Sustainable Urban Transport System Development Reducing Traffic Congestions Costs

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crossref http://dx.doi.org/10.5755/j01.ee.22.1.213

Traffic congestions are formed due to irrational city facilities in communication terms and improper traffic system’s facilities; improper crossings of streets with intense traffic; absence of high-speed continuous traffic main streets; no passenger traffic parking lots in the largest routes. In consequence of congestions there arises increasing pollution, impairment of people health and economic loss.

Investigation of traffic flows is complex multidimensional task, solution complication of which depends on complexity extent of transport network. In order to analyze the particularity of forming congestions, investigation describing in details the interaction of vehicles and road facilities are necessary.

The main research purpose is to determine vehicle’s waste of time with flow close to system overcrowding or moving in congestion. In order to evaluate congestions expenses and rare occasional loss many parameters and assumptions are necessary, because these parameters are expressed by physical expressions. The most important of them are: value of travel time is used to convert time loss and/or reduced reliability and comfort into monetary units; variation of demand, defining reaction of possible consumers to internalization of exterior expenses of congestions.

Expenses evaluation methods used are based on the evaluation of travel time. To this end lots of investigations have been performed in various European countries. Actually experts are inclined to use general VOT values for public and goods traffic. Traffic flow intensity is determined by specified averages traffic flow speeds in separate sectors, travel time and, the main thing, defining sector throughput. Flow particularity has been determined, as well, i.e. impact of a number of lanes and evaluated wasted time with different intensity of vehicles flow.

Having data on traffic flows, it is possible to determine frequency of arriving and outgoing vehicles and time intervals between them and evaluate situation in a crossing. Schemes of vehicles movement were formed, projecting the arrival of vehicles one by one or by blocks, and data on flows directions and intensity collected. According to queue extent it is possible to judge about quality of traffic control system and loading of crossing with transport and forecast possible congestions.

After the analysis of some transport flows in the city traffic, investigation of traffic congestions reasons, these conclusions could be made: there is no methodical facilities development programme of the city streets; roads with intense traffic crossings of the city are old-fashioned; and their throughput is three or four times smaller than streets throughput and traffic flows intensity; there is no high speed public traffic service created and this becomes a pretext to use an individual transport, increasing traffic intensity and traffic congestions; there is no reverse lanes in the streets with intense traffic, what could increase road throughput and no public transport traffic lights before crossings, which at least would reduce, congestions of this traffic.

Sustainable urban traffic system development reducing congestions costs shall be based on long term “sustainable people and goods mobility vision”.

Keywords: urban transport, sustainable development, traffic congestions, external costs.

Introduction

In a most important European economy parts - transport sector about 7 % of CIP there is produced and more than 5 % of EU working places are guaranteed (2009). Admitting transport importance in order to achieve social and economic cohesion of regions, European and world, assuring European industry ability and realizing Lisbon’s objectives, it could be stated that some fields of European transport system still do not meet the objectives of sustainable development.

Mobility and transport activity scale is growing in the world due to the increment of population and improvement of life quality (Cruzado, 2005, Ciegis, 2009, Kazlauskaite, 2008, Kilijoniene, 2010, Startiene, 2009). Amount of motorcars in the world might increase from approximately 700 mln at present up to more than - 3 mln in 2050 and if there are no vehicles less polluting environment or quite environment-friendly ones and a new mobility conception is not developed, big harmony and husbandry problems will arise.

In urban traffic policy till now there was the most important aspect – to meet traffic request, even a new request. Traffic needs were developed, because, firstly subsidies in economic aspect were granted to individual motor vehicles, economic division of labor was supported just taking into account the possibility of getting cheap oil and producing places and settlements.

It is very important to set, what political and planning solutions decide the formation of traffic flows and how it could be avoided (Baltrenas, 2009, Button, 2005, Cygas, 2009). During latter years some opinions were created on the optimization of various traffic policy areas and technical
and organizational control of traffic flows (Bickel, 2006): “Exterior expenditure of internalization realization strategy”, “Mobility actions plan in the city”, “Road traffic 2020”.

