FDM 23-25-1 Introduction

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According to 23 CFR 772.9(a), "Any analysis required by this subpart must use the FHWA Traffic Noise Model (TNM), which is described in "FHWA Traffic Noise Model" Report No. FHWA-PD-96-010, including Revision No. 1, dated April 14, 2004, or any other model determined by the FHWA to be consistent with the methodology of the FHWA TNM." These documents are available on the FHWA'a Traffic Noise Model website at the following URL: http://www.fhwa.dot.gov/environment/noise/index.htm.

Future sound level prediction must therefore be accomplished through the use of the latest version of the FHWA Traffic Noise Model (TNM).

Future sound level prediction is completed for the Design Year which the department defines as being 20 years after the completion of construction of the highway facility.

FDM 23-25-5 Design Features

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The designer should always attempt to realize maximum benefit from the establishment of design features when analyzing future sound levels. Design features are usually limited to new roadways or major reconstructions.

Increasing the roadway-receiver distance usually provides the greatest potential for sound level reduction. Since sound levels are reduced from 3 to 4.5 dB per doubling of distance between the source and receiver, shifting horizontal alignment away from an affected area can often be quite beneficial.

Other potential design feature measures that are less effective include using flatter grades and eliminating stop and go conditions.

Vertical alignment shifts, particularly depressing the highway to form a vertical cut section, can also be quite effective since this creates a barrier (the top of cut) between the source and receiver.

Sometimes, the roadway can be placed so that attenuation is provided by natural barriers, such as hills and wooded areas. It should be remembered that at least 100 feet of dense vegetation is required to produce a noticeable reduction in sound levels.

The same can be done with land use planning where existing man-made features, such as industrial strip development adjacent to roadway corridors, can be used as buffers for nearby receivers areas.

Excess spoil material on a project presents another opportunity for sound level reduction. If sufficient right-of-way is available, a berm can be constructed using the spoil material. A berm constructed from spoil material as a design feature should be engineered to provide the maximum sound level reduction possible. A retaining wall needed for the project can also possibly reduce future noise levels. If such a berm or retaining wall is included in the environmental document commitments, the berm or retaining wall may be considered in the analysis of future sound levels which could lead to a determination that no noise impact would occur.

Other design features may increase sound levels. Removal of a row of houses, topography changes, roadway grade increases and other design features can negatively affect receivers.

It is important that all design features that are proposed for inclusion in the project's final design be incorporated in the future sound level analysis using the FHWA Traffic Noise Model (TNM). These design features may increase future built environment sound levels to a level at which an impact occurs (or adds to an existing impact) or could reduce future built environment sound levels to a level at which no impact will occur as a result of the proposed Type I project.

FDM 23-25-10 FHWA Traffic Noise Model (TNM)

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The intent of this procedure is to provide an overview of the TNM program. It will not provide detailed instruction on the use of TNM.

The FHWA TNM is a registered copyright and trademark.

The FHWA TNM is a state-of-the-art computer program used for predicting noise impacts in the vicinity of highways. It uses advances in personal computer hardware and software to improve upon the accuracy and ease of modeling highway sound levels, including the design of effective, cost-efficient highway noise barriers.

The FHWA TNM contains the following components:

- Modeling of five standard vehicle types, including automobiles, medium trucks, heavy trucks, buses, and motorcycles, as well as user-defined vehicles.
- Modeling of both constant-flow and interrupted-flow traffic using a 1994/1995 field-measured database.
- Modeling of the effects of different pavement types, as well as the effects of graded roadways.
- Sound level computations based on a one-third octave-band database and algorithms.
- Graphically interactive noise barrier design and optimization.
- Attenuation over/through rows of buildings and dense vegetation.
- Multiple diffraction analysis.
- Parallel barrier analysis.
- Contour analysis, including sound level contours, barrier insertion loss contours, and sound-level difference contours.

10.1 Summary of Inputs

10.1.1 Roadways and Traffic Flow

TNM describes a roadway by the traffic flow conditions and a series of straight line roadway segments approximating the horizontal and vertical alignment of the roadway. The width of the roadway must be included as an input. The roadway can also be identified as being on a structure.

Pavement type is also a TNM input variable. TNM defaults to "average" for pavement type. It is FHWA policy that the use of any other pavement type must be substantiated and approved by FHWA.

TNM describes a traffic flow condition as a combination of vehicle speed and hourly vehicle volume for each vehicle type recognized by the program. The program predefines five vehicle types: cars, medium trucks, heavy trucks, buses and motorcycles. The program models traffic flow conditions based upon the noise emission characteristics of each vehicle type. The predefined vehicle types all consider the vehicle sound emissions as a function of vehicle speed. Also, the user may define an additional five (5) vehicle types by specifying constants to define the vehicle's sound emission characteristics.

If vehicle speeds, volumes, or both change, it is necessary to begin a new roadway at the point of change, such as at an interchange ramp where additions to or deletions from mainstream traffic take place. Another example would be the approaches to an at-grade intersection where each approach has a different volume.

10.1.2 Receivers

As a minimum, for those alternatives being carried forward for detailed study, locations at which existing sound levels were evaluated (see FDM 23-20-5.1) should also be included in the TNM model for future sound level analysis.

Because roadway coordinates are placed at the center of the roadways width, receivers should not be placed within 1/2 the distance of the roadway's width from the roadway. Additionally, a receiver should not be allowed to intersect with any other type of TNM input.

10.1.3 Barriers

TNM barriers are either walls or berms that intervene between roadways and receivers to reduce sound levels. For purposes of barrier design, TNM allows you to perturb barrier heights up and down to optimize the barriers effectiveness. TNM allows berm/wall combinations and barriers on structure to be input. You may designate whether the barrier is absorptive or reflective.

10.1.4 Building Rows

TNM building rows are long rows of buildings, with gaps, that intervene between roadways and receivers, like barriers, to reduce sound levels. Unlike barriers, however, a portion of the sound energy penetrates through building-row gaps, thereby making them less effective than comparable-height barriers.

10.1.5 Terrain Lines

TNM terrain lines define where the terrain is located, both horizontally and vertically. Where terrain lines protrude vertically through lines-of-sight, they reduce sound levels just as do intervening berms. It should be noted that small changes in terrain elevations have little effect on the overall shape of the ground and on the final sound levels.

10.1.6 Ground Zones

Ground zone inputs allow TNM to determine propagation rates. TNM built-in ground zones include; pavement, water, hard soil, loose soil, lawn, field grass, granular snow and powder snow. The pavement ground type should be used if you would like to model a generic acoustically hard ground surface. The field grass ground type should be used if you would like to model a generic acoustically soft ground surface.

10.1.7 Tree Zones

Tree zone inputs allow TNM to account for additional attenuation due to trees between the roadway and receptor. The average tree height is entered into the program. Tree zone inputs should only be used if the trees are sufficiently dense to completely block the view along the propagation path including dense undergrowth and tree-top foliage.