

# THERMAL COMFORT PERCEPTION AND EVALUATION IN URBAN SPACE.

G. Scudo, A. Rogora, V. Dessì

*Department Building & Environment Science & Technology (BEST), Politecnico di Milano  
Via Durando 10, 20158 Milano, ITALY  
Email: [gianni.scudo@polimi.it](mailto:gianni.scudo@polimi.it)  
[alessandro.rogora@polimi.it](mailto:alessandro.rogora@polimi.it)  
[valentina.dessi@polimi.it](mailto:valentina.dessi@polimi.it)*

## ABSTRACT

The paper describes the comfort analysis based on simulation tools, microclimatic measurements and people response to interview. The results confirm a discrepancy between quantitative evaluation and sensation vote, but lower than one reported by other authors.

## KEYWORDS

Comfort perception, urban space, comfort evaluation, field survey

## INTRODUCTION

Urban open space -squares and streets- are the places where environmental phenomena together with social interaction take place.

There isn't a deterministic relation between environmental dynamic and activities, but anyway, a well tempered urban spaces enhance social and individual activities in "consonance" with natural energy fluxes.

The attractiveness of urban space are therefore influenced also by the microclimate and its perception by people, which is a mix of psychological and physiological process.

In this context The UE is financing the RUROS project (Rediscovering the Urban Realm and Open Spaces) with the aim to develop comfort models for different climatic conditions through Europe. The used approach is to have a platform in which is possible to combine physiological environment (through measurements, simulation, morphological analysis) and psychological ones through people behaviour observation and interviews.

The discrepancies between the comfort evaluation based on the measurements (and/or simulation) and the sensation perceived by the people is the study area to focus on.

To reduce this gap means give answers to the people needs from the quantitative point of view (reduction of the thermal stress) as well as the qualitative one (attractiveness, expectation).

## THE STUDY AREA

The analysed area is a middle size square in Sesto san Giovanni, an ex industrial town close to Milan. Square shape is rectangular following the traditional Italian square, dimension is 35 x 70 metres and orientation of the main axes is N-S.



Fig. 1 Petazzi square

A preliminary morphological analysis for winter and summer has been done with the software Townscope. The analysis gave sky view openness associated with solar chart to have solar access trough all the square (fig. 2).

In winter solar access is very low and mainly concentrated in the afternoon close to the middle of the square; at contrary summer access to sun is wider but contained at pedestrian level by the double arrow of small deciduous trees.

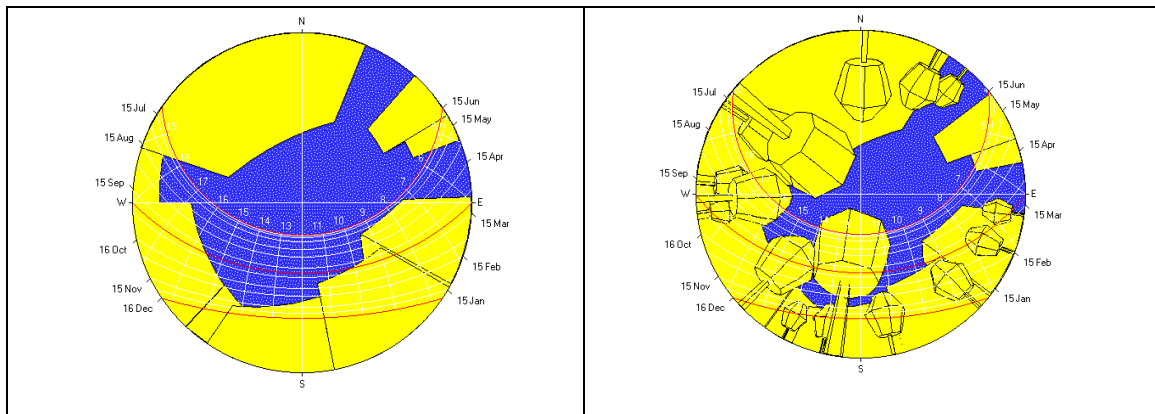


Fig. 2 Stereographic view of Petazzi square without and with trees

Field survey has been done from fall to summer. Microclimatic data where collected in five fix point of the square. The environmental parameter for people comfort situation have been monitored trough thermal, luminous and audible spot measures along with direct observation and socio-economic and environmental sensation questionnaires.

A first analysis of the use of the space has been done based on the people behaviour observation: actually people, choosing the place where stay, characterise microclimatic “niches” changing according with the different climatic condition of the year and the day.

