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REHABILITATION OF THE ACOUSTIC ENVIRONMENT OF THE CITY OF RHODES

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ABSTRACT

The Ministry of Planning, Environment and Public Works assigned in 1997 to the Department of Transportation Planning and Engineering of the National Technical University of Athens, the research project "Programme for Noise Abatement in Tourist areas". The project, completed in 1999, investigated the causes of noise in tourist areas, developed guidelines and general specifications for planning and implementing a programme of short and long-term antinoise measures and projects and carried out a pilot application in a Greek tourist city. The paper presents this pilot application in the selected city of Rhodos. Detailed acoustic measurements, compiled with traffic counts and opinion surveys were carried out in the summer of 1998 with 1999 in Rhodos and were compared with the results of similar earlier works. Based on the evaluation of the above, noise sources were identified and a quantitative and qualitative differentiation of the effects by category of source and time was carried out. Short and long-term interventions were proposed concerning: a. Legal changes b. Administrative changes c. Town Planning d. Transportation Planning and Traffic Management e. Technical Applications f. Information of Public and Competent Authorities Such interventions included measures extending from the relocation of night activities away from noise-sensitive areas, to the proper noise-control of the large and increasing number of motorcycles which, in some cases, constitute the 50% of the traffic flows.

1 - INTRODUCTION

The Greek Ministry of Planning, Environment and Public Works assigned in 1997 to the Department of Transportation, Planning and Engineering, of the National Technical University of Athens, the research project "Programme for Noise Abatement in Tourist Areas". The *scope of the project* was:

1. to investigate the causes of noise in tourist areas
2. to develop guidelines and general specifications for planning and implementing a programme of short and long-term anti-noise measures and projects
3. to carry out a pilot application in a Greek tourist city.

The *first phase* of the project, presented in the report [1], dealt with the collection, analysis and evaluation of information. The following areas were examined:

1. The characteristics and grouping of tourist areas in Greece and the effects of noise in urban areas, in general and in the tourist areas, in particular.
2. The identification and classification of noise sources and of anti-noise activities.

3. The identification of factors for the development of an anti-noise strategy in tourist areas (Legal and Administrative changes, Regional and Town Planning, Transportation Planning and Traffic Management, Technical Applications and Information of the public and of the competent Authorities).
4. Review of International Experience. In this respect, an international forum was organized in Athens in February 1998 with the participation of five European experts, representatives of the Ministry of Environment, Planning and Public Works, the study team and their advisors.

In the *second phase of the project*, an anti-noise strategy was defined, for all factors already identified that affect the acoustic environment in tourist areas. Furthermore, the city of Rhodes was selected as the pilot area. An evaluation of existing studies was made and a series of acoustic and traffic counts, as well as a social survey, were carried out in September 1998. An interim report was submitted in December 1998.

In the *third phase* further detailed acoustic counts were made in July 1999 during the peak of the tourist period, to investigate variations during this period. A series of interventions were elaborated and specific recommendations for noise abatement and a system of follow-ups were prepared for the city of Rhodes in close cooperation with the local authorities. A final report and a summary report were submitted in October 1999.

2 - ACOUSTIC ENVIRONMENT EVALUATION AND SOCIAL SURVEYS

Within the framework of the present programme, the attitude of tourists was investigated toward fundamental quality parameters of the city of Rhodes and the accommodations of the tourists during their vacationing, as well as towards the level of services rendered to them in the whole of the tourist activities with which they came in contact. Naturally, added emphasis was given to the parameter connecting the acoustic environment with the tourist operation of the city, since the latter was the primary investigation factor.

According to the acoustic measurement results in the framework of the study of the Road Traffic Noise map of 1999 [2] and in comparison with the corresponding Road Traffic Noise map of 1990, **a significant environmental noise reduction is observed in the city of Rhodes**. More specifically, the average L_{eq} value for the measurement period of 1990 is in the region of 74.1 dB(A), while, correspondingly, during the same period of 1999, it is in the region of 69.4 dB(A). A reduction of the order of **4.7 dB(A)** is determined at a city level. This reduction is considered to be a significant one, especially if contrasted against the comparative examination of Athens noise maps of 1977-1987-1997, according to which a significant noise increase is presented for the first decade, with a 3 dB(A) increase of the L_{eq} index, after which a stabilization is shown [3]. The reduction observed in Rhodes appears to be primarily due to the significant improvement of traffic conditions, as well as of motorcycle quality in the urban road network. Table 1 presents the variation of the average L_{eq} index value during the years 1990, 1998 and 1999, while Table 2 shows the change of the average value of the L_{eq} index.

