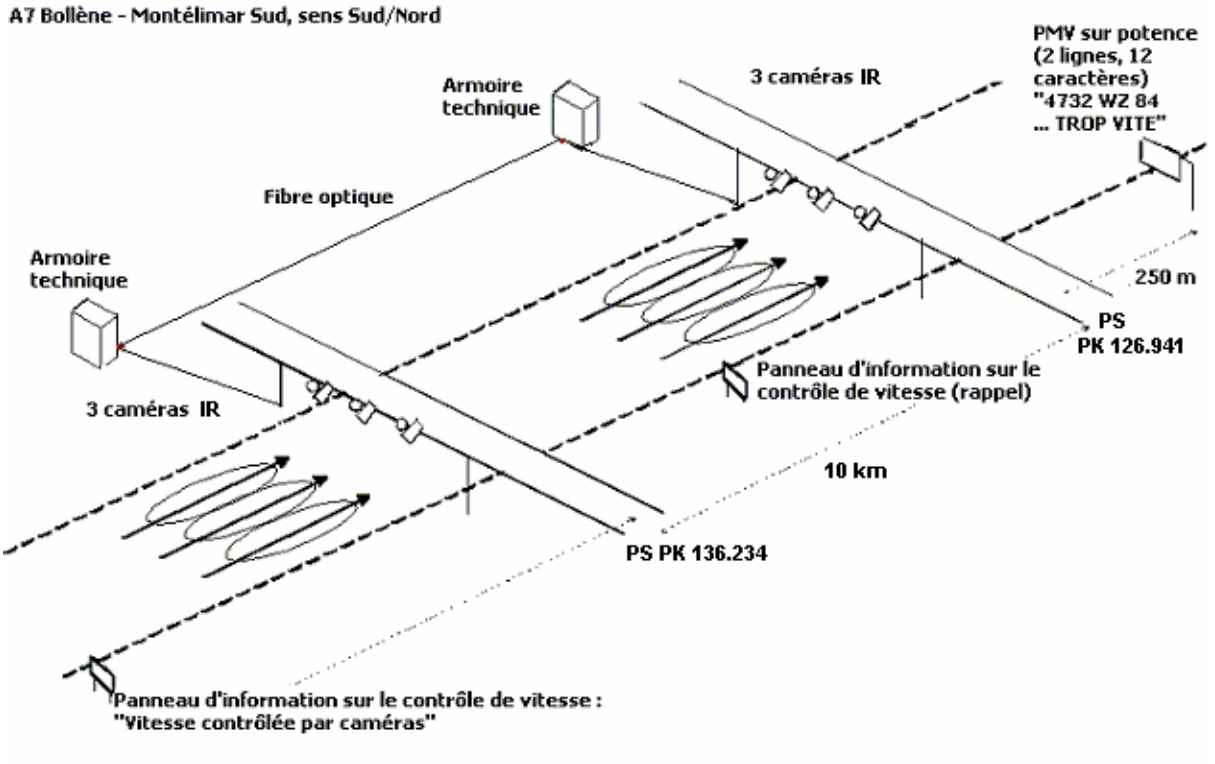
Drivers were informed of the speed limits implemented by the speed control system via radio news flashes of FM 107.7 broadcast every 15 minutes and by the dynamic information system in the field, composed of VMS messages (with related regulatory pictograms) located on the corridor section. These VMS messages were completed by other VMS messages located at the entrances to the toll plazas involved in the activated controlled speed limit system.

The following diagram summarizes the dynamic information system implemented in the field when the speed control system is activated:



As described above, the control system was reinforced by information to raise awareness on the speeds in use. This information was derived from video cameras and license plate recognition software that calculated drivers' average speed on a 10-km basic section. If the calculated speed was over the speed authorized at the time on the corridor, an information sign lit up, displaying the driver's license plate number and advising that driver to slow down.

The following diagram shows the system:



Throughout the entire experimental period, the speed control system was relatively intensely used, and was activated several hours a day during the heavy traffic periods.

Speed control was implemented during 29 % of the "daytime" period, between 8:20 a.m. and 8:20 p.m. during the 37 days the experimental period lasted (31 July to 6 September 2004).

The daily average for the 31 days experiencing speed control, control was activated for 4 hours, including 3 hours at 110 km/h and 1 hour at 90 km/h.

The period during which speed control was activated daily varied from 50 minutes (Thursday 19 August) to 10 hours and 35 minutes (on 14 August). It began at 8:25 a.m. at the earliest (on 31 July) and ended at the latest at 8:20 p.m. (on 5 September).

August 14th was the day with the longest period of speed control (9:10 a.m. to 7:45 p.m.).

ASSESSMENT OF THE EXPERIMENT

The “CETE du Sud-Ouest (ZELT)” assessed the experiment, focusing on the impacts of the speed control system, in particular on the capacity gains, the reduction of the global volume of congestion and the monitoring of the average speeds.

In addition to the evaluation work conducted by the CETE, ASF did field surveys in order to analyze how drivers on the A7 motorway accept this new motorway management measure.

Estimating capacity gains

On the subject of estimating the gains obtained on the corridor’s traffic flow capacity due to the speed control system, the work done by the CETE analyzes the maximum traffic flows and the relative gains.

Analysis of the maximum flows enables estimation of the corridor’s instantaneous capacity to flow traffic, whereas analysis of the relative gains enables the measurement of the impact of the speed control system by comparing traffic flow on the corridor with and without speed control.

