Environmental Performance of Underground Railway Stations in Athens

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ABSTRACT

In this research the stations of the new subway in Athens are studied as transition spaces between indoors and outdoors, as well as surface and underground uses. The importance of transition spaces has been recognized through architectural research for many years, as they form a link between interior and exterior, public and private domains, and as such their role in the integration of public transportation to the urban structure is essential.

The aim of this study has been to tackle with some of the main issues of user thermal and visual comfort in the public railway stations in Athens, which involve both underground and surface spaces. The research involves user questionnaires as well as measurements of temperature, relative humidity and daylight levels in selected railway and “Metro” stations within the metropolitan area of the city.

1. INTRODUCTION

In the last few years there has been a wave of initiatives in favour of public transportation in Europe, both in theory and in practice, involving policy makers, local governments and citizen groups of most major European cities. These initiatives have led to the implementation of several prototype public transport actions and the development of new organisation models and benchmarking indicators, as well as new regulations and directives for European public transport.

All these actions exert a serious influence on urban planning, acting as a basic link of “door to door” trips interconnecting citizens’ daily life with the urban network. The philosophy of cities based on developed and convenient public transport networks, as contrasted to a network of streets and highways devoted to private cars as the main transportation medium, is an innovative perspective combining high technology and sustainability that can present appropriate solutions to the problems of 21st century urban centers (Vlastos, 2003).

In fact a well designed public transportation network is very important for the development and comprehension of a city structure and character, for the citizen and the visitor alike. It becomes part of the city identity as one of its structural elements, offering an easily comprehensive “image of the city” to guide the visitor through its main parts and bring him closer to everyday life in an active and varied way, well suited to his own rhythms. As such it becomes a symbol of city hospitality and attractiveness not only for visitors or citizens but also for prospective investors, who can be attracted by a well organized and efficient transportation network.

Energy conservation and reduced and environmental impact are further arguments for the increased use of public transportation systems which can make a serious contribution to the reduction of environmental pollution, affecting climate change, the security of European energy supply and overall quality of life in urban settings.

The expansion of cities in reduced densities has also influenced road networks and daily transportation routes of European citizens. In fact although the number of daily trips per citizen has remained constant, their length has more than doubled as shown in recent surveys. What is more mean velocity
of cars in big cities is reduced by over 10% in the last 10 years, while in periods of increased traffic it approaches this of 19th century horse carriages (!).

For public transportation energy consumption per passenger is estimated at 1/5 of this of private cars, while air pollution is reduced by 4 to 8 percent. Only well designed public transportation networks can in fact reduce traffic congestion, noise, traffic accidents as well as air pollution, thus increasing quality of life in the urban centers.

2. PUBLIC TRANSPORTATION IN THE CITY OF ATHENS

Public transportation has been largely neglected in Athens in the last decades. However, the multiplication of private cars combined with an obsolete and highly restricted street network, has resulted in an overall stifling and blocking of both circulation and public outdoor spaces in the city. Although the city of Athens subsequently made many efforts to improve its public transport system, these were finally brought to fruition only recently, due to the prospects of the 2004 Olympic Games, for which the development of an efficient and well designed public transportation system was essential.

The new public transport system was based on the development of two new “metro” lines, combined with a new high-speed suburban train, also connecting the city center to the airport (Fig. 1).

![Fig. 1. Map of public transportation network in the Athens metropolitan region (source Attico Metro).](image)

At the same time a new tramway network was developed, linking the city center to the southern suburbs on the seashore, while the pedestrianisation of many streets, combined with circulation restrictions of others, resulted considerable an immediate reduction of car use levels at the center of Athens.

This led to a drastic reorganisation of circulation of vehicles throughout the Athens metropolitan area and a parallel restructuring of the whole public transportation network. The latter has in fact had to overcome many barriers in order to succeed only recently, in showing to the public its advantages for the development of a new sustainable and hospitable city.

