A STUDY ON ROAD TRAFFIC NOISE AND ITS MITIGATION IN DEVELOPING COUNTRIES: CASE STUDY OF MAKASSAR CITY, INDONESIA

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ABSTRACT

Nowadays, the increase of vehicle number in developing countries including Indonesia leads to the rise of the road traffic noise (RTN), and the RTN becomes a serious problem in living environment. Therefore, a guideline to reduce the RTN is needed. However, in many cities in developing countries such as Indonesia, any guidelines for the RTN mitigation have not been established yet, unlike developed countries. For example, in Japan, an integrated noise-GIS (Geographic Information System) which provides general functions for urban traffic noise modeling, noise prediction, environmental assessment, and noise abatement design, has been established. Regarding the condition, the author conduct a research to develop a method to find an optimal solution for the RTN problem in Makassar City, based on the reference scheme conducted in Japan.

In the context of the RTN mitigation, this research has three objectives to achieve the goal; to grasp the present condition of the RTN, to construct the GIS of the RTN, to examine how to reduce the RTN.

In the first step, this study has carried out the investigation data to grasp the present condition of the RTN in Makassar City including physical characteristic of roadside that covering width of sidewalk, number of lanes, running direction for each time zone and traffic, noise levels ($L_{Aeq}$) at roadside, traffic data (traffic volume and running speed in each vehicles type), collect others information that covering
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photograph of the current state of investigation point, etc. The survey is conducted for 10 hours from 8:00 a.m until 5:00 p.m. at 35 road points as sampling road in Makassar City. In addition, the survey uses sound level meters (SLM), counter and videocamera, and speed gun as equipments of the each data collection, respectively. Then, the research analyzes the noise and traffic data in order to describe the present condition of the RTN, and analyzes data in order to develop prediction model of the RTN by following and adapting the ASJRTN-Model 2008 (ASJ Model). In order to achieve predicting results more precisely, the prediction model of the RTN using the exact power level of vehicles, and the power level of vehicle horn sound in the city, are conducted.

In the second step, the research investigates geographic data and applied the data using POEM for RTN prediction, analysis, and evaluating, to construct the RTN-GIS in Makassar City. POEM is RTN-GIS software which Fujimoto and his colleagues have developed in Japan. References.

In the third step, this research attempts to propose and examine the mitigation strategy how to reduce the RTN in Makassar City. A guideline or grand strategy for the RTN mitigation is arranged according to the short-term, middle term, and long-term solutions. Firstly, the strategy applies two physical abatement of the RTN reduction (i.e. barrier insertion and drainage asphalt pavement). Then, the strategy proposes some travel demand management (TDM) and incorporating traffic management system (TMS) measures in reducing the RTN problem, such three in one (3IN1) program scenario for passenger cars, two in one (2IN1) program scenario for motorcycle (MC), prohibition in generating horn sounds of vehicles, implementation of bus rapid transit (BRT) system.

The results of the first step show that the average noise level is 74dB ($L_{Aeq}$; equivalent continuous A-weighted sound pressure level) and more than 90% of the areas exceed the highest value of Indonesian’s noise standard (70dB). Further, MC is dominant
traffic in the city (approximately 67%), while the average speed of vehicles is below 40 km/h. Though significant differences are found between measured $L_{Aeq}$ and predicted one by the ASJ Model assuming non-steady traffic flow and ignoring the effect of horns on the RTN, the error can be reduced by assuming steady traffic flow and considering the effect of horns based on Asakura’s method.

In considering the power level of vehicles in the city, the analysis results show that the relation between the power level and speed correlates significantly with the speed in MC and light vehicle (LV), nevertheless the power level of heavy vehicle (HV) is not affected by the speed. The power level follows the trend of steady condition in the ASJ Model when the speed is under 40 km/h especially for MC. The power level that obtained in this study is appropriate to use in Makassar’s RTN prediction than that of the ASJ Model, because of the difference type of engine between Makassar’s MC and Japanese one. The RTN can be predicted by the ASJ Model assuming that traffic flow is steady thought the speed of vehicles are under 40 km/h.

In accommodating the effect of horns sounds, the power levels of vehicle horn sound are grasped. The results show that average A-weighted power levels are about 106.2 dB and 108.5 dB for MC and LV, respectively. However they have about 3 dB to 2 dB of standard deviations, and it might be caused by driver’s manner. In order to examine the validity of them, the RTN under the heterogeneous traffic condition in Makassar City are predicted on the basis of the ASJ Model when these values are used as power level of horn. The comparison with the measured one shows that the predicted $L_{Aeq}$ considering the effect of horn using the value obtained in this measurement is higher than the measured one.

The results of the second step show that the achievement rate through an analysis and assessment by RTN-GIS application to the Environmental Quality Standard for Noise in Indonesia is only 23.2% in the current condition. The result is poor and shows that
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Makassar City needs more efforts to decrease the number of vehicle for reducing the RTN, such as the implementation of TDM, TMS, etc.

The results of the third step show that the mitigation of the RTN reduction in the city through a tentative plan that consists of two physical abatements of the RTN measures achieve a rate grew to be 43.3%. However, these measures are not easy to implement because of the high cost and the necessity of wide space beside the road for noise barrier. Furthermore, by simulation of the TDM-TMS measures implementation, i.e. the combination scenario of the 3IN1, 2IN1, horn prohibition, and BRT programs, the RTN reduction has remained the achievement of 51.4% points up in the achievement rate of the EQS even though 3IN1, 2IN1, and prohibition to generate horn carried only 2.4 dB points up on average at 35 roads.

Briefly, the results of this study provide a basis for the Makassar’s RTN mitigation in the future toward the sustainable environment development in the city. However, further research works are still needed in order to complete and extend the results that achieved in this study.