While preparing new mobility conception it is important to investigate comprehensively the problems of the formation of traffic flows and compulsory mobility. Discussion on the nature of stable development strategy is necessary, because in this strategy till now traffic policy there was integrated insufficiently, thus ensuring possibility for future generations of using mobility freedom (Ciegis, 2009, Litman, 2001, Zuidgeest, 2006).

Research problem: investigation of possibilities to reduce factors conditioning forming of traffic jams in urban traffic network and costs caused by them.

Research objectives: to perform investigation of traffic congestions in urban traffic network and to find out part of congestions costs, evaluating waste of time and fuel consumption.

Research subject: traffic flows, congestions expenses, sustainable development of urban traffic system.

Research methods: natural traffic flows investigation, systemic analysis of scientific literature, statistical data grouping and comparative analysis.

Reasons of traffic congestions formation in an urban transport system

The main problem in Lithuania, as in all countries, there exists traffic congestions, formed because of these reasons (Butkevicius, 2005, Ilgakojyte-Bazariene, 2005, Jakimavicius, 2009, Guzys, 2006): irrational city facilities in communication terms and improper traffic system’s facilities; improper crossings of streets with intense traffic; absence of the main streets of high-speed continuous traffic; no passenger traffic parking lots in the largest routs; irrational usage of streets with intense traffic driving part.

In consequence of congestions there arises increasing pollution, impairment of people health, and economic loss. Every working day morning and afternoon traffic congestions are formed on the main city roads and they last one, two, sometimes even three hours. Subject to traffic intensity, crossings throughput, compatibility of traffic regulation, accidents, every car spends in congestions from some minutes to some tens of minutes. Some drivers in the congestions get into damage situations or traffic accidents, and the situation becomes heavier.

Irrational urban facilities in communication terms

Typical urban structure attributes:

- Central city part with narrow streets surrounding blocks of flats, buildings of administrative, cultural purpose – architecture monuments.
- Medium city part with broader streets, bigger blocks of flats, industrial and administrative buildings.
- Asymmetric city dwelling and industrial micro-districts formed in the last century.

Concentration of working places in the central zone of the city or in opposite sides of dwelling districts forms pulsatory flows of passengers in the morning and afternoon hours.

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Concentration of working places in the central zone of the city or in opposite sides of dwelling districts forms pulsatory flows of passengers in the morning and afternoon hours.
Statistical traffic researches data illustrate, that using of cars with average just 1.5 of passenger is the largest (even 69%) (Andersson, 2006). At the same time amount of buses, trolleys and microbuses, in total, makes up just 13.3%, though during congestions at least on an average 50 passengers go by them.

No high-speed continuous traffic main streets

While analyzing the main streets with intense traffic, no street with continuous traffic flow was found. High-speed and continuous traffic is possible just in the streets with two-level crossings, at least, and pedestrian traffic isolated or organized perfectly. An absence of continuous high-speed traffic the main streets force drivers to choose not the best driving routes, and this increases possibility of congestions.

No motor-less traffic facilities

Bicycle transport is one of ecological traffic, as communication means, usage possibilities. Another bicycle advantage is that people have good chance to improve in health. Therefore bicycle paths should be laid not by roads, but within flat blocks away from motorcars traffic flows. Then this traffic type will be more attractive and be in service in reducing traffic congestions on roads (Wang, 2008).

After the analysis of Kaunas urban public traffic routes (buses, trolleys and microbuses) and traffic flows (Figure 2), the conclusion should be stated, that the main corridors are the same – both for public traffic, and for individual - it is northern city part - centre.

