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## **INVESTIGATION INTO THE NOISE MAP BASED ON TRAFFIC FLOW PREDICTION IN THE CITYWIDE ROAD NETWORK**

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### **ABSTRACT**

As one of the measures for decreasing road traffic noise in a city, the control of the traffic flow and the physical distribution is considered. To conduct the measure effectively, the model for predicting the traffic flow in the citywide road network is necessary. In this study, the existing model named AVENUE was used as a traffic flow prediction model. The traffic flow model was integrated with the road vehicles' sound power model and the sound propagation model, and the new road traffic noise prediction model was established. As a case study, the prediction model was applied to the road network of Tsukuba city in Japan and the noise map of the city was made. To examine the calculation accuracy of the noise map, the calculated values of the noise at the main roads were compared with the measured values. As a result, it was found that there was a possibility that the high accuracy noise map of the city could be made by using the noise prediction model developed in this study.

## 1 INTRODUCTION

Road traffic noise is a serious problem worldwide. Prediction models of road traffic noise are very useful for the investigation of noise reduction measures, and therefore the prediction models are being developed in respective countries. As an ability of the road traffic noise prediction model, it is desirable to be able to predict the effects of the noise reduction measures for vehicles, road structures, roadside environments, traffic management and so on. Japan Automobile Research Institute (JARI) has developed the original prediction model for road traffic noise by integrating the micro traffic flow calculation model and the vehicles' sound power calculation model, and has been examining the effects of various noise reduction measures in detail. To advance the investigations for the noise reduction measures further, it is necessary to examine the noise abatement by the control of the traffic flow and the physical distribution in the city. For this purpose, the use of the traffic flow calculation model taking into account the citywide road network is effective. In this study, the new road traffic noise prediction model was developed by combining the citywide traffic flow calculation model and the road vehicles' sound power calculation model, and noise maps in the entire city were made.

## 2 STUDY AREA

Figure 1 shows the scale of the study area for road traffic noise prediction. In the case of local area shown in Fig.1(a), the optimum noise reduction measures for the individual area can be investigated. In this case, the use of the micro traffic flow model in which the running behavior of individual vehicles can be estimated in detail is effective. Such model has been developed in JARI, and the effects by the noise reduction measures from the pavement, the road structure and the environment is being analyzed in detail. On the other hand, to investigate the effect of the noise reduction by the management of the traffic flow and the physical distribution, it is necessary to examine the traffic flow taking into account the citywide road network. In this case, the whole of the city shown in Fig.1(b) becomes a study area and the road traffic noise in such area is examined.

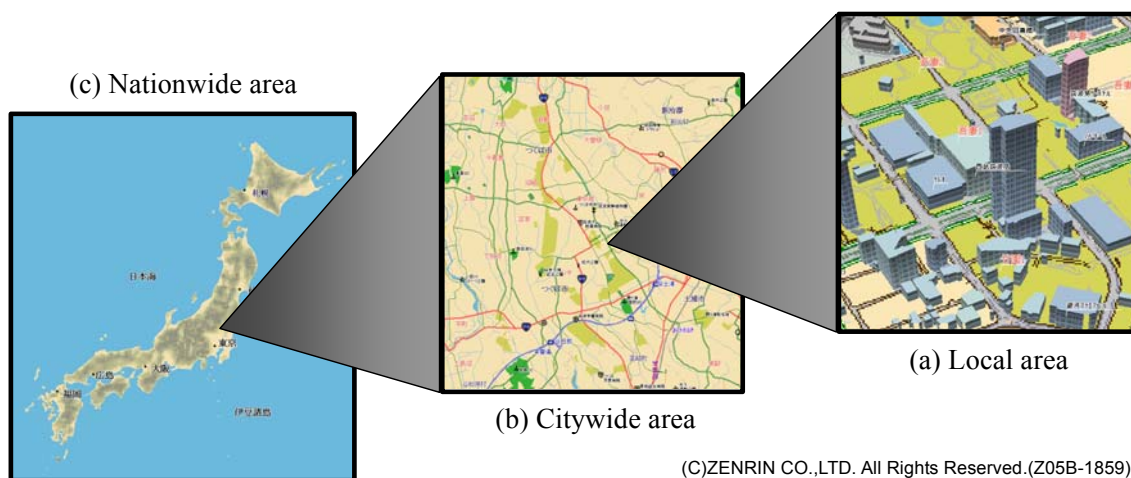


Fig. 1. Scale of the study area for the road traffic noise prediction

### 3 CITYWIDE NOISE PREDICTION MODEL

#### 3.1 Structure of prediction model

The road traffic noise prediction model developed in this study consists of the citywide traffic flow calculation model and the road vehicles' sound power calculation model as shown in Fig.2. The prediction model was linked with a database of the digital road map of the citywide road network. The calculation models and the input data are indicated as follows.