Year	Average L_{eq} Index Value
City Level 1990	74.1
City Level 1999	69.4
City Center (Mandraki- Niohori) Sept. 1998	66.0
City Center (Mandraki- Niohori) July 1999	69.8

Table 1: Variation of the average L_{eq} index value during the years 1990, 1998 and 1999.

Year	Change
City Level 1990-1999	4.7
City Center (Mandraki- Niohori) Sept. 1998 – July 1999	3.8

Table 2: Change of the average value of the L_{eq} index during 1990-1998 and 1990-1999.

According to the social analysis and the correlation with quantitative noise parameters, the following conclusions arose:

- As far as tourist recreational activity preferences are concerned:

- Strolling and, in general, pedestrian traffic and contact with the city is one of the primary recreational activities.
- Nightlife and recreation is included in the tourists' entertainment preferences at a relatively increased percentage.
- Driving is not a priority in tourist preferences.
- The interviewees appeared to now be relatively satisfied compared to beforehand, and the rating of the relevant parameters was on average higher than the mediocre score, but, nonetheless, was lower than the perfect score for the following:
 - Cleanliness of the shores, the sea and the streets.
 - Quality of service provision at hotels, as well as food quality.
 - Quality of nightlife and recreation.
- The interviewees appear to not be satisfied as far as the following are concerned:
 - Quality and, in general, pedestrian traffic potential, characterized "below average".
 - The city's acoustic environment, which was described as being relatively noisy.
 - Transportation quality, which was characterized as being in mediocre condition.

A fact that is of interest is that the largest percentage of people with a very negative viewpoint on the quality parameters of the city of Rhodes was found as far as pedestrian traffic, and hence, noise was concerned. Correspondingly, the largest percentage of cumulative statements of negative and very negative opinions was for the city noise parameter and therefore, for pedestrian traffic. It is apparent that the tourist population now seeks contact with a city on a human scale, while, as far as the acoustic environment is concerned, its negative reaction is less focused on entertainment activities noise and more on road traffic noise.

In the total sample of the social study, the general evaluation of "a very pleasant stay at the city of Rhodes" was made by the majority of those interviewed (around 70% of the sample), while only 35% of the sample –approximately- phrased a positive viewpoint on the quality of sleep. From the analysis of relevant answers, it was established that people who stated that they were less than satisfied in general by their stay in the city, also exhibit the largest percentages as far as quality of sleep dissatisfaction is concerned.

Actions and measures aiming at the improvement of the acoustic environment must therefore be directed to road traffic noise, as well as to noise from bars and discos. Certainly, the specialization of relevant measures must also be correlated to the character of secondary areas, as well as to land uses, while the temporal operation parameter takes a decisive effect. Hence, the management choice of relevant land uses per area must be made both temporally and according to the acoustic environment quality requirements, based on the existing residential uses but also on the relevant prospects of future development – evolution of each urban area. More specifically:

- The demand for an improved acoustic environment and for a further reduction of road traffic noise to even lower levels, especially in tourist residence areas, must be a tool for the design of land uses and for the development of city regions with the priority given to the introduction of pavements and their parallel put to use so that bars and discos are located in non-residential areas.
- The location of bars and discos must be made in areas that do not directly adjoin hotel lodgings nor permanent inhabitant residences, combined with time operation limitations and spatial choices.
- It is pointed out that the relatively high level of "demand" for nightlife and recreation by tourists leads to the need for examining areas which could house entertainment clubs which are not too far away from the tourist residences, so as to avoid the desolation effect, as well as to limit the indirect sources of noise pollution.
- The need to protect the permanent population from the deterioration of the acoustic environment in the immediate vicinity of its residence, poses an additional fundamental parameter in the choice of areas for installing annoyance-generating uses during night hours (bars and discos).

3 - REGIONAL AND TOWN PLANNING MEASURES FOR BARS & DISCOS

Based on the present study, the Municipality of Rhodes established that the further amelioration of the problem requires the introduction of decisions with consideration to the appropriate temporal and

spatial factors and, in essence, to their interdependence in the choice of spatial location, licensing and management of bars and discos. This consideration must replace the singular and radical solution of the operation ban, which unavoidably, along with the positive effect of eliminating annoyance, brings indirect negative socio-economic effects. An example of this was presented in the medieval city of Rhodes where such recent bans led, to a degree, to its "desolation" during night hours, a fact that led the responsible authorities to solve the problem by prolonging the operation schedule of stores. Based on the above, the establishment of an **Operation schedule for bars & discos (especially for open air installations) in the city center with time limitations** concerning their operation with or without music was proposed. More specifically,