The largest traffic flows in Kaunas city are at exits and entries to the centre, where streets of high throughput with large traffic intensity meet together– Savanoriu av., Jonavos st. and Karaliaus Mindaugo av., Veiverių st. Cars’ flows moving by them distribute among some Senamiestis streets of smaller throughput (Sv. Gertrudos, Gimnazijos, Birstono, Saukliu st.), making jams in them (especially during peak hours).

Evaluation of expenses for urban traffic congestions

The main research purpose – to determine vehicle's waste of time with flow close to system overcrowding or moving in congestion.

In order to evaluate congestions expenses and rare occasional loss many parameters and assumptions are necessary, because these parameters are expressed by physical expressions. The most important of them are (Armelius, 2005, Grant-Muller, 2007, Verhoef, 2004):

- value of travel time is used to convert time loss and/or reduced reliability and comfort into monetary units;
- speed-flow relations, describing additional vehicle impact on transport system and, herewith, expenses of other consumers and society;
- variation of demand, defining reaction of possible consumers to internalization of exterior expenses of congestions.

Expenses evaluation methods used are based on evaluation of travel time. To this end lots of investigations have been performed in various European countries (Cordis, 2000, Doll, 2002, Johansson, 1997). Actually experts are inclined to use general VOT values for public and goods traffic.

Marginal exterior congestions costs for concrete traffic level are calculated (Bilbao-Ubillos, 2008, Maibach, 2008, Safirova, 2007):

\[ MSC_{ep}(Q) = VOT \times \frac{Q}{\nu(Q)} \times \frac{\delta \nu(Q)}{\delta Q}, \]  (1)

here \( MSC_{ep} \) - marginal exterior congestions costs; \( VOT \) - value of time (Lt./vh.h.); \( Q \) - existing traffic level (vh./h.);
\( \nu(Q) \) - function of traffic flow (km/h.).

Exterior costs are the difference between social (appearing due to usage of traffic facilities – wear of facilities, congestions, environmental pollution, traffic accidents) and internal costs (conditioned by traffic user – wear of vehicle, energy expenditure, time expenditure, transport taxes and tariffs).

Function of speed-flow depends on facilities’ features, topography, weather conditions, network structure, possible travel alternatives, various traffic regulations (speed control, embark/loading procedures and so on) and driving habits.

All estimation steps depend considerably on dynamics of variation of transport system, quality of data available, and time evaluation. There are two groups in evaluation methodology (De Palma, 2005, Goodwin, 2003, Luo, 2007, Stathopoulos, 2002): congestions of narrow places, forming in road crossings and mostly prevailing in towns and settlements; congestions of flows, referring to exceeding possibilities of transit in concrete sections.

One of the main features in flows investigation is setting an average flow speed in sector, usually calculated taking into account braking at prohibitive signs and durations of standing at them, acceleration up to permitted speed, and driving at steady speed (Schneider, 2002).
Investigation of traffic flows is a complex multidimensional task, solution complication of which depends on complexity extent of a transport network. In order to analyze the particularity of forming of congestions, investigation describing in details interaction of vehicles and road facilities are necessary.

While researching traffic flows, generalization problem is encountered. Firstly, it is a problem of vehicle’s individuality. Together with a driver vehicles are separate subjects with unique features, therefore in flows they depend on other vehicles, since they cannot move absolutely freely. Modern vehicles are designed to meet requirement to stand up in traffic flow, i.e. sustain normal dynamics of traffic flow.

It is rather complicated to evaluate individuality of all vehicles to investigate, therefore vehicles classification with some changes is used for research: cars, light trucks and microbuses, trucks of an average loading capacity, magistral trucks and trackers, buses.

This classification reflects particularity of vehicles moving in the city (vehicles of bigger size move slower in narrow streets), their acceleration and deceleration characteristics. Because of dynamics particularity (transportation of people), moving restrictions (required standings in stops) and impact on other vehicles, public traffic is excluded as a specific task.

