Kansas Department of Transportation Highway Traffic Noise Program

Fundamentals

1. **What is the difference between sound and noise?**

   Sound is anything we hear. Sound is created when an object moves that causes small, fast pressure changes whereby the vibrations reach our ears. Sound that is undesirable or unwanted is considered noise.

2. **How is sound measured?**

   Sound is measured in decibels (dB). To better represent human hearing, very high and very low-pitched sounds are adjusted, or "A-weighted" (dBA). Traffic noise is reported as dBA. There are two important things to know about sound energy. First, sound is measured logarithmically, so 60 dBA + 60 dBA = 63 dBA, not 120 dBA. In contrast, 60 dBA + 50 dBA = 60 dBA. And secondly, the perception of how "loud" a sound is varies by person. Generally, three dBA is considered the minimum audible difference between sound levels. A 10 dBA change is generally perceived to be 2x or one-half as loud depending on whether the sound is increasing or decreasing.

3. **How is traffic sound measured?**

   Highway traffic noise is not constant. Noise levels change with the number, type and speed of the vehicles. For example, traffic noise levels might be lower during rush hour when traffic speeds are reduced compared to other times when fewer vehicles are traveling at a higher speed. The most common statistical descriptor for traffic noise is Leq. For traffic noise assessment purposes, Leq is typically evaluated over worst one-hour period and is defined as Leq (1hr). Leq is time-weighted. It averages louder and quieter moments but gives more weight to louder moments in the averaging.

4. **What causes highway traffic noise?**

   Highway traffic noise is a combination of the sounds produced by vehicle engines, exhaust, and tires. Traffic noise is also increased by defective mufflers or other faulty equipment. Conditions, like a steep incline, that causes heavy laboring of vehicle engines, will also increase traffic noise levels. Other factors also complicate the loudness of traffic noise. For example, traffic noise levels are reduced by distance, terrain, vegetation and natural and manmade obstacles as a person moves away from a highway.

5. What can be done to reduce traffic noise?

Effective control requires: (1) noise compatible planning (2) source control through fewer loud vehicles, (3) and when feasible and reasonable, abatement of highway traffic noise for individual projects. The first component is traditionally an area of local responsibility. The other components are the joint responsibilities of private industry, Federal, State, and local governments. As part of the environmental review process for transportation projects, the Kansas Department of Transportation (KDOT) is required to determine if predicted noise levels could result in noise impacts. If there are impacts then methods are considered for noise abatement.

Highway Traffic Noise Impacts

6. What transportation improvements require an environmental review for traffic noise impacts?

Only those that meet criteria for Type 1 as defined by the Federal Highway Administration (FHWA) and KDOT are evaluated.

7. What are the criteria for Type 1 transportation improvements?

(1) The construction of a highway on new location; or, (2) The physical alteration of an existing highway where there is either: (i) Substantial Horizontal Alteration. A project that halves the distance between the traffic noise source and the closest receptor between the existing conditions to the future build conditions; or, (ii) Substantial Vertical Alteration. A project that removes shielding therefore exposing the line-of-sight between the receptor and the traffic noise source. This is done by either altering the vertical alignment of the highway or by altering the topography between the highway traffic noise source and the receptor; or, (3) The addition of a through-traffic lane(s). This includes the addition of a through-traffic lane that functions as a High Occupancy Vehicle Lane, bus lane, or truck climbing lane; or, (4) The addition of an auxiliary lane, except for when the auxiliary lane is a turn lane; or, (5) The addition or relocation of interchange lanes or ramps added to a quadrant to complete an existing partial interchange; or, (6) Restriping existing pavement for the purpose of adding a through-traffic lane or an auxiliary lane; or, (7) The addition of a new or substantial alteration of a weigh station, rest stop, ride-share lot or toll plaza.

8. Why does adding lanes only result in barely perceptible changes?

Adding lanes generally does not cause perceptible increases in noise levels. If a four-lane highway is widened to five lanes, it could carry 25 percent more traffic. This traffic increase will usually cause the Leq to increase by only one dB, well below what people can hear. Doubling the traffic volume could increase the Leq by three dB, the smallest change in noise level a person can detect.

9. How are highway traffic noise impacts identified?

Particular land uses are classified with Noise Abatement Criteria (NAC), and if predicted noise levels approach or exceed the criteria, then impacts are deemed to occur. Approach is defined as one decibel below levels shown in the NAC. Impacts can also occur when predicted future traffic noise levels substantially exceed existing sound levels, even though predicted levels may not exceed the NAC. Substantially exceed is defined as more than 10 dB. In order to adequately assess traffic noise impacts of a proposed project, both conditions must be analyzed. For example, a residence with an existing sound level of 60 dBA Leq (1hr), predicted to increase by six decibels does not meet the definition of substantially exceed. However, the increase reaches 66 dBA Leq (1hr), and this level approaches criteria of the NAC for residential land use. Therefore, an impact would be predicted for the design year. A design year is generally 20 years from the date of construction of a project.

10. How is traffic noise analyzed?

KDOT utilizes the approved FHWA computer model and sound level meter equipment operated by qualified noise analysts.

Abatement

11. How does KDOT consider noise abatement measures?

Impacts from highway traffic noise impacts must be identified and documented. Feasible and Reasonable criteria must be met for any noise abatement measures to be considered.

12. How does KDOT decide to build noise barriers?

A noise barrier incorporated into a project requires specific evaluation of Feasible and Reasonable criteria. Some considerations for a successful noise barrier include: careful attention to driver safety, including line of sight and emergency vehicle access; careful attention to neighborhood safety issues like fire access, security, and drainage; achieving a noise reduction of 10 dB; cost-effectiveness; and documented support from benefited receptors.

Noise Barriers	
• Can be a vertical wall, an earthen berm, or a combination wall and berm. • Are most effective within 200 feet of a road, generally for the first row of homes. • Can cut the loudness of traffic noise up to one-half. • Do not block all traffic noise. • Do not increase noise levels perceptibly on the opposite side of the road. • Because sound can bend around and over barriers, noise barriers must not have gaps. They must also continue past the last receptor for quite a distance, or wrap around them. Generally, the barrier must extend 400 feet past the last receptor for every 100 foot distance to the barrier. • Must be tall and long with no openings.	Once in place, maintaining noise barriers is a top priority for KDOT. The barriers built in Kansas are made of concrete. Some local jurisdictions may choose to fund some additional aesthetic enhancements. KDOT's maintenance staff responds quickly to problems such as graffiti.