3. UNDERGROUND RAILWAY STATIONS AS TRANSITION ELEMENTS IN THE CITY

As follows from the above discussion, the scope of the new development of public transportation in Athens is much wider than the convenient and pollution-free transfer of the inhabitants through the center and towards, or out of, main destinations in the periphery of the city.
As a matter of fact it includes restructuring and reshaping of the city itself, where the new railway and metro stations can perform not only as transportation nodes, but also as extensions of the urban space, offering a variety of choices in accommodation and leisure for the user, and accentuating particularities in character and “sense of place” of different parts of the city. In this sense subway stations become transition spaces for the city, acting as elements of connection, extension and/or separation between indoors and outdoors as well as between surface and underground uses on a multiplicity of levels. Transition spaces have been recognized as essential elements in the built environment and they occupy a central space in architectural design and research in the last decades. In most cases such elements form links or barriers between interior and exterior, public or private domains both at the scale of a building and this of a city or region, evoking a complexity of meanings crucial for the workings of a city at functional, aesthetic, social and symbolic levels. Traditional railway stations in Athens seem to act as transition spaces in all of the above levels, sheltering a variety of functions related both to travel (platforms, waiting rooms, information and ticket offices) and to the city in general (public services, passages, stores, cafes and restaurants). Their urban character is expressed at a social and symbolic level through the form of their buildings, which represent public transportation, acting as public landmarks at the scale of the city (Fig. 2). Although most of the original railway stations have been renovated, forming line No 1 of the new Athens underground network, they kept in general the same design principles as the traditional stations, thus acting as transition spaces at the scale of the city. New metro stations for lines No 2 and No 3, however opted for a more discrete or solely functional approach. In fact the station is hardly distinguished in the urban space, offering no more than a purely functional link of surface to underground space through an entrance often merely expressed as an opening (or a pit), by which escalators seem to mysteriously descend to the underworld (Fig. 3).

Fig. 2. View towards the old Monastiraki station. Fig. 3. Entrance to the new Monastiraki station.

4. ENVIRONMENTAL PERFORMANCE OF REPRESENTATIVE STATIONS

In addition to overall environmental benefits from the development of public transportation as compared to this based on the private car, as discussed above, recently there has been an effort to reduce the environmental impact of particular metro stations and increase thermal and visual comfort levels for their users in the Athens metropolitan area. Following a first phase of implementation of the basic network for lines No 2 and No 3, a second wave of metro stations have been realised after the Olympics, in conjunction to these lines. Some of these stations are designed in a more sensitive way concerning both their environmental performance and their role as transition spaces in the city.
In fact although typical first phase stations offer minimal contact to their surroundings, acting as zero-identity “black holes” with respect to the urban environment, some second-phase bioclimatic stations have increased public access levels, visible from the surrounding urban tissue, to which they are often well integrated by means of carefully designed public transition spaces. The latter may include green spaces at different levels which often surround the station, offering various perspectives of plants visible both from the outside and the inside of the station, where daylight levels are dramatically increased (Fig. 4,5).

Fig. 4. Master plan of Ag. Antonios station (source Attiko Metro).

Fig. 5. Section of Ag. Antonios station, showing landscaping and planting (source Attiko Metro).

In order to assess their environmental performance, an audit has been performed in representative underground metro stations including measurements of temperature, relative humidity and daylight levels at five main transition spaces at each station, located at successive levels with respect to the main access from the outside:

1) the ground level
2) the escalators No 1 (between ground and ticket levels)
3) the ticket level
4) the escalators No 2 (between ticket and platform levels)
5) the platforms of access to the trains
These measurements are supplemented by user questionnaires, observations and photographs. Results of temperature and relative humidity measurements are summarized in figures 6 and 7 below for representative stations.

Fig. 6. Temperature measurements in main metro stations in Athens (March, 2007).

Fig. 7. Relative humidity measurements in main metro stations in Athens (March, 2007).

As can be observed from figure 6, although small temperature differences exist among stations, these are minimal between different levels at each station. The station of Ag. Antonios, is an exception to this rule since there is a temperature difference between the platform level, which is located underground, and all the other levels which communicate openly due to the use of bioclimatic principles in landscaping of the station (Fig. 8, 9).

Relative humidity levels (Fig. 7) range between 30% and 44% and they show larger differences at larger stations that go deeper underground like Syntagma station, where a value of 33% is measured at ground level while at the platform level relative humidity had a value of 44% during the same measurement procedure.
As far as user questionnaires are concerned, our first results show a net difference in favor of bioclimatically designed stations, which are considered more “comfortable” and “pleasant” by the majority of users.

Fig. 8, 9. Views of Ag. Antonios station from the outside and the inside.

5. CONCLUSIONS

Although this is an ongoing research, our first results seem to confirm our hypothesis that the inclusion of environmental principles in the design of underground stations not only increases thermal and visual comfort of users, but also can contribute to a better integration of the different access levels of the stations to the city by treating them as transition spaces between the public transportation domain and the urban structure.

As psychological aspects of thermal and visual comfort are very important for their assessment by the users, it is obvious that a better integration of underground stations to the city through the intelligent use of transition spaces between indoors and outdoors, underground and surface uses not only improves environmental conditions in the station itself due to the improvement of microclimatic treatment around it, but also influences the psychological expectancy of thermal comfort which is associated to outdoor spaces by the user (Höppe, 2002). In such cases the user is much more favorable to transition spaces felt as an extension of outdoors due to the presence of ample daylight, landscaping and planting.

REFERENCES