Congestions of “flows” and “narrow places” are accentuated in investigation. Congestions of the first type appear, when street sector or part of traffic system is traffic-overloaded because arriving and outgoing vehicles flows are inadequate. Arriving vehicles’ flow is defined by oncoming sector throughput, outgoing – by throughput of the sector itself and existing behind it one.

The throughput of a street sector is evaluated by the parameter of traffic intensity – amount of vehicles for time unit. If an average vehicle speed in a sector is known: 

\[ I = \frac{v}{L + k_v \cdot v}, \]  

(2)

Here \( k_v = 0.3 \text{–} 0.5 \), \( v \) – speed in sector [km/h]; \( L \) – length of a car.

The main feature is an average vehicle speed in the sector, depending on facilities elements, traffic intensity, and vehicle characteristics. These parameters are associated, because, when approaching congestion making limit, cars’ interaction appears. Traffic flow intensity is determined with specified averages traffic flows speeds in separate sectors, travel time and, the main thing, in defining the sector throughput. Flow particularity has been determined, as well –impact of number of lanes and evaluated wasted time with different intensity of vehicles flow. Having data on traffic flows, it is possible to determine frequency of arriving and outgoing vehicles and time intervals between them and evaluate situation in a crossing. Schemes of vehicles movement were formed, projecting arriving of vehicles one by one or by blocks, and data on flows directions and intensity collected. According to queue extent it is possible to judge about quality of traffic control system and loading of crossing with transport and forecast possible congestions.

Traffic flow is not ideal – single drivers are unable to keep the minimal permitted distance between vehicles. In four-lanes streets crossings where duration of green traffic lights signal is 30 s, with permitted speed 40 km/h in a sector, 30–34 vehicles pass a crossing. Kaunas city crossings with three-lanes streets prevailing were chosen for the investigation. Wasted time (extra time to pass a sector) in them is calculated for one maneuver to change a lane under ideal conditions (all the drivers behave especially well-wishingly) till complete restoring of flow, subject to unspoiled traffic flow speed, varies from 6.6 s, with speed 18 km/h, up to 13 s, with speed 72 km/h.

It is necessary to specify traffic circumstances when flows are approaching to a throughput limit of the traffic system sector. When a sector without any holdup is getting longer, an average speed of vehicle increases, but, while moving in a flow, additional factors appear: in long sectors vehicles start re-forming, occupying more convenient positions, drivers go at uneven speed, that is why there in long sectors an average speed has a tendency to decrease.


![Figure 3. Investigation of traffic congestions in the crossing regulated by traffic lights](image-url)
To evaluate probability of congestions, dependencies of traffic intensity during 24 hours are used. In accordance with traffic intensity Karaliaus Mindaugo av.- Birstono st. (Figure 4) 58 vh./min for this crossing is marginal value. Congestions here formed on the average \(10.5 \times \frac{6}{7} = 6\ h/24\ h\) and during 24 hours \(3500 \times 6 = 20000\) vehicles were involved. Large traffic intensity was found out in six (1-3,9,10,18) sectors. On the supposition, that congestions length in separate sectors proportional to flow intensity (an average factor of six sectors is 0.838), flow unevenness during year \((1+0.8+0.7+0.6+0.4)/6=0.583\), we get, that during 24 hours \(20000 \times 0.838 \times 0.583 = 58632\ \text{vh}/24\h\) wasted time in congestions. In 2005 in Kaunas city 21533 motorcars there were registered, 19890 of them of M1 class, 69 of M2 class, 90 of M3 class, 882 of N1 class, 206 of N2 class and 396 of N3 class. With an assumption, that cars driving in the city groups composition was similar, and one motorcar wasted in jams on the average 0.25 h, duration of time-waster is obtained.

Calculations were performed for the situation of 2010 year. In order to define congestions loss, the assumption, that traffic flows in Kaunas city increased by 5 percent every year (information of Kaunas city Transport department) was done. According to „Regitra” registration data, there was no essential change in vehicles composition, but since 2005 every year 6 percent of cars of M1 class used fluid fuel. It is necessary to take into account additionally, that traffic intensity in the main and country roads in Kaunas city has increased by 20-30 percent and approached the flow intensity in city streets. This increases probability of congestion in cities.

