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HEAVY GOODS VEHICLES (HGV) AND THEIR ENVIRONMENTAL IMPACTS IN CENTRAL URBAN AREAS

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Abstract. Traffic and the associated environmental problems characterise the majority of urban areas, and more especially their centers. Traffic of heavy goods vehicles (HGV) is responsible for a number of environmental impacts, which include – among others – the emissions of various pollutants. Within the framework of this paper an attempt is made in order to assess the environmental impacts from the HGV traffic in the center of the city of Thessaloniki. HGV volumes are presented for eleven intersections along the two main arterial streets in the city center and also for ten intersections along the city ring road. Data sets refer to the situation before and after the construction of the city ring road, which actually serve nowadays the major part of the HGV traffic in the area. Data from the air pollution monitoring stations found in the central area are also used for the purposes of this research. Findings show the significant contribution of the ring road to the relief of environmental problems due to HGV in the city center and also the need for intense enforcement of the prohibition of HGV traffic in the same area.

Keywords: HGV, environment, traffic, urban area.

AIMS AND BACKGROUND

Traffic and associated environmental problems appear to be of great importance in modern cities. Transport sector and more especially private cars, taxis, buses, trucks and motorcycles contribute to air pollution at different levels of significance. As shown in Table 1, heavy goods vehicles (HGV) mainly contribute to particulates, NO_x, and HC (hydrocarbons)[1]. The environmental impacts from private cars (PC), taxis and buses in the case of Thessaloniki have been examined in the framework of various research activities[2-12].

In order to avoid or minimise traffic and environmental impacts from HGV in central areas, these flows are facilitated along certain roads. However, it is difficult to control the road network, which is not supposed to serve the HGV traffic. In some cases, alternative routes for HGV are quite difficult to be found.

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In any case the environmental problems arising from the HGV traffic are very important and a lot of effort has been paid from both planners and engineers in order to find adequate solutions.

Table 1. Classification of pollutant emissions per vehicle km (Ref. 1)

Vehicle type	CO	HC	NO_x	PM
Old technology PC	***	***	**	*
New technology PC	*	**	*	*
Taxi	*	**	**	**
Bus	**	***	***	***
Light trucks	*	**	**	**
Heavy trucks	**	***	***	***
Motorcycles	**	**	*	*

* Low, ** moderate, *** high.

Within the framework of this paper an attempt is made in order to assess the environmental impacts from the HGV traffic in urban areas. More especially, the examination of the air pollution is presented and discussed in this paper. It must be mentioned at this point that there are also other environmental impacts from HGV traffic, like noise, visual intrusion, reduced road safety level, severance effect, energy consumption due to the delays imposed to the rest of the traffic, etc. The case study is the city center of Thessaloniki and the reference road network consists of the two main arterial streets crossing the study area.

EXPERIMENTAL

The research is based on traffic data for three discrete years (1988, 1998, 2001) and includes the percentage of HGV in the total traffic flow before and after the construction of the ring road in the city (no ring road exists in 1988)[13].

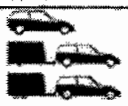
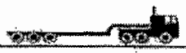
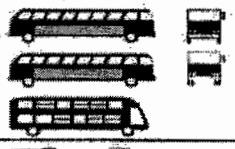
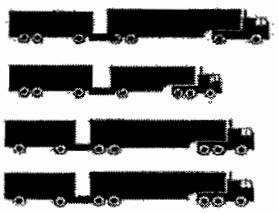
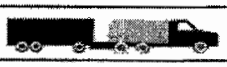
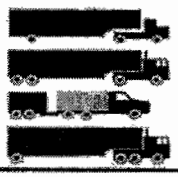
Part of the traffic and emissions data result from the General Transportation Study initiated by the Organization for the Master Plan and Environmental Protection of Thessaloniki (OMPEPT). This study started in 1988 and its second phase was conducted in 1997-1999 and included – among others – a roadside survey with a sample size of 33 836 drivers and a home based interview survey with a sample size of 3324 households. Traffic scenarios have been tested and evaluated with the use of the EMME/2 traffic model. The evaluation of the scenarios concerning their air pollutant emissions was based on the use of the COPERT II methodology, which was developed within the framework of the EU program CORINAIR[14-18].