- In **areas of mixed use** (with emphasis given to general residential use) a time limit should be imposed to establishments with music, and a schedule extension should be given for operation without music. A fundamental parameter of this temporal – spatial management is that annoyance from speakers is systematically much more intense than the noise of conversing customers. Hence, the temporal extension of the schedule is possible up to, for example, 00:30 for music and 01:30 or 02:00 for simple operation with customers conversing without music.
- In **areas characterized exclusively by administrative and commercial uses without presence of residences**, it is possible to use a more extended operation schedule with music, given that the absence of sensitive receivers minimizes annoyance.
- Finally, in **residential areas**, provided that their existence and conservation under tourist city center conditions is possible, to impose a full ban on operation of such establishments, at least as far as establishments with music are concerned.

According to the above conclusions, a relevant proposal was formulated which concisely deals with interventions at corresponding areas in the city (see figure 1):

- **Location (A1): Mandraki – Niohori** – mixed use areas (general residence) where the operation of bars and discos will be allowed under strict time limitations on music and a further small extension of the schedule will be made for operation without music.
- **Location (A2): Triangle Papagos – Rimini Square – 7 Martiou – Galias and Makariou** (with possible expansion to 7 Martiou square until the intersection with Ethnarhou Makariou street) – areas with commercial land use, offices, mass transport installations, as well as with restaurants (see figure 2), where the operation of bars and discos with open air activities with a significant annoyance factor will be allowed.
- **Location (B): Port area to the East of the city** – port/marina land use region, combined with all the other uses related to its operation, where the operation of bars and discos with open air activities with a significant annoyance factor will be allowed.
- **Location (C): New marina area S-East of the city** – region where, as above, the installation of land use with a considerable annoyance factor will be allowed (night clubs, discos, etc.), with emphasis given to those which require space for open air activities.
- **Location (D): S-W zone in the town perimeter**, where, for a more radical confrontation with annoyance at a city level and combined with a strategy of dynamic reinforcement and improvement of entertainment, recreation and culture or, additionally, sports, the investigation of the creation of a new "**entertainment-cultural and sports park**" is suggested, within a newly designed zone for which the whole of the required town planning, environmental etc. studies will be carried out, using as basis the suggestions of the current research project.

The applications presented above require for their successful application the following **basic relocation motives** that are analyzed below (with emphasis given to location A2):

1. The ensuring of a prolonged time limit of operation with music in areas that are not characterized by residences and where the annoyance factor does not exist (location A2).
2. The determination of a limited and strict time schedule of 2-3 years, of bar and disco relocation from areas with severe annoyance problems.
3. The ban on open-air activities in noise sensitive areas.

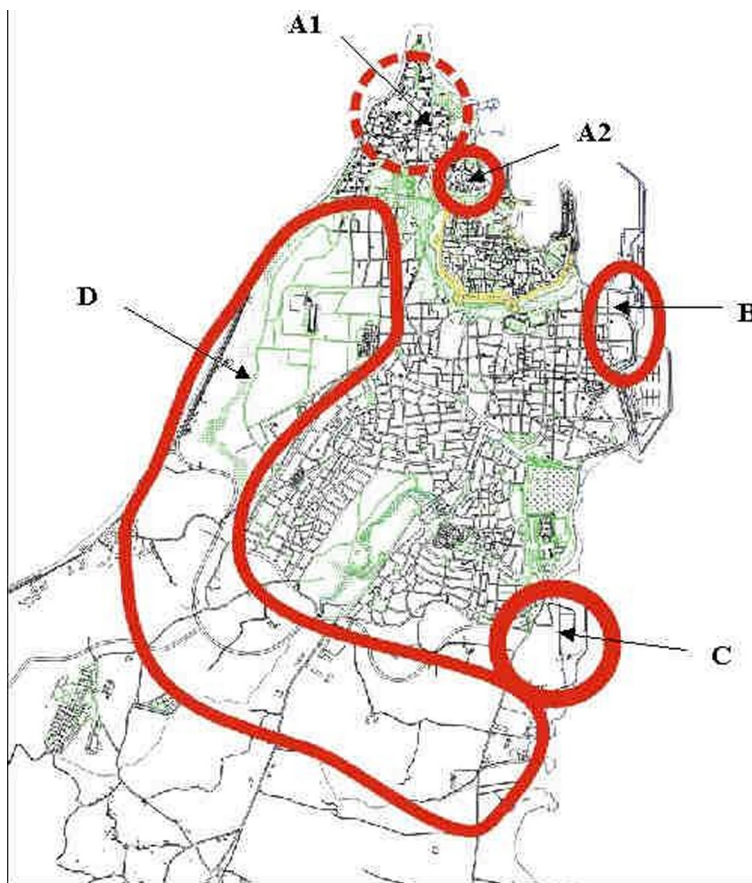


Figure 1: Planning zoning for bars & discos at Rhodes.