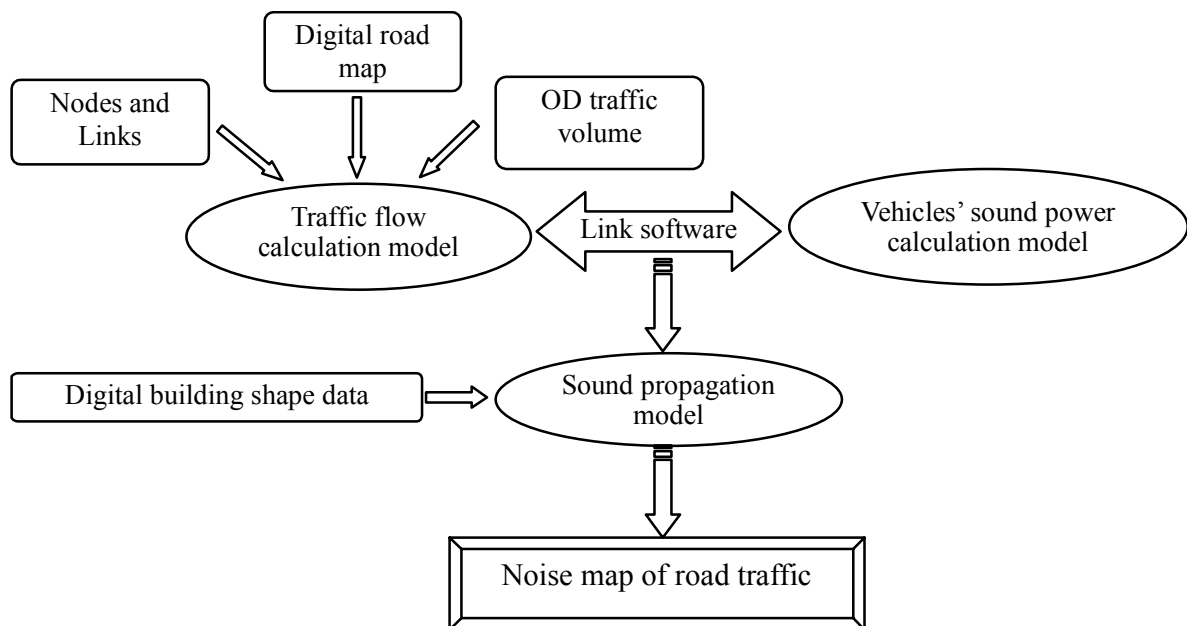


Fig. 2. Structure of prediction model

#### 3.2 Calculation models

##### (1) Traffic flow calculation model

In this study, as the traffic flow calculation model, AVENUE was used [1]. This consists of the models for the vehicle movement and route choice. In the vehicle movement model, the traffic flow is assumed to be compressible fluid and the vehicle running behavior is expressed as a flow of the fluid. In the route choice model, to reach the final destination, the route that individual drivers select is decided.

##### (2) Sound power calculation model

The vehicles' sound power calculation model proposed by the Acoustics Society of Japan (ASJ) was used in this study [2].

### 3.3 Input data

#### (1) Road map

The database of a digital road map is being linked to the traffic flow calculation model taking into account the citywide road network. Tsukuba city was selected as the target area in this study. This area is at about 60km away from Tokyo in the direction of northeast. In this area, there are two major roads, the national route No.6 and the Joban highway.

#### (2) Nodes and links

Based on the above-mentioned road map, the nodes and links were set to the intersections and between them, respectively. Figure 3 shows the nodes and links in the Tsukuba city. In the figure, the small squares and the solid lines indicate the nodes and links, respectively. In this area, the numbers of nodes and links were 1,723 and 4,832 respectively.

#### (3) OD (origin-destination) traffic volume

The traffic volume toward each destination is given to each edge node of the road network as an OD traffic volume. The vehicles that arrive at the destination disappear from the network. The generation and the disappearance of the vehicles inside of the road network are also considered.

