

TRANSPORT NOISE AFFECTION TO THE HOUSING ESTATES

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Introduction Transport noise level increases together with the cities growth. Statistic data about noise affection to the human population shows that approximately 100 millions people of West Europe and North America suffer from noise "inadmissible", which is exceeding 65 dBA, and 300 millions - from noise "undesirable", which exceeds 55 dBA. In such cities as New York, Paris, Rome, Mexico, Moscow etc. equivalent noise levels achieve 75-80 dBA. The main danger is that city noise is tending to increase. Noise level in the cities is growing every year up to 0,5-1,0 dBA. This tendency still remains despite on the transport noise levels restriction. Disturbing acoustical impact influences half of Earth population. Therefore acoustical pollution for the time being is a global ecological problem among such problems as water and atmosphere pollution, radioactive waste, ozonosphere destruction etc. Since transport noise is one of the greatest of transport impact on the city environment, it is necessary to use all humans knowledge, all intellectual and technical resources to reduce it. This paper is devoted to investigations of transport noise affection on the housing estates of modern industrial city. As a prototype for investigations Togliatti city had been selected.

Peculiarities of transport noise impact Increased noise levels affection to the housing estates leads to cities population disease growth. It is well known, that the strongest impact produced by noise effects on man is in frequency range from 1000 to 4000 Hz (middle- and high frequencies). But for industrial city environment the most strong noise impact to the city population is first of all caused by low frequency noise (from 20 to 300 Hz). Analysis of inhabitants complaints confirms it. Low frequency noise is spreading for a long distances without significant absorption. There are also some peculiar characteristics of low frequency noise affection such as the resonance of humans body, the association with natural phenomena etc. Thus, we can determine the zone of main physiological discomfort in frequency range 1000 - 4000 Hz, and the main ecological and psychological discomfort in frequency range of low frequencies. The number of transport parks in cities increases every month. Therefore the problem of transport noise reduction in large cities is very important. The main input to transport noise generation in modern cities is the automobile transport (up to 90% from all population complaints). Automobile transport is intensive source of low-frequency noise generation, which is radiating from internal combustion engine intake and exhaust and by automobile tyres.

Methods and results of analysis of transport noise affection in Togliatti city There are legal, normative and technical documents, determining the procedure of investigation of acoustic pollution of environment and noise affection to the urban living territories. There are international and national standards of noise assessment. When the scale of city transport flows is growing, acoustic discomfort zones are considerably increased. Let us to consider in this paper the main issues of noise assessment of Togliatti city as a typical industrial city. For Togliatti city the acoustic radiation is mainly determined by the effect of automobile transport. Comparatively homogeneous composition of transport flows is typical - rail city transport is absent, impact of aircraft noise is excluded. Specific city peculiarity is large automobile transport park, which mostly consist of cars. This leads to the intensive transport flows at city's streets, which are generating significant noise impact. The problem is intensified by the fact

that considerable number of the city highways is situated close to the living areas and transport (especially of the Central and Komsomolsky districts). As result there are increased noise levels for some dwelling houses. Method of noise measurement in noise "dangerous" points has been carried out according to the Russian State Standard 23337-78*. Noise of transport flows is unstable, oscillating in time. For this kind of noise there are some main requirements to carrying out the measurements:

- Time of noise evaluation T in dwelling houses, public buildings and in living territory should be accepted in the day-time - continuously during 8 hours, at night - continuously during 0,5 hour (in the most noisy periods of day).
- Measurement of unstable noise should be carried out at the periods of time of noise evaluation T , which include all typical variations of noise regime in evaluated point. Duration of every measurement of unsteady noise T_m in every point should be at least 30 minutes.
- Reading of sound levels of interrupting noise, which are remaining stable in the intervals with duration less than 0,5 minute, and also of oscillating and impulse noise should be carried out with intervals from 5 to 6 seconds. In every point during the period of noise T_m should be conducted 360 readings of sound levels etc.

Measurements of noise levels in places of living territory of Togliatti city adjoining to noise dangerous zones have been conducted in strict correspondence with above mentioned requirements. Concrete points for measurements carrying out were determined in co-ordination with the Committee of Ecology and Natural Resources of Togliatti city. Measurements were conducted during weekdays' daytime mainly in rush hours and also during to the lunchtime. In total, over 30 points have been investigated, and for evaluation of equivalent sound levels in every of these points according to the Russian State Standard requirements 360 readings of sound levels have been carried out. Measured noise levels evaluated according to hygiene requirements, stated by valid sanitary norms CH 2.2.4/2.1.8.562-96, according to requirements of which normative parameters for unstable noise are equivalent sound levels $L_{A_{ecv}}$ and maximal sound levels $L_{A_{max}}$, dBA. For evaluation of obtained results following normative values of equivalent and maximal sound levels were used:

$$L_{A_{ecv \text{ norm}}} = 55 \text{ dBA} + 10 \text{ dBA} = 65 \text{ dBA} \quad (1)$$

$$L_{A_{max \text{ norm}}} = 70 \text{ dBA} + 10 \text{ dBA} = 80 \text{ dBA} \quad (2)$$

Discussion of experimental investigations results Collaborators of Togliatti State University R&D laboratory "Vibroacoustics and life protection" have carried out investigation of external noise sources affection and experimental investigations of transport noise affection to the city housing estates living area of Togliatti city. In total, over 30 points have been investigated. Results of measurements in every point have been presented as measurements registration forms, which including date, time and place of measurements carrying out, measuring points numbers and digital data of readings of noise levels in measured point (360 values for every point). Analysis of measurement results of external noise levels in living territory of Togliatti city shows, that there are noise dangerous zones of dwelling territory. Population of Togliatti city is approx. 800 thousands people, and at least 100 thousands are living in areas with increased noise levels. The most serious problem of noise influence is for the dwelling territories of Central district adjoining to transport highways. The most significant excess of standard equivalent noise levels is observed for the point 6-1, Central district, Mira street (near to bus stop "House of Nature") - 6 dBA; point 5-2, Central district, Banykina street - 4 dBA; point 7-1, Central district, Komsomolskaya street - 3 dBA. Values in a number of measured points are extremely close to maximally admitted normative requirements. Thus, it is possible to speak about the existing of real problem of noise safety of Togliatti city provision. It is necessary to carry out further investigations of noise levels in all districts of Togliatti city.

Keywords: transport noise, impact, low frequency, measurement