Trucks in urban flows made up to 25 percent of a common traffic flow (Birstono st., Karaliaus Mindaugo av., Savanoriu av., Parodos st., Tvirtoves al., Ateities r., T. Masiulio st., Veiverių st., Raudondvario r., Zemaiciu r.).

Impact of sustainable urban traffic system development on the reduction of congestions expenses

Traffic ecological, economic ones and other problems associated with traffic can be solved just with a complex implementation of the whole group of means and radical changes of traffic facilities, which include correction of passengers’ flows.

There are rather many means to solve traffic congestions issue, but they are of not equally efficient, and their realization calls for huge funds and financing possibilities (De Palma, 2005, Greenwood, 1996, Liedtke, 2005, Van Woensel, 2009).

Additional traffic lanes

The mean possibly able to reduce delays is to arrange crossings and in them so many additional traffic lanes and of such length, that they were packed by driving transport in operation of cycle traffic lights cycle. This solution would allow avoiding congestions, increase crossings throughput, but it requires large additional areas in front of crossings, in the crossings and even larger ones after crossings. So this measure does not eliminate pulsatory traffic and could even increase risk of traffic accidents.

<table>
<thead>
<tr>
<th>Expenses of traffic congestions in the crossing of Sv. Gertrudos st. – Gimnazijos st.</th>
<th>Cars</th>
<th>Goods</th>
<th>Public transport</th>
<th>Coaches</th>
<th>Mikrobuses</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wasted vehicles/day</td>
<td>5090</td>
<td>156</td>
<td>396</td>
<td>46</td>
<td>1068</td>
<td>374</td>
</tr>
<tr>
<td>Wasted hours</td>
<td>1542</td>
<td>47.7</td>
<td>120</td>
<td>14.3</td>
<td>324</td>
<td>113</td>
</tr>
<tr>
<td>Hour cost, Lt./h</td>
<td>16.73</td>
<td>6.5</td>
<td>40.92</td>
<td>20.5</td>
<td>6.5</td>
<td>6.5</td>
</tr>
<tr>
<td>Waste-time cost, Lt.</td>
<td>25798</td>
<td>310</td>
<td>4910</td>
<td>293</td>
<td>2106</td>
<td>754</td>
</tr>
<tr>
<td>An average amount of people in a car</td>
<td>1.5</td>
<td>1.0</td>
<td>40</td>
<td>20</td>
<td>8.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Wasted people hours</td>
<td>2313</td>
<td>47.7</td>
<td>4800</td>
<td>286</td>
<td>2592</td>
<td>113</td>
</tr>
<tr>
<td>Fuel expenditures per hour, l</td>
<td>4.0</td>
<td>6.5</td>
<td>6.0</td>
<td>6.0</td>
<td>5.0</td>
<td>5.0</td>
</tr>
<tr>
<td>Total fuel expenditures, l</td>
<td>6168</td>
<td>310</td>
<td>720</td>
<td>85.8</td>
<td>1620</td>
<td>565</td>
</tr>
<tr>
<td>Total fuel expenditures, Lt.</td>
<td>24055</td>
<td>1209</td>
<td>2808</td>
<td>336</td>
<td>6318</td>
<td>2203</td>
</tr>
<tr>
<td>Total congestions expenses per day in the crossing, Lt.</td>
<td>71080</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
after the crossing in a narrowed down road. That is why it is not quite attractive and impossible to realize everywhere, but very often used as partial measure of reduction of traffic congestions.

