

# Influence of Highway Traffic Noise on Environment and Governance Methods

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**Abstract.** With social development, urban highway traffic problem has become the focus of all sectors of society. Highway traffic noise has become a social issue which endangers people's living environment. Thus, relevant sectors need to construct effective governance measures to fundamentally reduce the influence of highway traffic noise on environment. In this paper, the main sources of highway traffic noise are briefly analyzed, and influencing factors and governance methods are discussed for reference.

## Introduction

Under the background of economic development, social demand for traffic highways gradually increases. The total highway mileage is one the rise in China. In combination of development program of national main trunk line, five vertical and seven horizontal national main trunk lines which consist of 12 expressways and highways will have been built by 2020. It is necessary to indicate that the integrated development of highway business causes that highway pollution problem and highway noise problem stand out gradually. Relent sectors should pay high attention to the problems.

## Main courses of highway traffic noise

During comprehensive analysis of highway traffic noise, there are two main sources of noise. The first source is construction process. The machines such as excavator, earthmover and generate noise pollution. Noise not just has perdurability. Besides, the sound level is high. The second source includes trumpet and engine. In addition, there is driving noise, exhaust noise and noise of cooling system. The convergence of these noises results in serious highway traffic noise which seriously restricts people's daily life. It is necessary to notice that in the normal driving process, tyre noise of passenger cars accounts for over 80% of automobile noise, while tyre noise of large trucks accounts for about 70%. So, to effectively reduce noise influence, it is urgent to optimize tyres and highway noise.

## Influencing factors of highway traffic noise

During analyzing the influencing factors of highway traffic noise, systematical analysis of the following factors should be carried out.

Firstly, driving speed of vehicles. Tyre and highway noise will gradually increase with the rise of driving speed. In other words, tyre noise, highway noise and driving speed can form the direct proportion relation.

Secondly, tyre load and charge pressure are also important factors influencing highway noise. The influence of tyre load and charge pressure on noise will differ due to tyres made of different materials. The tyre with longitudinal pattern will almost not generate the influence. But, the tyre with transverse

pattern will generate direct influence on noise. Besides, ground pressure will rise, with the increase of load and charge pressure. Correspondingly, noise will also increase gradually.

Thirdly, ambient temperature will also affect tyre noise. Especially when outdoor temperature rises, tyre noise will decrease gradually, and the difference value can exceed  $-0.1 \text{ dB}/^\circ\text{C}$ . Such noise is generated under the joint action of tyre and pavement. In other words, the temperature rise will make tyre temperature increase, and tyre and pavement noise will reduce after the structural material of the tyre is softened.

Fourthly, the performance of pitch mixed material of pavement will influence sound absorption effect of the pavement. Especially for porous absorption material, certain gap exists and connection structure exists in the gap. The connection structure is connected with the outside through the surface. In other words, after sound wave transfers to the surface of material, some materials will connect the outside. Due to the gap, friction appears in the wall. Thus, glutinousness and heat conduction effect will appear. Sound energy is gradually consumed in the conversion process. On this basis, multi-gap materials can effectively absorb sound energy to ensure optimization of gap connection effect.

### **Influence of highway traffic noise on environment**

Among main pollution sources in cities, highway traffic noise is the main source. According to the relevant report, among urban noise pollution, 50%-70% comes from traffic noise. In addition, more than 70% of urban traffic noise exceeds  $70 \text{ dB}$  on the average. Noise pollution problem in the cities with different development situation is also different and presents the deterioration trend. It is necessary to note that the noise below  $55 \text{ dB}$  will not have large influence, but if the noise exceeds  $70 \text{ dB}$ , severe harm will be generated on human body. When vehicles run on the expressway, large volume of traffic and high speed problems are serious, and the traffic noise will also result in serious pollution to residents and environment.<sup>[1]</sup> If people are in the noise environment for a long term, hearing will be damaged. Noise induced deafness and explosive deafness are common problems. Hence, relevant sectors should pay high attention to traffic noise.

Furthermore, noise will affect surrounding environment. Noise pollution problem will form within 200m-300m at both sides of the highway. Both noise pollution and vehicle exhaust will seriously affect habits of forest animals at both sides of the highway. For example, noise will affect the gender proportion and age proportion of songbirds. Meanwhile, the reproductive rate will decline sharply. Noise will restrict economic development along the highway. Real estate industry, plants and business buildings troubled by noise will suffer economic decline to different degree. Relevant technical personnel have measured the geological parameters around the highway. When the noise around the highway increases by  $1 \text{ dB}$ , land value will decrease by about 0.8%. Thus, in order to fundamentally improve control effect of highway traffic noise, effective measures should be taken to ensure all-round reduction of adverse influence of noise or avoid it<sup>[2]</sup>.

### **Governance methods of highway traffic noise**

In highway traffic noise management, it is required to actively practice systematic control mechanism and maintenance mechanism so as to make sure highway traffic noise handling effect conforms to practical standards. Urban noise pollution treatment and research started late in China. In the last century, the research on noise still focused on industrial noise, and the research field concentrated on noise elimination and insulation aspects. After 1970s, some scientific research departments studied urban environmental noise and proposed the specific evaluation indexes and noise environment indexes. At present, governance measures for highway traffic noise mainly focus on the following aspects:

