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STANDARDIZATION OF ROAD TRAFFIC NOISE MAP IN KOREA

In-Sun Park[1], Sang-Kyu Park[1] and Daejoon Kang[2]

[1]Department of Environmental Engineering, Yonsei University Wonju Campus
Wonju, Gangwon, 220-710, Korea
[2]National Institute of Environmental Research
Kyungserdong Sergu, Inchun 404-708, South Korea
djkang@me.go.kr

Abstract

Since study on noise map in Korea has begun in the late 1990, focus was on how to use interpolation methods of Arc GIS to compare the measured noise data with predicted result. However, use of professional noise map has been very rare because basic data such as information of roads, traffic flows and geography are not enough.
In this study, noise maps of a city in Korea have been made using commercial noise map software by measuring the basic data in the city. This result will be used to evaluate the environmental impact of noise from various noise sources and to implement the Korean noise map standard.

1. INTRODUCTION

As the economic level and conscious level of people have been improved, the desire for the quiet environment has grown larger, but the civil appeals and disputes have increased due to the noise generated because of the overcrowded city and the high density of population.
Especially, the traffic noise as a main cause of raising annoyance greatly influences on the daily life and leisure activity of residents and a measure of solving this problem is urgently in need.
In order to establish a fundamental measure for solving traffic noise, it is important to understand or predict the actual influence of noise, but, the measurement-oriented assessment method has a certain limitation in grasping and predicting the current situation of traffic noise generation.
Recently in relation to this, European Union (EU) as means of noise reduction requires writing the noise map until the year 2007 for the city that has a population of 250 thousands and operates a yearly traffic volume of 6 million motor vehicles, a yearly railway traffic volume of 60 thousand trains, and a yearly air traffic volume of 50 thousand aircrafts; also in Korea, studies on the noise map are actively carried out from the needs mentioned above.
Noise map, as a tool of visually showing the current and predicted level of noise, has its importance in selecting and applying the prediction method that predicts the noise generated from the interactions of various influence factors. However, the commercial software

widely-used up to the present has not applied the prediction method suitable to Korea.
Since the prediction method for the road traffic noise of England, Germany and EU that is commonly used by several commercial software the applications has shown the errors less than 3 dB from the values of actual measurement; hence, we have judged that oversea prediction method can be temporarily used until we can prepare and establish our own prediction method.

In this study, we would like to suggest the standard procedure for preparing a noise map by using a standard plan and commercial software.

2. STANDARD PLAN FOR NOISE MAP

2.1 Selecting the noise prediction method and noise map software

Selecting the noise prediction method and noise map software is needed when preparing a noise map.
We have reviewed the prediction method and software that have been used by the EU directive and European countries of preparing a noise map. This study, in addition to the XPS31-133 (previously NMPB) suggested by EU Directive, has also reviewed RLS90 (Germany), CRTN (England), RMR 2002 (Netherlands) and the commercial software applications such as LimA, CadnaA and SoundPLAN.

2.2 Considering the size of noise map preparation area

The subjected cities were selected while considering the noise map preparation criteria of EU and the administrative districts and environmental noise monitoring network of Korea. Table 1 and 2 are the examples that have selected the noise map preparation criteria of EU and the cities subjected for preparing domestic noise maps.

Table 1. The object site of noise map in EU directive

Enforcing year / Object	2007. 7	2012.7
resident	250,000 persons	100,000 persons
road	6,000,000 vehicle passages a year	3,000,000 vehicle passages a year
railway	60,000 train passages a year	30,000 train passages a year
airport	50,000 movements per year	major airport

Table 2. The object site of noise map in Korea

Enforcing year / Object	2010	2013	2016
First agenda	500,000 persons	250,000 persons	100,000 persons
Second agenda	250,000 persons	100,000 persons	-

2.3 The standard size of noise map grid

The EU Commission Working Group Assessment of Exposure of Noise (WG-AEN) recommends to make a noise map by using the grid no larger than 10×10 m in the agglomeration area and the 30×30 m grid in the outside of agglomeration area, but Korea suggests using the grid size as shown on the Table 3 while considering the interruption and distortion of sound when predicting it in the city area where multifloor buildings are highly crowded.

