RING ROUTE OF VELOBUSES IN HANOI: OPTIMIZATION OF TRIPS

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ABSTRACT

The level of bicycling in Hanoi is quite high compared to other major cities in the world and from the point of view of the health of residents it is desirable that it does not decrease, but increase. Therefore, the use of a specialized bus for mass transportation of passengers with bicycles (see World of Transport and Transportation, 2015, Iss. 4 [3]), for variability of route combinations in the interests of cyclists, is a promising area for improving the organization of bus transportation in the city. The article details the optimal ring route for this purpose, which will improve the quality of transport services to the population by buses without increasing the density of the route network, which would require very large capital expenditures.

Keywords: velobus, ring route, bicycling, urban passenger transportation, Hanoi.

Background. *In Hanoi, population movements within the city are carried out on bicycles, mopeds, motorcycles, taxi cars, private cars and buses. The main role is played by bus transport, but the quality of passenger service is low. There is no route connecting all major areas of the city, so passengers are forced to make interchanges. In addition, with a high level of bicycling and low density of the route network, it is not possible to rationally combine bicycle and bus routes (that is, in fact, to use buses for carrying a passenger with a bicycle).*

The level of bicycling according to our research is about 150 units of bicycles per 1000 inhabitants. More than half of the passengers (60 %) using buses are young people, students and schoolchildren, who ride bicycles and are easy to board and leave the bus with a bicycle (not only specialized «velobuses», which were described in our previous article [3]). Studies have also shown that most students and schoolchildren (about 60 %) use a bicycle when the distance from home to the bus stop is more than 400 m. With a smaller distance, they usually come to the bus stop on foot.

Objective. *The objective of the authors is to consider the possibility of organization of a ring route for velobuses in Hanoi in order to optimize traffic.*

Methods. *The authors use general scientific methods, economic evaluation, analytical approach, comparative analysis.*

Results. *Let's turn to the possibility of finding butt routes for cyclists and buses. The route is usually a regulated route of vehicles during transportation. By nature, the routes can be pendulum and ring. Pendulum route is such a route, in which the route of vehicles in forward and reverse directions runs along the same line. Ring route is a route when the path is a closed loop [1].*

Routes depending on their location on the territory of the served area are divided into diametric, connecting the peripheral areas of the city and passing through the center; radial, connecting the peripheral areas of the city with its central part; semidiametric, passing through the center and urban areas, but not diametrically located; circular; tangential, connecting individual peripheral regions and not passing through the center; departuring, going beyond the serviced area, but in nature corresponding to the main routes of the urban transport network.

The route has terminal and intermediate stop points. Intermediate in turn can be: permanent – in points with a constant and sufficient passenger exchange; temporary, when the passenger exchange is unstable for hours of the day – near theaters, concert halls, stadiums, or in the seasons of the year – in the resort areas in the summer near beaches, attractions and etc.; at the request of passengers on long haul distances at points where there is a minor but periodically arising passenger exchange. All intermediate stops are divided into ordinary and nodal ones, where several routes intersect and passengers transfer from one route or mode of transport to another.