4 - TRANSPORTATION PLANNING AND TRAFFIC MANAGEMENT

The increase of the number of cars and motorcycles in urban circulation, mostly rented, combined with the inadequate road network, have made traffic the main source of noise in tourist areas. A comparison of the traffic composition and flows resulting from the traffic studies conducted for Rhodes in 1974 and 1984 with the results of the 1998 counts carried out within the context of this research project, showed that:

- The percentage of motorcycles has greatly increased (up to doubling in certain roads), especially during the period 1984-98.
- On the contrary a decrease is observed in the percentage of trucks.
- Simultaneous traffic and noise counts, showed a strong correlation between noise and traffic flows composition especially truck and motorcycle traffic.

After examining the existing methods to control traffic noise at the source or its dispersion and to reduce its effects through proper protective measures, the following specific proposals were made for the pilot city of Rhodes

- *Motorcycles.* "On the road" control of motorcycle noise. Implementation of the "Noise Control Card for Motorcycles" considered by the Ministry of Transport. Training and Information of motorcycle drivers.
- *Pedestrianisation.* Extensive pedestrianisation carried out in the central areas of various cities in Greece had positive effects both in reducing noise as well traffic accidents, especially those involving pedestrians. In the city of Larissa, Greece (population 150.000 inh), where 5 kms of pedestrian streets were constructed, a reduction of the percentage of pedestrian accidents in the whole city from 37% to 22% was observed. In Katerini, another Greek city (60.000 inh) a similar reduction from 38% to 20% was observed [4]. Until a new traffic study is conducted for the city of Rhodes, specific pedestrianisation proposals were made in this research.

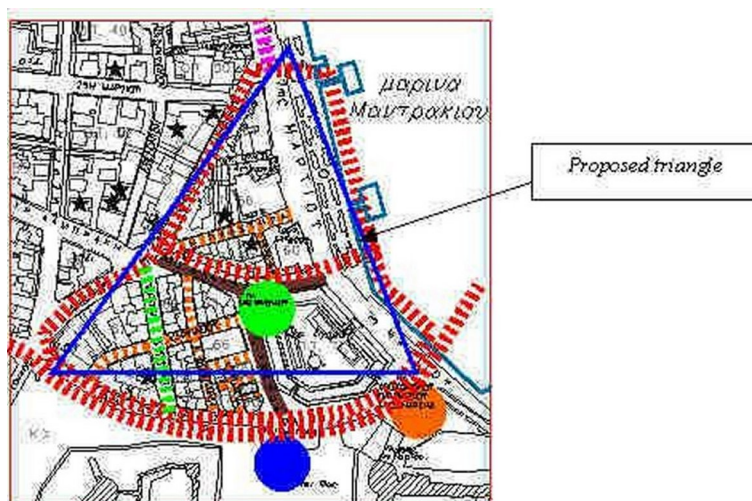


Figure 2: Location A2.

- *Encourage Public Transportation, Walking and use of Bicycle.* Proposals were made to reduce the use of motorcycles and passenger cars by improving public transport and encourage organised tours by tourist buses. Also, taking advantage of the good weather, encourage trips with human energy (walking, bicycle) through building pedestrian and cycle facilities.
- *Anti-noise asphalt pavements.* Considering the importance given by the EU in reducing the noise from tires, it was proposed to construct anti-noise asphalt pavements in certain roads surrounding a pedestrianised area.
- *Other traffic management measures.* Other traffic management, measures that reduce traffic noise, could be implemented following the anticipated new traffic study of the city. They include:
 - Improvement of traffic flows* (one way streets, coordination of traffic lights, prohibition of conflicting movements etc.) to reduce the frequency of stops, accelerations and decelerators.
 - Speed reduction.* In low traffic urban roads elsewhere, where humps and cushions were constructed, a reduction of noise levels by 2 to 4 dB(A) was observed [5].
 - Parking Management* (Construction of off-street parking, parking fee policy, control of on-street parking, park & ride etc.) to improve the distribution of traffic flows and encourage the use of public transport.
 - Traffic Restrictions* (discouragement of through traffic, prohibition of traffic or of certain categories of vehicles at certain critical periods and/or sensitive areas etc.).
 - Application of new technologies* to facilitate the application of the above measures.

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