Table 3. The grid size of noise map in Korea

Area	high density area	agglomeration area	outside of agglomeration area
Grid side	5 m x 5 m	10 m x 10 m	20 m x 20 m

3. STANDARD PROCEDURE FOR ROAD TRAFFIC NOISE MAP

3.1 Acquisition of geographic information

In Korea, it is possible to obtain 3 types of geographic information and the 3 dimensional map of Korea is expected to be prepared by the year 2010.

3.1.1 Topographical Map

This is the method that arranges the topographical map on the software background by opening it and that creates respective objects directly. It allows opening the maps in the graphic types of BMP, JPG, PNG and GIF and also, there is a difference in the file size even though it has the same topography. Since buildings, roads and other objects shall be created directly through the mouse pointer and digitizer, it may be possible if the subjected area is relatively small or has a limited number of objects. However if the number of objects increases, its use is highly limited.

3.1.2 GIS data (ArcView)

This is the method of using the ArcView file in the shape file form of GIS software. Although it is efficient in that the shapefile information of holding the characteristics of each object can be directly used, usable areas are limited when considering the actual domestic circumstances that GIS database has not been completely built.

3.1.3 Digital Map (DXF file)

It is the DXF file format of AutoCAD as the method of using a digital map. Since the layer of constructing digital maps can be created by using respective objects, the noise exposure properties and object properties need to be directly inputted. Currently, the digital maps for most of areas can be obtained from the National Geographic Information Institute (http://www.ngi.go.kr) and it is the most relevant method of acquiring geographic information at this moment.

3.2 Creation of geographic information (Geo-database)

When obtaining the geographic information by using a digital map, it is necessary to import the layer needed for preparing a noise map and to input the properties of each object.

3.2.1 Topography altitude

If the subjected area is hilly or not flat, the altitudes of roads and buildings may be needed in order to predict the characteristics of noise propagation acculately. However since the altitude for all the layers of a digital map except for the contour lines is not applied, the height information shall be calculated and entered by using the layers of contour line.

3.2.2 Noise source (road)

Roads, which are the noise sources of road traffic noise map, are converted into the road objects by using the road center-line layer of DXF and the properties of each road (road width, traffic flow, traffic speed, heavy vehicle rate, etc.) are inputted.

3.2.3 Buildings

The building layer of DXF is converted into the building object and then, the object properties such as the height, the number of floors, receiver point height, façade and population are inputted. When calculating the façade map, the subjected façade of the building should be designated.

3.2.4 Receiver point

In order to compare the survey value and the prediction value, the accurate survey point may be created as an object. An object can be created by designating the area and position of the area interested to measure the noise level or a receiver point may be created in the vertical direction when desiring to know the vertical distribution characteristics of a sound.

3.3 Noise Calculation

The general settings and calculation standards can be set prior to the calculation. For the general settings, more accurate results can be obtained while considering the incidence angle and reflection of a sound.

3.3.1 Single Point receivers Sound (SPS)

This calculates the noise level of a specific point and it shall create the receiver point object.

3.3.2 Grid map

It calculates the noise level for the area designated as a receiver area and indicates the grid map as the noise contour. The size and position of a grid may be set in the type property. The noise map can be more accurate and the calculation time may increase as the grid size gets smaller.

3.3.3 Facade map

It calculates the noise level from the surface of building. The façade to be calculated from each building can be designated and the size and number of calculation points may be arbitrarily adjusted.

3.3.4 Cross section map

It is calculated to check the distribution of noise level for the vertical side; setting the grid size like a grid map and inputting the height for the distribution shape to be known.

3.4 Result checking (result tables)

In case of the SPS or façade map, the noise calculation result and time lapse of each receiver point can be arranged on a table and they can be shown by processing the items such as the daytime, nighttime, daytime limit and nighttime limit value, and violation level of limit value. The result of other noise maps can be checked through the graphics.

3.5 Graphical representation (graphics)

The calculation result can be graphically represented in a form of 2D or 3D. In case of grid map, façade map and cross section map, the noise level or noise propagation of each point can be checked by representing the noise level in color.

3.5.1 Grid map

The daytime or nighttime noise level of the area designated as a receiver area can be diagrammed.