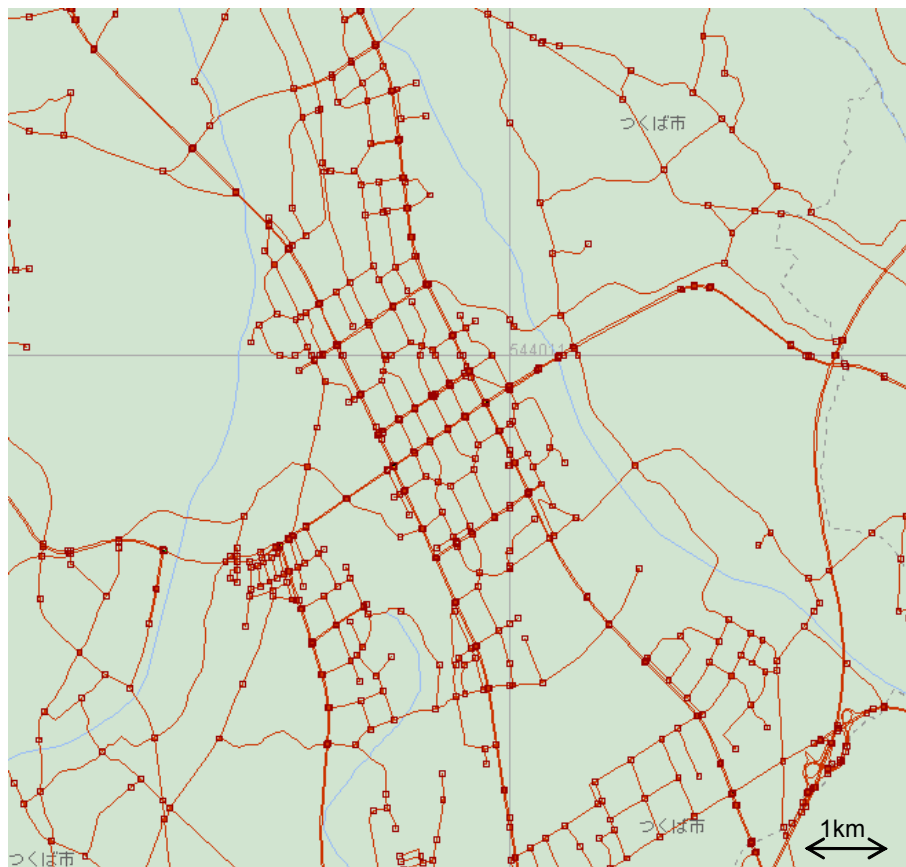


Fig. 3. The nodes and links in the study area (Tsukuba city)

#### 4 ESTIMATION RESULTS OF CITYWIDE ROAD TRAFFIC NOISE

The citywide road traffic noise was calculated from the traffic volume, the vehicle speeds and the percentage of the heavy vehicles, and the noise map was made as shown in Fig.4. In this noise map, at present, the reflection and diffraction by the buildings etc. were disregarded from the calculation of the noise propagation. The road traffic noise on the road network including not only the main roads but also the minute streets can be estimated by using this prediction model. Figure 5 is the same result focused on a city center and the noise distribution in this region is examined in detail. To examine the accuracy of the noise map, the calculated noise values at the main roads were compared with the measured values. The calculated value is corresponding to the measured one within 2 dB. However, since there are the streets in which the error of five decibels or more is detected, the investigation for the accuracy improvement will be necessary.



Fig. 4. Citywide noise map

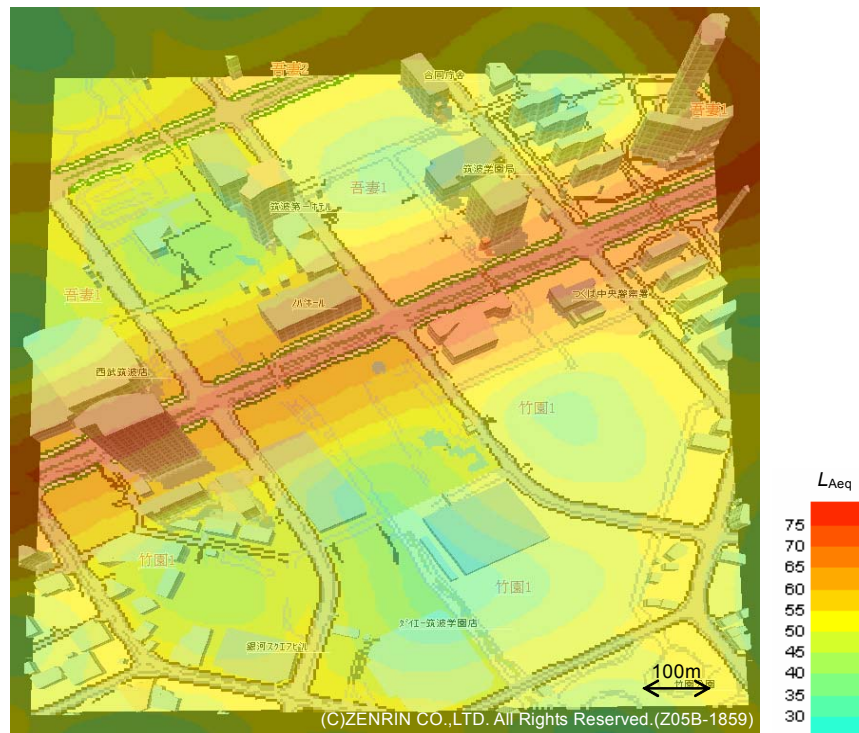


Fig. 5. Noise map of the local area

## 5 CONCLUSIONS

In this study, the new prediction model for the road traffic noise was established by adopting the traffic flow calculation model applicable to the citywide road network, and the noise map was made.

The main results are as follows.

- (1) By combining the citywide traffic flow calculation model and the vehicles' sound power calculation model, a new road traffic noise prediction model was developed.
- (2) By introducing the road map data and the traffic data to the prediction model, it is possible to make the citywide noise map.
- (3) Because a traffic situation on the citywide road network is calculated by using this technique, our prediction model has the ability to estimate the change of noise distribution by the newly established roads and the traffic management.

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