Green wave

Another more efficient measure of reduction of traffic congestions in all street crossings and crosswalks is a coordinated traffic regulation by “Green wave”. This measure reduces driving time, probability of traffic accidents, pollution, if transport traffic intensity does not exceed throughput of crossings, regulated by “Green wave” (Daunoras, 2008). Unfortunately, its disadvantage is that it does not increase throughput of crossings, because this requires big initial and operational costs. In road and crossing with „Green wave” left turn would be limited, and varying traffic intensity on the road would remain – streets throughput would not be used to end. In order to achieve traffic by “Green wave” without any troubles, duration of a green signal on traffic lights in all the crossings of this road shall be set in accordance with maximum traffic flow on the road. Therefore this traffic regulation measure is usable only in those roads, throughput of which is three – five times bigger than predictable calculated maximum value of varying traffic intensity period.

Reverse traffic lane, traffic lights of public transport

In streets of intense traffic it is reasonable to arrange of reverse traffic lanes, capable to increase the amount of traffic lanes in required direction during congestion hour, secure undisturbed public traffic between crossings. An additional traffic lane and traffic lights regulating public transport traffic should secure undisturbed public transport traffic in crossings.

Crossings of different levels

The best traffic congestions prevention measure might be roads nods of different levels in streets with intense traffic. They would secure continuous traffic flow in the roads, make possibility to use streets designed throughput completely and 3–5 times increase their actual throughput, considerably decrease probability of traffic accidents, negative impact on peoples health, driving time, pollution due to cars, fuel and time expenditures.

Now in all Lithuania cities there are no high speed public transport routes without intermediate stops and with traffic lights controlled by transmitter mounted in it.

Popularity of such traffic would grow considerably having organized high speed transit of part of public transport traffic, improved driving conditions in it, arranged parking-lots for cars and bicycles at the beginning of route. Some part of passengers of an individual transport would choose high speed public transport, and therefore traffic amount would decrease itself in congestion hours.

If at least one third of passengers using individual transport had ran away with public transport, then vehicles amount of public transport (in examined zone) would have increased just by 12–13 pc., and total amount of transport vehicles would have decreased even at 400 pc., or about 22%. Such vehicles amount in one traffic lane would extend for two and half kilometers, and by removing this amount of cars from congestions the problem would have been solved completely or by great part, at least.

City arterial streets, evaluation of their classes according to traffic intensity conformity with requirements of standard acts have to be listed exactly in the city general plan.

It is necessary to use existing facilities optimally, new and better informational and communication technologies are needed for this, the “advanced and integrated logistics system” has to be implemented, new ideas, firstly speaking about city traffic, are required. It is important to improve coordination of various transport vehicles and stimulate the choice of more ecological transport vehicles and apply technologies with less amount of exhaust and so on.

Conclusions

In order to make public service more efficient, it is centralized gradually. The distance between citizens and service conveyor is increasing. Plants, as well, follow this tendency – amount of the centers of production, storage and distribution is reduced. Activity is concentrated because of deteriorative accessibility conditions, so partially mobility is forced.

Travels and distances are conditioned by personal, political and business solutions. Cost value shall for some distance is very important. In the future a lot should be changed in this field, because stock cost will be increased (firstly of mined out fuel), exterior expenditures will be internalized, public funds for facilities will decrease and so on. But nevertheless clear political solutions on conclusions what should be done are missing. While carrying resolutions on facilities, it should be necessary to more extensively take into account stable development. It should be necessary to take into account not only the improvements of links, efficiency and less time expenditures, but related ecological and social expenditures, as well.

After the analysis of some transport flows in the city traffic analysis, the investigation of traffic congestions reasons, and conclusions could be done:

there is no methodical facilities development programme of the city streets;
routes with intense traffic crossings of the city are old-fashioned, and their throughput is by three, four times smaller than streets throughput and traffic flows intensity;
there is no high speed public traffic service created in the, what becomes a pretext to use an individual transport, and this increases traffic intensity and traffic congestions;
there are no continuous traffic roads of radial directions in the city, therefore the largest traffic congestions are city centre;
there is no reverse lanes in the streets with intense traffic, what could increase roads throughput and no public transport traffic lights before crossings, which would reduce, at least, congestions of this traffic.