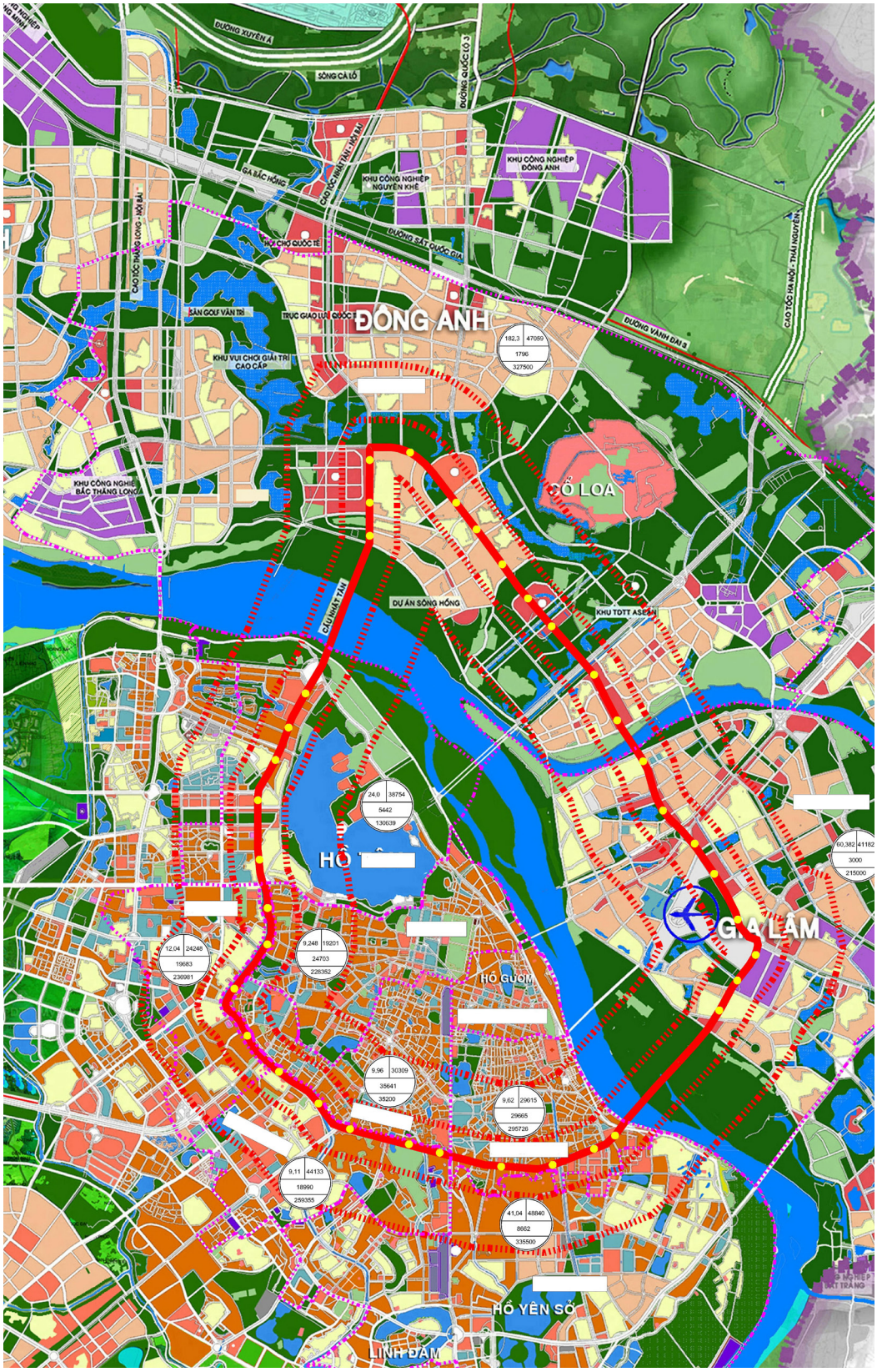
The locations of the stopping points are determined taking into account the distribution of passenger flows along the route sections, ensuring traffic safety, the comfort of boarding and disembarking of passengers and is coordinated with the traffic police. On urban routes with intensive traffic, stopping points are usually located at intersections. The cost of time for passengers to approach stop stations in cities should not exceed 10–15 minutes, if possible, taking into account the routes of all types of urban transport [2]. If several urban routes are combined in separate sections at a high frequency of traffic, dual stopping points should be organized, usually stops with a higher frequency of traffic are located ahead.

The distance between the stopping points is chosen taking into account that, on the one hand, small distances provide the least time for approaching the stopping point, but, on the other hand, with such distances the speed of traffic decreases and the duration of the trip itself increases.

