Journal of Environmental Protection and Ecology 3, No 3, 691–697 (2002)

Ecology

NOISE LEVELS BASED ON URBAN TRAFFIC MODELLING

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Abstract. In this paper, an environmental evaluation of various traffic scenarios is realised using the Thessaloniki urban area as a case study. Traffic and noise data have been studied for the main road network of the urban area. Traffic data include traffic volumes, composition and vehicle speed. Noise levels have been calculated and measured. The evolution of the relationship between traffic – noise levels during the decade 1988-1998 is examined at a first level. Furthermore, the relationship between traffic – noise levels is examined for the four discrete traffic scenarios, which were developed for the following target years: a) 1998, b) 2004, c) 2014, and d) 2014+ and a qualitative and semi-quantitative prediction is made for the expected noise levels.

Keywords: noise, urban area, traffic modelling.

AIMS AND BACKGROUND

Urban noise is determined mainly by traffic noise. The temporal increase of passenger car ownership, the increased use of passenger cars, the reduction in the use of public transport systems and the renewal of the vehicle fleet by new technology vehicles influence the noise levels in urban areas[1].

The Thessaloniki butterfly-shaped urban area is densely built and several central area arterials are now considered as "congested" mainly due to limited excess capacity given the increased volumes and the space taken by numerous parked cars.

The first systematic measurements of traffic noise in Thessaloniki have been realised by the Organisation for the Master Plan and Environmental Protection of Thessaloniki (OMPEPT) during 1988-1989 (Ref. 2).

In this paper, an environmental evaluation of various traffic scenarios is realised using the Thessaloniki urban area as a case study. Traffic and noise data have been studied for the main road network of the urban area. Traffic data

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EXPERIMENTAL

Traffic and noise data are considered in five street links representative of the urban area of Thessaloniki. The names of the streets are: KOR (Monastiriou street at Kordelio, an urban-industrial area in West Thessaloniki), DIM (Dimokratias square at the city centre, the most important crossroads of the urban area), EGN (Egnatia street, a very important road at the city centre), SOP (Agias Sophias square, an open space area at the city centre), MAR (Martiou street, an important road in East Thessaloniki). Also, five street links of the Dimokratias square are included in the study area. The street names are: Egnatia, Karaoli-Dimitriou, Lagada, Monastiriou and 26th Octovriou.

Traffic data include traffic volumes, composition and vehicle speed. Noise levels have been measured and calculated.

Traffic and noise calculated data were based on the General Transportation Study initiated by the Organisation for the Master Plan and Environmental Protection of Thessaloniki (OMPEPT). This study started in 1988 and its second phase was conducted in 1997-1999 and included – among others – a roadside survey with a sample size of 33 836 drivers and a home based interview survey with a sample size of 3324 households[3-5].

All traffic scenarios have been tested and evaluated with the use of the EMME/2 traffic model[6]. Within EMME/2 the geometrical and functional characteristics of the road network of the study area were represented in an adequate way and thus, the analysis of the trip characteristics at strategic level was made feasible. The model supports the four stages of the classical transportation planning process concerning the future traffic forecasts (trip generation and distribution, modal split, traffic assignment).

The study area was divided into 316 internal and external traffic zones and the origin-destination matrices include data for all zones. The length of the EMME/2 network was 4357 km including 1335 nodes and 5120 links. The total number of daily trips made in the study area with all transport modes is 1 600 000 and 400 000 of them refer to the city centre. Internal trips were divided into home-based and non home-based while external trips were divided into trips having one trip end into the study area, and into transit trips.

The scenarios were formulated for the year 2004, the year 2014 and the period after the year 2014 (2014+). The proposals within all scenarios were then tested and evaluated with the EMME/2. The evaluation results of the above 3 scenarios were compared to the results of the base-year scenario (1998, do nothing scenario). All scenarios cover road infrastructure, parking and public transport tasks.

Within the scenario for the year 2004 the basic proposals include (among others) the construction of the outer ring road, changes in the basic road network servicing the access to the city centre, a metro line of length 9.8 km, the connection of the city centre with the eastern suburbs via the sea transport, the introduction of mini-buses in the city centre and finally the construction of parking stations.

Within the scenario for the year 2014 the basic proposals, in addition to those of the 2004 scenario, include (among others) the construction of the 3.5 km underwater tunnel for the bypass of the city centre, the construction of four tunnels in the city, the two new metro lines connecting the basic line with the western and the eastern part of the city.

Within the scenario 2014+, the basic proposals, in addition to those of the two previous scenarios, include (among others) the extension of the underwater tunnel, the construction of a bridge over the city bay, a third metro line towards the industrial zone.

The evaluation of the scenarios concerning the produced noise levels was based on the use of the methodology CRTN (Calculation of Road Traffic Noise)[3,7].

The noise indicators used in this paper are: (a) L_{eq} (Equivalent Continuous Noise Level, measured from 8:00 to 20:00, total: 12 h): limit value L_{eq} = 67 dB(A); and (b) L_{10} (measured from 6:00 to 24:00, total: 18 h): limit value L_{10} = 70 dB(A) (Ref. 8).