### **To effectively reduce sources of noise**

It is required to start from the source of noise, lower the occurrence frequency and ensure orderly implementation of highway management work. In the highway, an ideal sound mode is steady motor sound and low exhaust sound. To achieve the ideal mode, the highway should be integrated from the aspects of the tyre and pavement structure. 1) Tyre transformation may be adopted to reduce noise decibel. Tyre pattern groove may be set to reduce pavement noise to certain degree. Most importantly, tyre vibration effect should be improved. Increasing the print on the ground at front end and rear end of the tyre can effectively ensure the angle of tyre pattern groove, fundamentally lower the noise caused by air compression within the horizontal pattern groove, effectively strengthen actual angle of pattern groove and make sure the vibration is treated effectively. 2) It is required to enhance noise management level with the form of improving pavement conditions and improve control level while reducing noise effectively. It is necessary to note that noise reduction pavement is also called interspace bituminous pavement or Porous asphalt pavement. In the process of management mechanism establishment and operation, bituminous concrete material with high voidage will be directly paved on the ordinary bituminous pavement or cement concrete pavement. It is necessary to note that the voidage should be controlled between 1% and 25% in order to give full play to the functions of noise reduction, low splashing and increase of adhesive force. After the improvement, the pavement can effectively reduce air explosion noise when the tyre and pavement contacts. In this way, driving comfort and safety can improve in rainy days and winter and light reflection degree of pavement can be avoided fundamentally<sup>[3]</sup>.

### **To effectively prevent noise transmission**

Technical personnel of relevant departments should carry out targeted handling mechanism and control measures for the specific problems.

Firstly, sound barrier technique. The sound barrier can effectively eliminate or reduce noise. At present, an effective handling mechanism is noise prevention dyke and sound barrier wall. The former mainly includes through cut or excavation section. The excavated earth can be directly used to build the noise prevention dyke. This can not just effectively reduce noise, but also overall govern and beautify the environment and ensure optimization of entire treatment effect and integration level. The latter applies reflection-type barrier wall to treat noise. Diffuse reflection can effectively reduce the noise in the area. The raw material used mainly includes sound absorption material. It is necessary to notice that sound barrier can save land and enhance noise reduction effect. The assembling-type processing mechanism can be utilized to optimize treatment effect. But, the biggest defect of sound barrier is that it will cause mental stress to drivers. The transparent sound barrier will result in dazzling and light reflection problem. Thus, overall cost of road management project will obviously increase, and even landscape structure of the highway will be destroyed.

Secondly, green belt may be planted to reduce noise. Trees and green plants will form a natural green belt which is a natural noise reduction device and can enhance noise treatment effect to certain degree. Besides, green belt planting at both sides of the highway can effectively prevent traffic noise problem and achieve the goal of environmental protection. The green belt can effectively absorb carbon dioxide and other harmful gases, improve climate conditions within a small area and avoid air pollution problem to certain degree. Meanwhile, the green belt can hold back highway drainage system and satisfy the requirement of environment beautification. In the process of green belt design, the following requirements should be practiced by combining actual requirements. 1) Noise prevention forest design work for each noise sensitive point along the highway not merely includes side slope treatment, but also involves the integration of isolation belt and noise prevention forest. It is necessary to notice that side slope greening project involves road shoulder management, excavation slope management and fill slope greening management etc. Shrubs or short arbors may be applied to ensure noise reduction and beauty. To further improve noise reduction and greening level, technical personnel may choose mixed plant planting and practice plant arrangement principle. The

basic effect of noise prevention forest will be influenced by the density and width of forest. So, different kinds of trees should be chosen according to actual conditions of soil. 2) Noise reduction function of the green belt is not merely related to the parameters of trees, but also is highly related to sound source and actual height of receivers. Thus, the experiment has proven that, tree leaves can effectively absorb the sound of low and medium frequency, except sheltering sight and high-frequency sound<sup>[4]</sup>. 3) During management of forest belt, the structure of forest belt should be near the highway as far as possible, and the interval should be controlled within the parameter system. The interval should be maintained between 6m-15m. The actual width of forest belt should exceed 30m, and the height should exceed 10m to ensure moderate forest belt position and height. The height of shrubs should exceed 3m, and the length should exceed the height of protection point to ensure optimization of green belt treatment effect. 4) Administrative staffs should analyze the distance between trees to make sure trees can get sufficient space, to improve overall level of moisture, nutrient and light and to avoid adverse effect caused by noise. It is necessary to note that administrative staffs should ensure optimization of control effect of noise control forest cutting. Especially after the economic forest becomes mature, cutting should be implemented by stages. New seeds should be planted in time to ensure optimization of management effect. 5) In a bid to control noise through plants throughout the year, some hardy plants should be planted. Common hardy plants such as *Sabina chinensis* and privet should be chosen to effectively upgrade the ability of disease and insect resistance, make sure the complete degree of ecological community conforms to the expectation, improve survival rate of trees and ensure optimization of management effect and systematic treatment level. In addition, administrative staffs should rationally match the colors of trees, reduce the influence of single color structure on drivers' sight and make sure colors and beauty conform to standards.

Thirdly, keep away from sources of noise. In noise management work, noise volume will gradually reduce with the increase of distance. So to effectively improve noise treatment level, it is required to pay attention to route design. The line selection of highway should avoid cities and towns or sensitive environment and belt. Moreover, the position of middle line of highway should keep away from the environmental sensitive area (at least over 100m). Especially for schools and hospitals, the distance should be at least 200m. It is necessary to note that, it is required to make sure nobody live in the houses when the use function of buildings near the source of noise is adjusted. The noise reduction measures can reduce the influence of operation noise and improve practicality of noise control forest. Meanwhile, the relation between lien structure and landscape of highway can be handled well[5].

## Conclusion

In one word, in highway traffic noise management, it is required to focus on highway environment protection, enhance environment and plant management measures and make sure traffic noise pollution can be treated effectively. Especially in highway traffic construction project, vehicle management effect should comply with standards. It is required to start from actual environment and demand, strengthen environmental protection construction force, ensure technical feasibility in combination of actual conditions of engineering and lay a solid foundation for sustainable development of traffic noise management.

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