The air quality data result from the monitoring stations of the Ministry of Macedonia-Thrace network[19-21].

Although some special routes for the HGV traffic exist within the study area, the amount of traffic of this category of vehicles is also significant when considering the rest of the city road network.

The classification system adopted for the purpose of the research was the Federal Highway Administration – FHWA, which was implemented by the Department of Transportation (DoT) in the U.S.A. to counts of vehicle's weight[22]. This system consists of fifteen classes as presented in Table 2.

Table 2. USA FHWA 15 classification system[22]

USA FHWA 15 (with axle detection)			
Code	Vehicle type	Code	Vehicle type
1		9	
2		10	
		11	
3		12	
4		13	
5			
6			
7		14	
8		15	Unclassified

RESULTS AND DISCUSSION

Traffic counts of HGV for the year 1998 concerning the Thessaloniki ring road are presented in Table 3. Traffic counts of HGV for the two main arterial streets in Thessaloniki city center (Tsimiski and Egnatia) for the years 1988 (no ring road existed), 1998 and 2001 are presented in Tables 4 and 5. It seems that HGV traffic is much higher in the ring road when compared to the city center results for the years 1998 and 2001. The overall traffic of HGV in the city center is nowadays smaller when compared to 1988 results, when no ring road existed.

Table 3. Traffic of HGVs in Thessaloniki ring road (year 1998)

Intersections	% of HGVs – morning peak				% of HGVs – afternoon peak			
	heavy trucks	typic. trucks	light trucks	total	heavy trucks	typic. trucks	light trucks	total
K16 (Lahanagora)	8.7	6.8	11.9	27.4	11.2	5.8	10.6	27.6
K17 (Monastiriou)	18.1	14.5	13.2	45.8	13.5	10.5	11.1	35.1
K18 (Lagada)	6.4	8.2	9.4	24	5.9	7.1	10.1	23.1
K6 (Asvestohori)			10.9				11.8	
K7 (Eptapirgio)			6.1				8.9	
K8 (Triandria)			6.1				8.9	
K9 (Toumpa)			8.4				9.3	
K10 (Toumpa)			7.0				7.8	
K11 (Panorama)			7.4				7.8	
K12 (Chalkidiki)			10.2				7.8	

Table 4. Traffic of HGVs along Tsimiski road axis (Thessaloniki central road network)

Intersections	1988				1998				2001			
	morning peak		afternoon peak		morning peak		afternoon peak		morning peak		afternoon peak	
	HGVs	%	HGVs	%	HGVs	%	HGVs	%	HGVs	%	HGVs	%
Tsimiski – Aggelaki	n.a.	n.a.	n.a.	n.a.	n.a.	1.60	n.a.	2.70	n.a.	n.a.	n.a.	n.a.
Tsimiski – Eth. Aminis	96	1.88	192	5.16	n.a.	1.50	n.a.	0.50	39	0.95	55	1.47
Tsimiski – Ag. Sofias	84	1.92	170	4.95	n.a.	1.40	n.a.	n.a.	45	1.08	88	2.40
Tsimiski – Venizelou	118	2.70	205	7.00	n.a.	1.80	n.a.	0.60	n.a.	n.a.	n.a.	n.a.
Tsimiski – I. Dragoumi	170	3.59	202	7.25	n.a.	n.a.	n.a.	n.a.	77	1.79	76	2.08

Table 5. Traffic of HGVs along Egnatia road axis (Thessaloniki central road network)