Within the framework of this paper the evolution of the relationship between traffic – noise levels during the decade 1988-1998 is examined at a first level. Furthermore, the relationship between traffic – noise levels is examined for the four discrete traffic scenarios, which were developed for the following target years: a) 1998, b) 2004, c) 2014 and d) 2014+.

RESULTS AND DISCUSSION

The noise levels (calculated as L_{10} and measured as L_{eq}) during 1988-1989 in the above mentioned five street links of the Dimokratias square crossroads in Thessaloniki are presented in Fig. 1.

Peak traffic volume and calculated noise levels in the Egnatia street link (the main road connecting the Dimokratias square crossroads with the rest of the city centre) during the decade 1988-1998 are presented in Fig. 2. The noise level remains statistically the same while the peak traffic volume increases. The duplication of the vehicle fleet (and the resulting traffic volume increase) seems to be equilibrated by the vehicle fleet renewal (vehicles renewal by new technology vehicles equipped with lower noise engines) leading to a temporal stabilisation of the noise levels.

The noise levels measured as L_{eq} during 1988-1989 in five street links of the urban area of Thessaloniki are presented in Fig. 3.

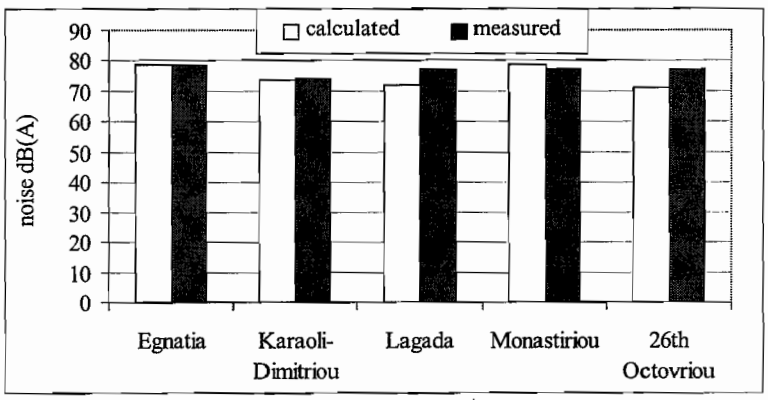

Fig. 1. Calculated (L_{10}) and measured (L_{eq}) noise levels during 1988-1989 in 5 street links of the Dimokratias Square crossroads in Thessaloniki

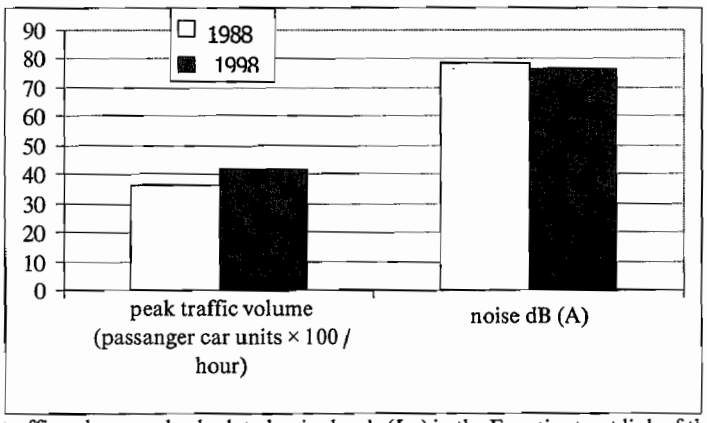

Fig. 2. Peak traffic volume and calculated noise levels (L_{10}) in the Egnatia street link of the Dimokratias square crossroads

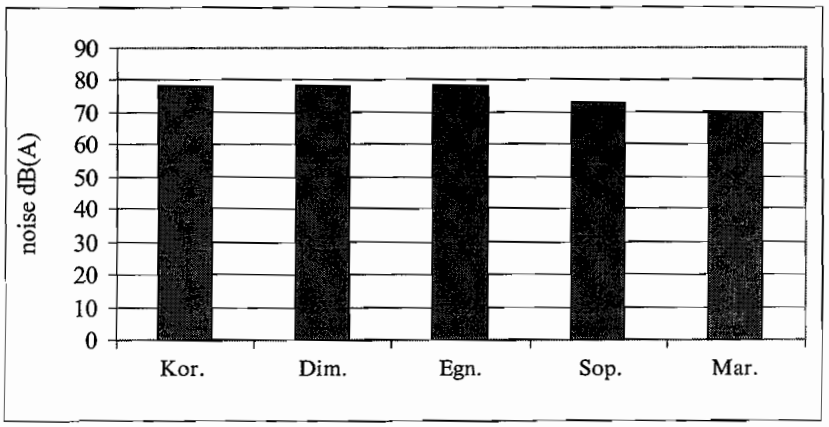

Fig. 3. Measured noise levels (L_{eq}) during 1988-1989 in 5 street links of Thessaloniki

The peak traffic volume and the vehicle speed for the examined traffic scenarios in the 5 street links of the Thessaloniki urban area are presented in Figs 4 and 5, respectively. A significant increase of peak traffic volume is expected for the scenario 2014 and a decrease after this year (scenario 2014+) for the most important street links. A stabilisation or a slight increase of the vehicle speed (strongly related to the traffic volume) is expected mainly after the year 2014.