Data processed for these capacity analyses involved all of the 6-minute counting data (flow, speed) recorded throughout the experiment by 17 counting stations located along the Orange-Valence section.

The first results from this analysis work estimate that the gains obtained by the speed control system are approximately 5% on the average, with peak gains exceeding 10% over periods of 30 minutes to 1 ½ hours. CETE’s analysis of this point is currently the subject of additional work whose results will be known in January 2005.

Evolution in traffic jams

Concerning the evolution of the global congestion, the data processed by the CETE comes from the disturbance reports recorded by the Rhône-Alpes-Auvergne CRICR and the Mediterranean CRICR for the 2004 experimental period and for the comparable period in 2003 (use of the notion of equivalent calendar context blocks).

The global congestion, expressed in hkm (hours x kilometers of congestion), is reached by taking the sum of the products of the lengths of the traffic jams (reduced to one lane) by the length of these jams. The scope of the term traffic jam covers slowing of traffic which begins when speed falls below 30 km/h and ends when speed goes back up over 70 km/h.

Analysis of the traffic jams between 2003 and 2004 shows a clear decrease in congestion during speed control on the Bollène-Valence section (-35% over this 70-km section). Detailed analysis is underway on the various cases encountered on the Orange-Bollène section (20-km section located as you enter the controlled corridor) where speed control has not been able to be applied (Pollution Plan in Vaucluse county, rapid occurrence of recurrent congestion at the point of convergence of the A7/A9 motorways). However, the first results on the Bollène-Valence section appear to confirm the positive effect of the speed control system on the traffic load carrying capacity of the corridor.

Monitoring average speeds

The average speeds driven during the experimental period were monitored using the data produced by the awareness system which calculated average driver speed over 10 km.

Analysis of this data shows that drivers accept well, even very well the 110 km/h instruction but shows greater reticence when the speed instruction drops to 90 km/h.

Indeed, a 90% rate of compliance is obtained with the instruction of 110 km/h (90% of the drivers drive at speeds below 115 km/h), whereas with the 90-km/h instruction, 80% of the driver drive below 100 km/h.

Among the vehicles driving over the speed limit, there is very little “major” deviation from the instruction given, and nearly 100% of the vehicles maintain speeds below 30km/h over the instruction speed. 68% of the vehicles remain below 10 km/h over the instruction speed.

Good driver reactivity to the recommended speed is noted, since the average speeds observed stabilize around the recommended speed less than 5 minutes after the information is activated.

Further analysis of the speeds measured at the counting stations show that displaying the speed limits and the license plate numbers of the vehicles exceeding that speed on VMS helps maintain these results throughout the controlled corridor, thus creating a context conducive to safety.

Customer satisfaction

The customer satisfaction survey, conducted on 21 and 22 August on 2 sites (Montélimar and Portes les Valence service areas), questioned over 1000 persons.

Survey results show that the operation is well-perceived by the clientele:

⇨ Positive reaction from drivers

- 73% of the drivers state that they slowed after seeing the signs.
- Driver compliance is correlated to exposure to VMS (drivers who saw 3 or more VMS slowed down 80%).

⇨ Good perception of raising awareness of the speeds driven

- 61% of the drivers think it is a very good initiative.
- 17% think it is a safety-inducing operation.
- 54% think that it promotes driver responsibility.

⇨ Good opinion of the operation

- 87% of the drivers thought the operation was useful or very useful.
- 77% of the drivers though the operation was hardly restrictive or not restrictive.
- 75% state that they benefited (clearly or probably) from the operation during their trip on the A7.

CONCLUSION

The results from the work done by the "CETE du Sud-Ouest" and from the field surveys are very encouraging, for they show that the speed control system does not penalize the level of service provided by the corridor, that the operation is well-understood and appreciated by the drivers and that the expected gains in terms of volume and safety appear to have been confirmed.

Given this context, the experiment was renewed at the time of the Fall holiday weekend departures and returns (29 October to 1 November 2004) and for the New Year's returns (2 January 2005) in order to validate the context for the use of this new operations measure outside of the summertime context.

Final evaluation of the system took place in early 2005, with the perspective of continuing the system and even extending it to other highly congested parts on the ASF network (the A7/A9 corridor).

Taking into account these positive results, the ASF top management decided, in April 2005, to extend the system to the other direction of the A7 (southbound, towards Marseille and the French Riviera), but this time on a much longer corridor, i.e. 160 km between the cities of Vienne and Orange.

This 2005 extension was operational in July 2005, together with the continuation of the northbound (90 km) operational activation.

In July 2005, there were thus 250 km the A7 corridor which were covered by the "speed control system".

The evaluation results of this second extension phase are still extremely promising. Final assessment results provided by the end of 2005 highlighted :

⇨ Total number of incidents dropped 20%,

⇨ Congestion volumes decreased 38% during the periods concerned by the measure, corresponding to more than **200,000 hours of congestion saved**, that can be valued at **€9 million of socio-economic gain and 550 tons of CO2 emissions saved**.

⇨ A concrete customer satisfaction :

- The operation is considered useful by :
  - 80 % of customers at the beginning of the route,
  - 84 % at the half-way stage,
  - 91 % at the end.
- 80% thought they benefited from the operation during their trip (75% in 2004),
- 83% found the operation not restraining (77% in 2004),
- 68% understood that the displayed speeds were mandatory (61% in 2004).

The traffic flowed on the A7 motorway during peak-periods increased from 15 to 20% in average, with notably, a rise of more than 35% observed on the area where the ban on overtaking for heavy vehicles was in force.