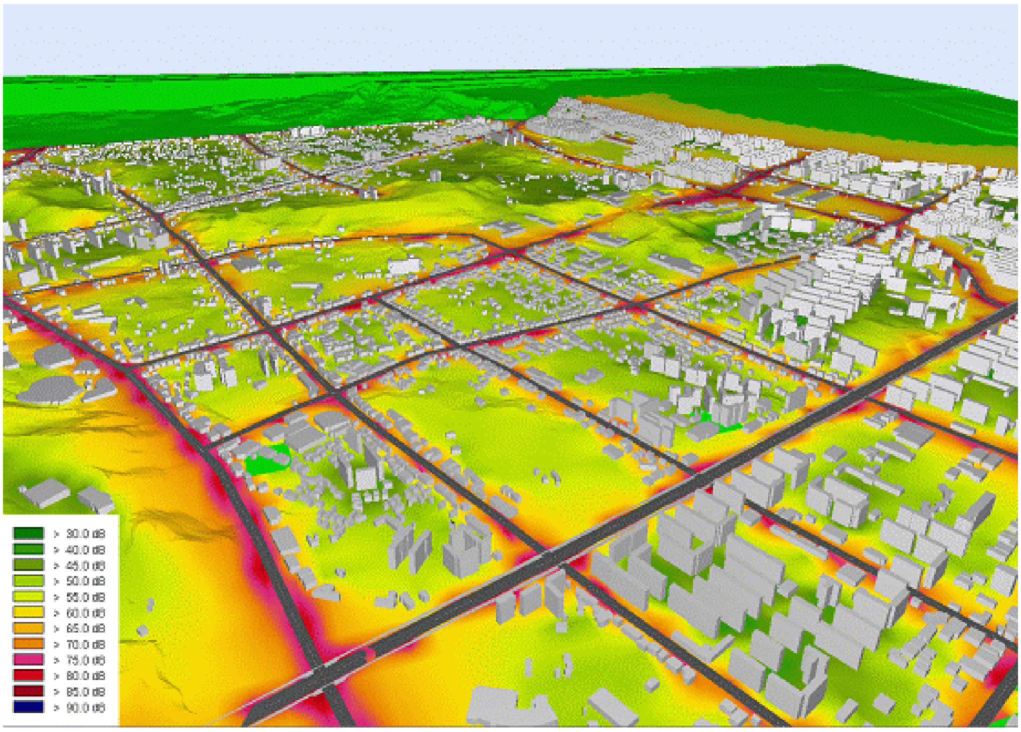

Figure 1. Grid map in Korea (3D)

3.5.2 Facade map

When diagramming in a form of 2D, the floors of the receiver point for the noise level subjected for display should be inputted and the noise level for all the floors can be displayed in the case of 3D. As receiver points increase for each façade, it becomes easier to observe the distribution and propagation of noise level, but it may take up a lot of computer resources and may generate image breakdowns.

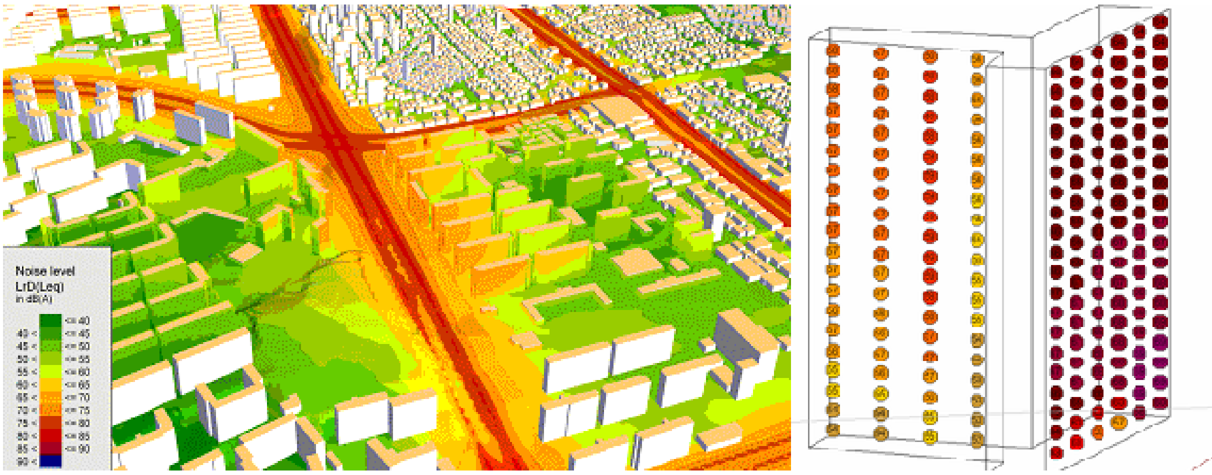

Figure 2. Facade map in Korea (3D)

3.5.3 Cross section map

Cross section map can check the noise distribution of the plane perpendicular to the surface.