The choice of the type of route is carried out with the following requirements: the routes of bus routes must pass through passenger-forming and passenger-absorbing points at the shortest distances; they are designed to ensure minimum time spent on the journey of passengers, as well as the possibility and convenience of interchange to other modes of transport. The length of the routes is determined depending on the amount of passenger traffic and the profitability of transportation. It should be remembered that long-distance routes provide a direct communication between the peripheral areas of the settlement and high operational speed, and short routes – a more even loading of buses throughout the route and more regular traffic.

The opening of the bus route is preceded by a lot of preparatory work, which should include: identification of possible passenger turnover, route selection, road conditions survey, location of stop points, development of feasibility studies of expediency of opening a route, drawing up a bus route passport.

The expected passenger turnover is established through a questionnaire survey, a population survey, forecasting and an approximate calculation. The route is chosen according to the expected and desirable directions taking into account the road conditions. A new route can be arranged if the condition of roads



Pic. 1. Hanoi ring route for velobuses.

Table 1

The population density and the number of people using bicycles in the regions of Hanoi, through which the ring route passes

Districts of the route					
№	Name of the place	Area of the territory km²	Population number people	Density people/km²	Number of bicycle users people
1	Dong Da	9,96	352000	35641	30309
2	Long Bien	60,382	215000	3000	41182
3	Thai Ho	24	130639	5442	38754
4	Dong Anh	182,3	327500	1796	47059
5	Hai Ba Ching	9,62	295726	29665	29615
6	Cau Jai	12,04	236981	19683	24248
7	Thanh Xuan	9,11	259355	18990	44133
8	Ba Dinh	9,248	228352	24703	19201
9	Hoang Mai	41,04	335500	8662	48840

and their arrangement meet traffic safety requirements. The carriageway of streets and roads must have a width that ensures safe transportation of buses with oncoming vehicles without reducing the speed. The throughput of artificial structures must correspond to the mass and dimensions of buses.

After choosing the route, the location of the stopping points is determined, taking into account the availability of sufficient passenger exchange, pedestrian accessibility, their safe placement and ensuring the minimum total time spent by the passenger when using the transport (time of approach, waiting, following in the bus and movement from the final point).

A passport is drawn up for each bus route. Passport of the route is the main document describing the route, indicating linear and road structures; path of following, presence of stopping points; characteristics of the road; main operational indicators; route tarification. The passport should contain all the basic information about the route: the scheme, the measure of the length of the route, the table of distances between the stops, the numbers of the belts for determining the cost of travel, the characteristics of the autopavels, bus stations, bus stations, control points, the time of the beginning and the end of the bus traffic, traffic intervals by periods of the day and days of the week, the time of the beginning and the end of the work of the main enterprises located near the routes.

The ring route offered for velobuses, developed taking into account the listed requirements, is shown in Pic. 1. It passes through nine districts of the city of Hanoi and connects many localities, universities, industrial parks, so the number of interchanges made by passengers (including bicycles) is greatly reduced. The total length of the route is 32 km. The population in these areas often uses a bicycle, and the road is quite wide, which allows the use of large buses.

Data on population density and the number of people having and using bicycles in the Hanoi areas through which the route, which is being developed, passes are shown in Table 1. It follows from the table that there are a large number of people using bicycles in all designated areas (from 19000 to 49000), for whom a trip in a bus with a bicycle is relevant.

Conclusion. *The developed ring route will improve the quality of passenger service with bicycles (and without them) by bus transportation and will have a significant socioeconomic effect due to the fact that the transport service covers a much larger number of city residents without increasing the density of the route network, the development of which requires very large capital expenses. The new organization of bus transportation, with the priority of bicycle users, will indirectly contribute, among other things, to reducing the number of mopeds and motorcycles on the roads, which will make the transport system of Hanoi more likely to be more convenient and environmentally friendly.*

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Article received 19.09.2016, accepted 21.12.2016.