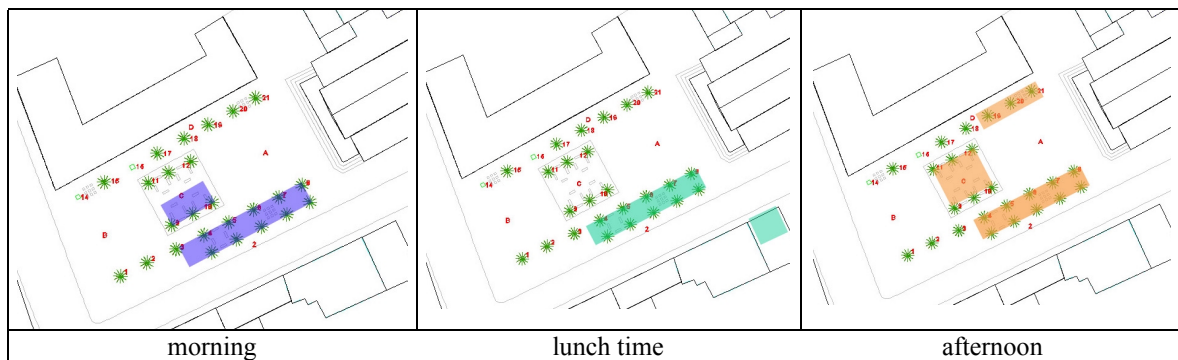


Fig. 3 microclimatic “niches” in Summer

During five days 160 people with different sex, age and behaviour have been interviewed. A first generic result from interviews points out 76% of interviewers replied yes to the question: “Are you in comfort?”

## MICROCLIMATIC SURVEY

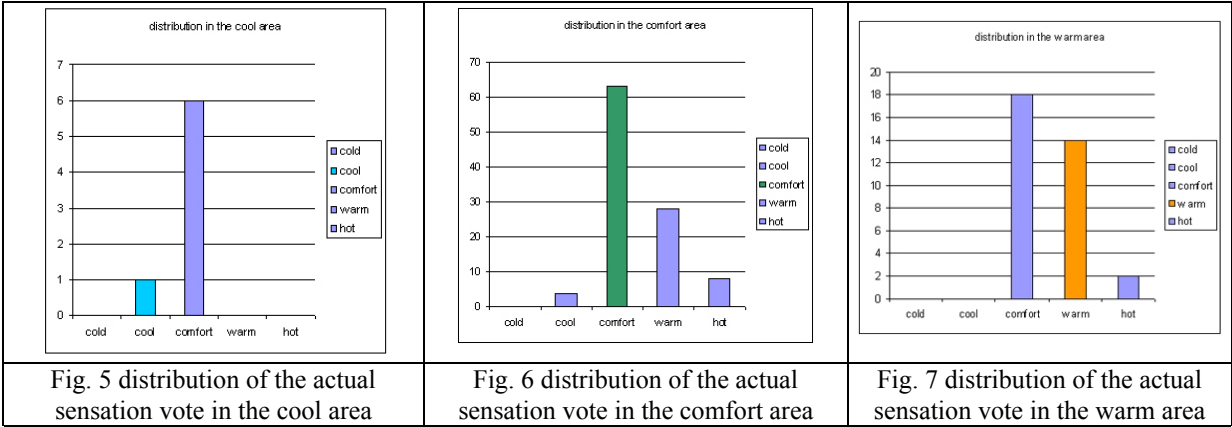
Each interview goes along with a microclimate survey done with a special mobile equipment (fig.4) made by a data logger with a set of different probes (air and globe temperature, relative humidity, air velocity, global radiation, luminance and sound pressure). This mobile monitoring equipment was designed and assembled to be quickly moved in the square in order to follow people environmental sensory behaviour (in example people moving from sunny to shaded area).



fig.4 field survey: interview and measurements

Collected data have been used to calculate PMV as outside thermal comfort indicator. Taking into consideration the well known discrepancy between physiological and psychological thermal adaptation a more detailed analysis of people answers to the questions “Do you feel neither hot/cold (0), warm (1), hot (2), cool (-1), cold (-2)?”, has been done. People who replied neither cold/hot (0) to the question was 60% , percentage consistent with the calculated PMV.

Focusing on data is possible to do interesting considerations, in particular through the comparison between answers and the calculated PMV; then the concordance between the specific answers and PMV score scale has been elaborated (fig.5-8).



In the comfort area the great majority of answers overlap to the calculated PMV. In the cool area (-2<PMV<-1) and in the warm one (1<PMV<2) the majority of the people answered neither hot/cold (which means they feel in comfort).

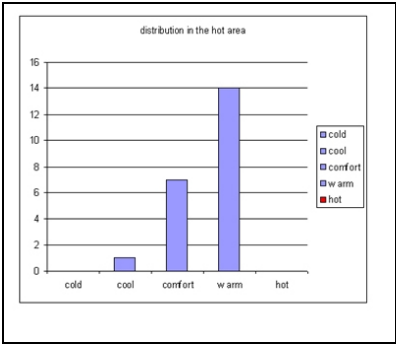


Fig. 8 distribution of the actual sensation vote in the hot area

In the hot area PMV calculation gives 22 people, while any people are inside the hot score. The majority of the people answer warm. This considerations are very meaningful because the people answers have a clear trend to set one level lower or higher in the PMV score scale, actually in warm and cool area the majority of the answers are in comfort area, in the hot area the majority of answers are in the warm area. This means that the people perceive microclimate in much more mild way then the value calculated to PMV.

## **CONCLUSION**

The very preliminary results presented from the survey in Sesto san Giovanni has concentrated in the thermal environmental of the users of open spaces in summer. A comparison between objective comfort evaluation (through measured or simulated data) and subjective comfort sensation (through questionnaire answers) reveals a discrepancy between the two which was found also in other climate by authors (Nikolopoulou, et al.). On the basis of a first analysis, discrepancy seems lower than one reported by the above quoted authors and a kind of empirical correlation between subjective and objective comfort evaluation could be elaborated when the results of the wide range of data collected in field survey by project RUROS will be available in the near future.

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