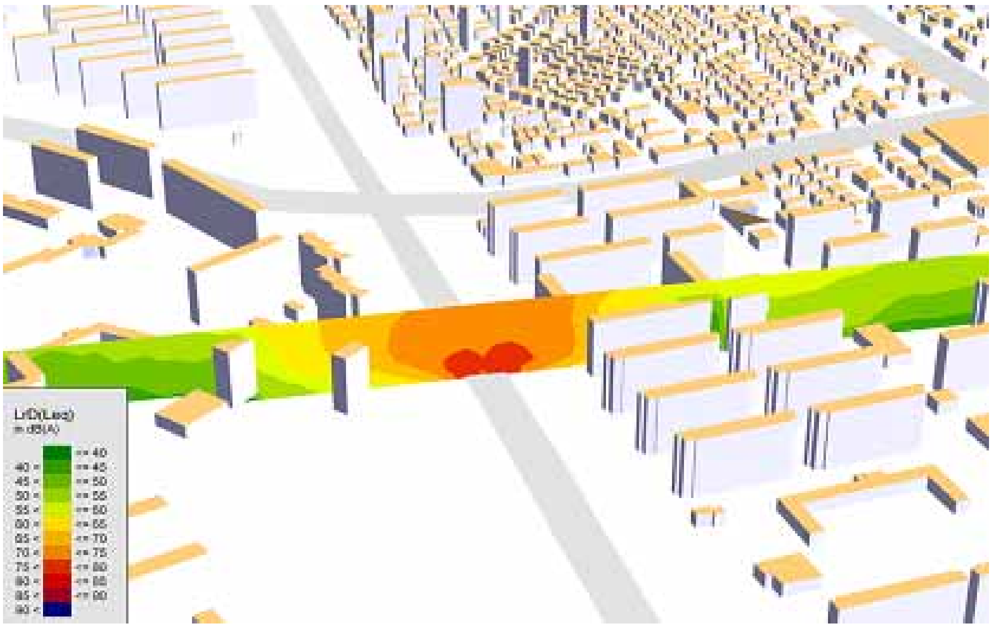

Figure 3. Cross section map in Korea

3.6 Saving the result (export data)

The data obtained in each phase of preparing the noise map can be stored in several types of formats. First, the created geographic information can be saved in a form of shape file, DXF or ASCII and this helps to use data by linking to other software applications.
When the noise level in a fixed receiver point as in the SPS or façade map is calculated, the calculation result can be diagrammed and saved in the ASCII format and other types of noise

maps may be saved as a picture file (BMP, TIF, JPG or PNG) or metafile (WMF or EMF) by being visualized and adjusted arbitrarily. Especially when saving in the PNG format, it has the advantage of saving them in a small capacity without a big distortion.

4. CONCLUSION

The importance of traffic noise map gradually increases from the advantage that it provides the information for the effective control of noise by understanding and predicting the influence of road traffic noise.

This study suggests the standards and procedures of preparing a traffic noise map and through these, it helps to understand and solve the problem raised when preparing the noise map or running the software. Also when making or updating the noise map for a target area, it can raise the efficiency of time and economy by eliminating a repeated process.

The noise map prepared according to the standards helps to meet social expectations by predicting the area that a civil appeal may occur from a noise and by taking an appropriate measure for the prevention of noise. Together with these, this study helps to minimize the economical losses by taking an efficient noise abatement measure in advance and hence, we can expect to have economic gains from the reinvestments on the technical research and development.

In the future, we are to study on standardization for the fundamental survey like the method of determining influence factors about the standard procedures for preparing the noise map with the noise sources such as trains and aircrafts, traffic speed and volume.

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