Sustainable urban traffic system development reducing congestions costs shall be based on long term “sustainable people and goods mobility vision”.

Inzinerine Ekonomika-Engineering Economics, 2011, 22(1), 5-13


Artūras Kerlys

**Spūstų sąnaudos mažinant darni miesto transporto sistemos plėtra**

Santrauka

Pagrindinė Lietuvos, kaip ir visų pasaulio didmiesčių, problema – transporto spūstys, susiformuojančios dėl šių priėmąsių; neracionali susisiekimo požiūrių miesto ir netinkama transporto sistemos infrastruktūra; netinkamos intensyvaus eismo gatvių sakyklos; nėra greitojo nenutrūkstamo eismo magistralinių gatvių; keliavimo transporto stambiausiuose maršrutuose nėra automobilių stovėjimo aikštelė; neracionaliai išnaudojama intensyvaus eismo gatvių važiuojamoji dalis. Transporto spūstų padariniai: didijančia tarpusavio šalpos, blogėjantį tarpvedų, ekonominių nuostolių. Kiekvienos darbo dienos rytą pradėdama siekti mažinti spūstų intensyvumą, kai kurių veiksniai įveikti. Gali būti priskirta įvairių transporto priemonių ir nuostolių. Įvairios transporto priemonių ir veiksmai labai priklauso nuo transporto sistemų turinio ir plėtos. Gali būti priskirta įvairių transporto priemonių ir nuostolių. Įvairios transporto priemonių ir veiksmai labai priklauso nuo transporto sistemų turinio ir plėtos.

priklauosmybės. Sprendžiant pagal eismo intensyvumą Karaliaus Mindaugo pr. – Biržtono g. 58 aut./min. šiai sienkraži yra ribinis dydis. Spūstys čia susidarydavo vidutiniškai 10.5×4/7=6 val./parai ir buvo susijusios su per parą paliesdavo 3500×6=20000 transporto priemonių.

Transporto eismo ir juo susijusias ekologines, ekonomines problemas įmanoma išspręsti tik kompleksiškai įgyvendinant visą aibę priemonių ir radikaliai keičiant eismo infrastruktūrą, kuri apima keleivių srautų koregavimą.

Yra gana daug priemonių transporto spūstų atidavimai išsprendžia, tačiau jos neįvedant vieškinamos, o jas įgyvendinti trukdo didžiuosius laikos ir finansavimo galimybes.

Viena iš priemonių, kurių naudojant būtų galima sumažinti prastus, – prieš sankryžas ir sankryžose nuotėstį tiek papildomomis eismo juostomis ir tokio ilgio, kurias užpildytų kelii važiuojant transportas per šviesoforo darbo ciklo laiką. Taip būtų galima išvengti spūstų, padidintų sankryžų pralaimėjimą.

Tačiau šių priemonių įgyvendinti reikia didelių papildomų plotų prieš sankryžas, pačioje sankryžose ir dar didesnių už sankryžų. Ši priemonė nepanaikina pulsuojančio eismo ir gali pildinti eismo įvykų pavojų už sankryžų susiaurėjus kelius. Dėl to ji nėra itin patraukli ir ne visur įmanoma įgyvendinti, tačiau labai įdomi naudojama kaip dalinė transporto spūstų mažinimo priemonė.

Kita veiksmingesnė spūstų sumažinimo priemonė visose gatvės sankryžose ir pėstįcų perėjose – koordinuotas eismo reguliavimas „žalia bangą". Ši priemonė sumažina važiavimo trukmę, eismo įvykių tikimybę, darbą, jeigu transporto eismo intensyvumas neviršija sankryžų, reguliuojančių „žalą bangą” pralaimėjumą. Deja, šios priemonės trūkumai yra toks: kurį ne nėra nukryžiuos sankryžų pralaimėjimui, nes tam reikalingos didelės pradinės ir eksploatacinės investicijos. „žaliosios bangos” kelio ir sankryžose būtų ribojamas kairysis postikis, o kelyje išlikęs kintantis eismo intensyvumas – nebūtų iki galo išnaudojamos gatvės pralaimėjus.