The noise levels (Fig. 6) show stabilisation or slight temporal decrease during all the scenarios and mainly after 2014, due considerably to the passenger car composition (100% new technology passenger cars), the temporal amelioration of the traffic volume and the improvement of vehicle speed caused by applied interventions according to each scenario[9]. Traffic interventions are not sufficient for noise considerable decrease and further anti-noise measures are needed in order to fulfil the EC standards in the future, given the fact that noise levels seem to be over the limits today in main central area arterials[10-12].

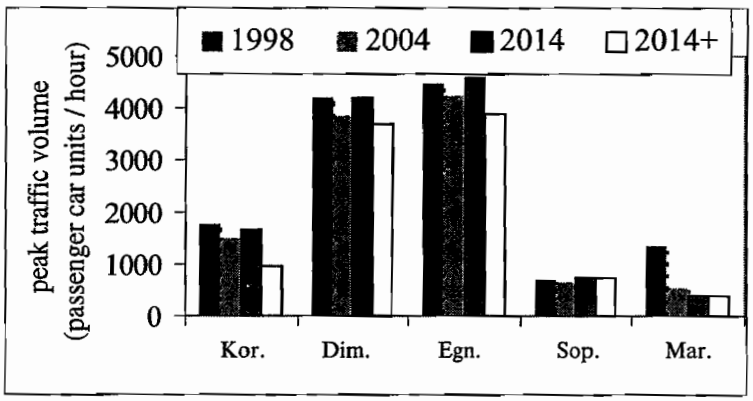

Fig. 4. Peak traffic volume in 5 street links of Thessaloniki for various traffic scenarios

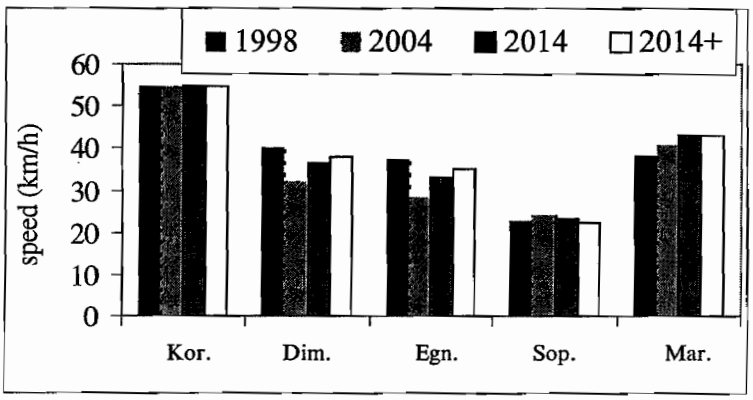

Fig. 5. Vehicle speed in 5 street links of Thessaloniki for various traffic scenarios

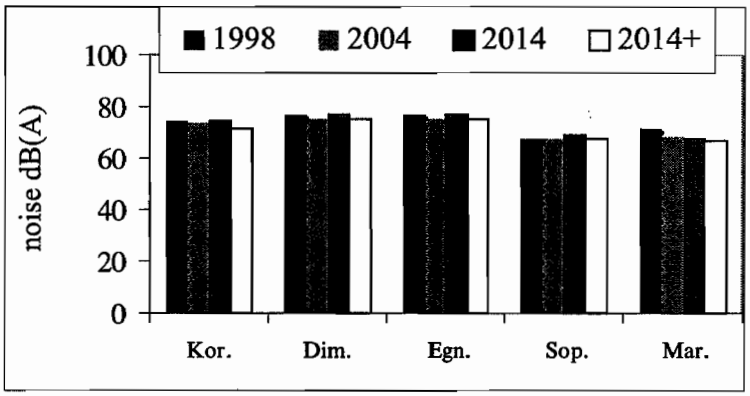

Fig. 6. Noise levels (L_{10}) in 5 street links of Thessaloniki for various traffic scenarios

CONCLUSIONS

The vehicle fleet increase during the last decade in Thessaloniki urban area seems to be equilibrated by the vehicle fleet renewal leading to a temporal stabilisation of the noise levels. The noise levels show stabilisation or slight temporal decrease during all the scenarios and mainly after 2014, due considerably to the passenger car composition (100% new technology passenger cars), the temporal amelioration of the traffic volume and the improvement of vehicle speed caused by applied interventions according to each scenario. Traffic interventions are not sufficient for noise considerable decrease and further anti-noise measures are needed.

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Received 20 October 2001
Revised 15 September 2002