ROAD LINE TRAFFIC CONTROL – KNOWLEDGE AND EXPERIENCES FROM TESTING OPERATION

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Abstract: One of the most significant road structure completed in 2010 was the construction of southern part of the Bypass around Prague (BPAP). ELTODO group was a general supplier of technological equipment and a part of supply was design and implementation of Road Line Traffic Control System. In Czech Republic is this system absolutely innovative and brings new organizational and regulational elements into operation. The system is primarily intended for traffic flow harmonization. It is based on usage of variable message signs to affect the traffic flow so the fluency, security and communication permeability is increased. Thank to automatic speed reduction by defined traffic data is traffic flow more fluent, distances between vehicles are smaller and throughput of communication increases. RLTC system can both identify traffic excesses on communication thanks to vehicle queue detection. All algorithms were designed and tested under project of science and research of Ministry of Transport Czech Republic, project INEP, n. CG944-033-120, whose main contractor is ELTODO group. In current time testing operation on BPAP and on a part of D1 Highway is proceeded. System is monitored and all functionalities are evaluated for further debugging and adaptation of system for local conditions.

Keywords: Road Line Traffic Control System, highway, traffic flow, harmonization

1. INTRODUCTION

Outstanding increase of traffic volume during the last years reflects in more often traffic congestions. Their sources are besides high traffic loads both incidents, which substantially increase the risk of traffic accidents.

Last year was in Czech Republic completed a long-awaited construction of the southern part of Prague Ring road. This built has significant importance not only in terms of Prague city area, where significantly decrease traffic, but for entire state because of cross connection of important highways. Traffic forecasts predicted traffic load up to 60 000 vehicles per day on this important construction. For this reason was on southern part of ring road and part of D1 installed first Road Line Traffic Control system in Czech Republic.

Figure 1 RLTC installation scope on R1 and D1

General supplier of technological equipment was ELTODO group, which has an experience with similar implementations. It supplied Road Line Traffic Control System, Tunnel control system and technological equipment in tunnels and highway technological equipment. Southern part of RRAP measures 30 km. during the construction was necessary to built 70 bridges in total length of 6,7 km.

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two road tunnels Cholupice and Lochkov with length 1937 m and 1661 m. Road Line Traffic Control System is installed in both directions on RRAP marked as motorway R1, between intersections with D1 and D5 highways and on D1 highway between intersections Mirošovice and RRAP. Currently, we already have more than a half year operation and functioning of RLTC system on RRAP, thus in this article we can evaluate its first results.

2. ROAD LINE TRAFFIC CONTROL PRINCIPLE

Road Line Traffic Control System (RLTC) was supplied for open route and cooperates closely with control systems of both tunnels. Based on measuring traffic flow parameters system affect flow fluency, increases communication permeability and security of traffic flow. Based on timely provision of information may drivers adapt their driving way and substantially reduces the risk of traffic accidents.

2.1 Range of functions

In cases when situation requires, on control profiles of RLTC system are displayed variable message signs (VMS) with warning symbols, prohibitory signs limiting maximum allowed speed or prohibiting drive of trucks outside of right lane. Important part of each control profile (RLTC Gantry) are both detectors measuring volume, speed, traffic flow composition and other parameters. Based on these data is system able to perform these proceedings automatically, without system operator intervention.

![Figure 2 Schematic principle of Road line traffic control functionality](image)

Thanks to RLTC system is possible to extend highway capacity during the peak hours and both reduce creation of congestions, which often causes traffic accidents. During high traffic volumes often occurs so called “Stop and Go” waves, which are typical with high differences in speeds in the downstream sections. Consolidation of these speeds on the same level reduces accumulation of these waves together with increasing communication permeability. At lower speeds are spaces between vehicles minimized which leads to higher road capacity. The traffic flow harmonization is assured by Road Line Traffic Control system by reducing maximum speed using variable message signs (VMS) installed on control profile gantries, which are located on regularly spaced locations. Further RLTC system detects formation of vehicle queue and warns concerned drivers against these drivers using VMS. Another important feature is warning against meteorological states inconvenient for traffic and based on dangerousness is reduce traffic flow speed. In this case system collect data from meteosensors on the highway, which are automatically processed and evaluated. Of course there exists a warning before accident, work or obstacle such as debris or animals on the road. In case of restrictions on driving in selected lanes is possible to activate light arrow, which order drivers to leave the driving lane.
2.2 Algorithm design