Intersections	1988				1998				2001			
	morning peak		afternoon peak		morning peak		afternoon peak		morning peak		afternoon peak	
	HGVs	%	HGVs	%	HGVs	%	HGVs	%	HGVs	%	HGVs	%
Egnatia – Eth. Aminis	116	2.32	172	3.06	n.a.	1.60	n.a.	2.70	n.a.	n.a.	n.a.	n.a.
Egnatia – Ag. Sofias	n.a.	n.a.	n.a.	n.a.	n.a.	2.70	n.a.	1.10	71	0.83	81	0.86
Egnatia – Venizelou	114	2.98	124	3.03	n.a.	3.00	n.a.	1.70	82	1.76	103	2.04
Egnatia – I. Dragoumi	124	2.96	146	3.73	n.a.	2.10	n.a.	2.40	n.a.	n.a.	n.a.	n.a.
Egnatia – Dodekanissou	280	5.37	318	6.05	n.a.	2.00	n.a.	2.30	82	1.49	83	1.17
Egnatia – Lagada	250	4.43	304	4.91	n.a.	2.20	n.a.	2.50	n.a.	n.a.	n.a.	n.a.

Due to restrictions in HGV traffic along the main arterial streets of the city center, HGV over 4 t are not allowed to use the specific road network. Therefore, HGV coded 6 and above (according to FHWA classification system) can not enter the city center without special permission. For the purposes of this research, HGV counts in the city center referred to code 5 and 6 (permission holder only). HGV of codes 7 and above are supposed to use the ring road.

The annual average concentrations and the temporal linear trend of air pollutants emitted mainly from diesel engine vehicles (like HGV) and specifically SO_2 (sulphur dioxide) and TSP (total suspended particulates) present a very important decreasing trend for the same period (1988-1998) in Thessaloniki city center.

As shown in previous studies[11,12], the bus and taxi traffic was not changed considerably in the city center. In contrary, the HGV traffic has been decreased considerably. Consequently, the observed decreasing temporal trend of SO_2 and TSP, which are emitted significantly from diesel engine vehicles are not due to a temporal change of bus and taxi traffic, but mainly to other reasons such as the HGV traffic reduction in the city center. Also, the considerable renewal of bus and taxi fleet (vehicles equipped with new technology diesel engines) during the last decade, the improvement of fuel quality and the emission control programs seem to have an important impact on the temporal decrease of SO_2 and TSP in the city center. Furthermore, it must be underlined that the SO_2 levels are finally below the air quality standards, but the TSP levels are still remaining above the EU standard, although their values have been decreased considerably during the examined decade[23-25].

The TSP traffic emissions show a continuous temporal decrease in the city center during all the scenarios (of the General Transportation Study) and mainly after 2014, due considerably to the amelioration of the traffic volume and the improvement of vehicle speed caused by interventions applied according to each scenario[26-27]. The concentrations of the suspended particulates are expected to have a similar trend and fulfill the EC standards in the future.

CONCLUSIONS

The HGV traffic in the Thessaloniki urban area has been changed dramatically during the examined decade 1988-1998 due to the construction of the ring road of the city. It is resulted that the average percentage participation of the HGV traffic in the overall traffic in the central area of the city has been decreased considerably during the decade 1988-1998.

The results show the significant contribution of the ring road to the urban air pollution temporal reduction due to the traffic decrease of HGV in the city center. Also, the improvement of the diesel fuel quality and the temporal renewal

of the diesel vehicles are considered as important factors for the observed temporal decreasing trend of the air pollutants with diesel oil origin.

Measures which can be taken in order to reduce the environmental impacts of the HGV include the proper maintenance of HGV engines, the use of new technologies, the use of diesel fuel of improved quality, etc. These measures refer to the vehicle itself. Traffic management measures like the prohibition of HGV traffic in the road network of central areas (which must be accompanied by the construction of inner and outer ring road in order to bypass the city center) are very important towards the direction of the overall improvement of the quality of environment and the quality of life for the residents, employees and visitors of the city[28-32].

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