Kad eismas „žalia bangą" vykdytų būtų susijęs su kelioje sankryžose šviesoforo žalio signalo trukmė. Turi būti nustatyta pagal didžiausią transporto srautų atrodo. Todėl ši eismo reguliavimo priemonė tinkama naudoti tik tuoje keliose, kurios pralaimėjus yra tris – penkis kartus didesnis už prognozuojamo kintančio eismo intensyvumo periodo skaičiuojamą didžiausią reikšmę.

Intensyvaus eismo gatvėse racionalu įrengti reversinio eismo juostas, dėl kurio gatvės padaugėjus kurios gatvės padidinti eismo juostų kaigių reikia kryptimi spūsties valandą, taip pat gatvės būtų užtikrinamos viešojo transporto netrumpinomos eismos tarp sankryžų. Sankryžose netrumpinomu viešojo transporto eismą turėtų užtikrinti papildoma eismo juosta ir viešojo transporto eismą reguliuojantis šviesoforas.

Bene geriausia transporto spūstų prevencijos priemonė – skirtingų lygių keliių mazgai intensyvaus eismo gatvėse. Jie užtikrinimų neįterpti transporto srautų kelio nuosluobapj sodybų galimybę iki galo išnaudoti gatvės projektinį pralaimėjumą ir 3–5 kartus padidinti faktinį jų pralaimėjumą, gerokai sumažintų eismo įvykių tikimybę, neįgaliomų požiūriu žmonių sveikatai, važiavimo trukmę, automobilių tarybą, degalų ir laiko sąnaudas.

Aštuoju metų visuose Lietuvos didmiestyse kaimynystėse néra nei vieno greitojo viešojo transporto maršrutų, kuriame nebūtų tarpinių stotelii, o sankryžų šviesoforai būtų valomai jamie sujungtoje siužetų organizuose greičiui tranzitinių transporto maršrutų pradžioje įrengtas lengvųjų automobilių ir dviračių stovėjimų aikštelės, tokio transporto populiarumas gerokai padidėtų. Nemaža dalis individualaus transporto keleivių pasirinktų greitį viešojo transporto tiek, o dėl to savaimė sumaišėtų transporto kiekis spūsties valandomis.

Jeigu bent trečdalį individalių transporto pasiūlymų individualiams keleiviams ir pavyktų suvieninti viešojo transporto, tai viešojo transporto priemonių kaigių (neįgaliommprato juros) padaugėtų tik 12–13 vnt., o bendrai transporto priemonių skaičius sumaišėtų net apie 400 vnt., arba apie 22 %. Toks automobilių tiekėjų vienoje eismo juostoje nusidriekintis per pustrečio kilometrą, o pašalintas tiek automobilių iš spūsties problema būtų išspręsta visiškai arba bent iš dalies.

Miesto bendražymai planu būtų tiksliai įvardytos miesto inteleigės atitikties norminio aktų reikalavimams vertinimas.

Būtina optimaliai naudoti esamą infrastruktūrą. Tam reikalingos naujos ir geresnes informacines ir ryšių technologijos, turi būti išdėstytas „pažangi ir integruota logistikos sistema“, reikalingos naujos idėjos, visų pirma kalbant apie miesto transporta, reikia gerinti įvairių transporto priemonių derinimą ir skatinti rinktis ekologiškesnes transporto priemones bei taikyti mažesnį išlakų kiekį išskiriandčias technologijas ir kt.

Raktąžodžiai: miesto transportas, darni plėtra, eismo spūstys, išorės sąnaudos.

Received in August, 2010; accepted in February, 2011.