All algorithms were designed and tested under project of science and research of Ministry of Transport Czech Republic, project INEP, n. CG944-033-120, whose main resolver is ELTODO group. During the traffic solution design were algorithms applied on particular conditions and in some cases were modified based on experiences from real operation. Together with algorithms for evaluation of untypical traffic states was necessary to develop principles of application of single action on multiple sections simultaneously. Traffic precaution is applied on one particular profile or a group of profiles, but during operation there are situations, when is necessary to combine more precautions together with preserving the rules of reducing speed on highways and avoiding to display speed steps on subsequent profiles. In order to avoid step changes of speed, which has negative influence on flow fluency, were developed special smoothing algorithms. Smoothing algorithms manages displayed symbols in consecutive profiles with regard to exact profile location on the route.

Finally, it is necessary to activate the maximum speed limits in time shifts instead of simultaneously. This provides so-called dynamic sequences, which reduces speed on requested level in the shortest time so, that drivers actually moving on route are not forced to slow down sharply on low speeds. RLTC system doesn’t forget on extreme event of driving in inverse direction. Although this is not very frequent, but may have fatal consequences. In case of detected inverse driving event, RLTC system automatically reduces speed on its minimum and displays warning on traffic signs including information transmission in information gantries close to event occurrence.

Road line traffic control system, thanks to which is Prague ring road often called “Intelligent highway” is closely linked to traffic states of both tunnels located on the route of RRAP. Besides smoothing maximum allowed speeds on open route and inside tunnels there exists connections for traffic restrictions inside tunnels, which have significant influence on operation on open route and backwards. Information between these systems must be shared with regard on a good coordination of all precautions.

Road line traffic control system is connected to newly constructed supervisory centre SSÚD Rudná, where proceeds uninterrupted surveillance of the completed part of Prague ring road. Systems are monitored and during test operation are adjusted for having most fluent and safety traffic.

![Image of control centre SSÚD Rudná](image-url)
3. RESULTS FROM OPERATION

RLTC system is in operation more than half year and during this time is its function very carefully controlled and results are examined by representatives of national highway provider (RSD) and both by ELTODO group. With regards to complexity of system and quantity of its functions number of parameters can be evaluated.

3.1 Traffic harmonization

Main parameters for traffic flow harmonization are speed and traffic volume. These parameters are showed on figure. 4. RLTC system functionality is clear from upper bold red line, which shows adjustment of maximum allowed speed in time. From traffic volume graph is nicely visible day flow including morning and afternoon peak hours. Because of high traffic volume before eight o’clock was during morning peak hours reduced maximum allowed speed to 80 km/h and after volume decrease at 8:30 a.m. was increased.

![Figure 4 Volume and speed evaluation included adjustment of maximum allowed speed from 24th February 2011 on RLTC Gantry on R1 17 km right](image)

From further detail speed evaluation in driving lanes explicitly results that most of drivers respects actual traffic notation on VMS and differences between lanes are very small. This is both visible from speed flow showed with orange spline on figure 4. Traffic is effectively homogenized and beyond ensuring smooth traffic flow and extended road capacity is both substantially reduced the risk of traffic accidents.

3.2 Emergency situations

During the system operation happened also situations, when system reacted on occurred situations much earlier than surveillance operator, who is warned on exceptionalities by this system. It sometimes happens, that drivers are forced to react on small traffic accident event by reduce speed. RLTC system automatically detected and evaluated this accident and slowed down traffic on profile close to accident and both on previous profiles. Operator both reacted on this state by finding accident source thanks to video surveillance by sending police patrol to the accident and supplemented speed symbol on gantry profiles by warning symbol on VMS. Thanks to this proceeding was substantially reduced risk of another accident by preserving traffic flow continuity and speed up liquidation of incurred situation.
4. CONCLUSION

Although the RLTC system is a brand new issue in the Czech Republic, despite the generally lower respect of Czech drivers on VMS road signs, we can see its big benefits. Homogenization of traffic flow by speed limits is explicitly positive and risk of traffic accident is further reduced by activating warning symbols on VMS. An important factor influencing the proper system functionality is operator, who confirms selected events and sets other settings directly into the system. Overall, we can say that system performs its function, and significantly contributes to rising up traffic flow fluency and safety.

The trend of steadily increasing traffic volumes, both financial and time-consuming constructions of new highways, and finally increasing demands for transport security, we can assume, that telematic systems for increasing throughput and safety of routes should continue to be developed and improved.

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