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Effective tunneling transport system in Vladivostok city

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Abstract

The problems of the use of underground space in Vladivostok city are discussed. It is clearly explained that in mountainous conditions areas the road tunnel system can be effectively used to improve the difficult transport situation. The existing city network of roads cannot satisfy the criteria of transport stability, safety and ecological security. While the Administration is directing efforts towards the reconstruction of the city road system, there are many difficulties along the way because of the density of urban land buildings. The roadway tunnelling system can satisfy the criteria described above and be comparable in terms of cost and time to the surface construction system. A radial-orbital type of tunnel system has been developed for Vladivostok city, with some variants of technology, economically and ecologically designed of every one. The maximum time of a car journey across the city can be cut to 20 minutes from 2 hours, radically improving the ecology of air conditions. It is shown that after the realization of the best type of tunnel system the attraction of Vladivostok’s infrastructure would be on high level. The total cost of the Project is less than \$4 bn and time construction is less than 10 years. This Project is very important to the town that aspires to being the Far-Eastern Capital of Russia.

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1. Introduction

Based on the parameter of the number of cars per 1,000 inhabitants (520–560 numbers according to different estimations) Vladivostok city strongly holds first place in Russia [1]. The restricted carrying capacity of existing highways demands the development of a new road network. Another problem is the lack of parking spaces for motor transport. This creates spontaneous parking on existing highways and aggravates the transport problem even more.

During recent years much has been made of the traffic improvements that took place in connection with the preparation for hosting the APEC summit, when the basic route from the city centre to Knevichi airport was reconstructed and also two giant cable-stayed bridges were built. This reduced the stream of cars on the central street Svetlanskaya and reduced traffic congestion around Lugovaya Square – the most problematical sections of the highway network of the city. However, the improvements carried out only partially eased existing problems.

The transport specificity of the city – narrow roads, not capable of providing the necessary carrying capacity – becomes more complicated by having a mountain-type of relief and an urban territory bound by an area of surrounding gulfs. In conditions of such dense urban building surface use, the construction of new roads appears frequently impossible. Projects are beginning to appear that make use of the water area of the gulfs which sharply reduces infrastructural attractiveness of the territory, depriving townspeople of places of recreation. All these listed factors demand the creation of new transport highways underground, building a system of road tunnels with connected underground parking.

2. Criteria of transport system efficiency

In order to assess the feasibility of the accepted designs in the disposing of installations that are a part of the urban infrastructure, it is necessary to not only take into account the costs involved, but also the efficiency of the solution with regards to the other problems of a megacity, such as ecological, health and safety, living comforts and infrastructural attractiveness [2, 3].

For an estimation of the ecological efficiency of tunnel building, we must analyse the quantity of emissions of harmful substances into the air from motor transport on the city roads in Vladivostok as well as the noise levels.

2.1. Criterion of ecological safety

The demands of state standards for the safety of products, works and services for a circumambient, life and health, are obligatory for state structures of management and subjects of economic activities [4, 5]. We observe a state of environment in Vladivostok from these positions.

2.1.1. Estimation of quantity of harmful atmospheric emissions.

Motor transport is the main source of the harmful emissions which are polluting the city atmosphere. Agency of meteorological informs that parameters of the dispersion of harmful emissions from motor transport in a ground upper-air is in the case of Vladivostok an additional factor towards the city's the decline [6]. This problem is now at an acute level in the main parts of a city.

Emissions from motor transport in 2011 were 201.5 thousand τ (47.25% of the total volume of emissions in the region) [7]. The concentration of exhaust fumes at traffic signals and in residential areas is especially high. At 'peak' times if, for example at crossroads, traffic jams form, cars burn out oxygen and saturate the aerosphere with exhaust fumes. Such rush hours in the city of Vladivostok are in the morning, when adults leave for work and take their children to school and in a kindergarten, and in the evening when they return.

The monitoring of air pollution as recorded by the City Administration of Vladivostok is presented in tables 1 and 2 [8]. There is a mid-year concentration of nitrogen dioxide and dust exceeds the maximum concentration limit 1.5–2 times.

According to researches, the air basin of the city of Vladivostok is dangerously polluted by nitrogen dioxide, which irritates and frequently attacks the mucous membranes of eyes and lungs. This gas can cause a considerable deterioration in existing diseases of the respiratory system, such as bronchitis and asthma, and infections of

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