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# Tools for Urban Planners to Improve the Wellness during Urban Spaces Renovation

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**Abstract** Architectural modification of existing urban morphology sometimes result as improvements of aesthetic characteristics of open spaces but could produce detriment of pre-existing wellness for residential population. An example of ex-ante/ex-post study allows assessing a methodology devoted to planners for the maximization of physiological wellbeing.

**Keywords** Thermal Comfort, Wellness, ENVI-met, Urban Space Renovation, Urban Planning

## 1. Introduction

At the present, more than half of the global population lives in cities and cities themselves are growing to unprecedented sizes [1]. The high density of population and the consequent use of primary resources by urban residents, especially in the North Hemisphere, which makes cities and their inhabitants key drivers of global environmental changes [2].

The warming effects in urban areas, due to principally to the urban sprawl [3] giving rise negative impacts on the wellbeing of people.

The creation of comfortable living space from a thermal point of view has become a necessity in today microclimate conditions [4]. The aim is to found the optimal way to mitigate the climatic change, and the urbanization effect on thermal comfort by adjusting the green developments in urban planning.

The health and safety in cities are today at risk: partly due to the increase of the heat island effects but also for the inappropriate urban design decision (http://unhabitat.org/books/world-cities-report/)

In this paper it was studied a real case of an architectural renovation of an historical urban square in the center of Bologna (Italy). Minghetti Square, built between 1876 and 1896, adjacent to Via Farini and close to the Roman Quadrilateral in the historic center of Bologna (Italy) (Figure1), recently was the subject of a formal and functional reorganization, simultaneously with the renovation of several buildings overlooking it.


**Figure 1.** Pictures of Minghetti Square before modernization and in 2013

The work, begun in early 2011 and ended in July 2012, included the replacement of the flooring, the elimination of the bins and areas used for parking vehicles with the consequent removal of fences, pitons, and chains that marked these area, the realization of a new bus stop shelter and the reorganization of the green and of the street lighting. The primary aim of this renovation was to give back to the square its role as a meeting place and rest by increasing the quality in terms of aesthetic and social views, recreating a connection with the surrounding buildings that are architecturally and historically significant.

For this reason the designers and architects have been made choices which the flooring made with natural stone material, laid in different ways to give a reading of the areas and space; the placement of new wooden benches in the square (arranged as to describe an ellipse); the construction of shelters by minimal forms; the killing of certain species of trees that occluded the view on prestigious buildings and other, partially diseased, but that had nothing to do with the historic garden. Few tree species were saved for their historical and botanical value: the plane tree and the red beech along with others.

Were then removed: any prunus (11) in part because patients and still be considered non-matching with the context of the square; a magnolia tree as suffocated by his side (a Cladrastis lutea) and blocked the view of the building of the Savings Bank; all shrubs growing in flower beds because shabby and messy. Finally it was removed the hedge that surrounded the Minghetti statue because it seemed to annihilate rather than enhance it.

The following analysis aims to compare the microclimate in the square before and after the redevelopment, to understand if indeed this has improved physical wellbeing of the users who live the place.

## 2. Materials and Methods

The Minghetti square before and after the renovation was simulated with the fluid dynamic model ENVI-met.

ENVI-met [5] is a three-dimensional non-hydrostatic microclimate model designed to simulate the surface-plant-air interactions within daily cycle in urban environment with a typical resolution of 0.5 to 10 m in space and 10 sec in time. Several variables can be simulated, included flow around and between buildings, exchange processes of heat and vapour at the ground surface and at the walls, turbulence exchange of vegetation and vegetation parameters, bioclimatology and particle dispersion (ENVI-met, 2008). In literature is possible to found a lot of work where the ENVI-met model was validated [7-9].

The two cases (Figure. 2) were inserted into the model domain consisted of a 52 x 52 x 25 grid with a spatial resolution of 2 m x 2 m x 4 m, resulting in a horizontal area of 104 x 104 $m^2$ with a 100m vertical extent.

The case study reported here focused on the simulation of the summer solstice (June 21) by convection. The simulation started at 6:00 a.m. and lasted for 24 hours.

The configuration file contains the input atmospheric values. The data were obtained from the measures in the urban area of the city of Bologna made from the Regional Idrometeorological Service (ARPA-SMR).

- Wind speed and wind direction at 10 m: 1. m $s^{-1}$, 180°;
- Surface roughness length (z0): 0.1 m;
- Air temperature: 298.75 K
- Specific humidity at 2500 m: 7 g Water / kg air
- Relative humidity at 2 m: 50%

## 3. Results

The outputs of two ENVI-Met simulations were compared in order to highlight the meteorological parameters differences in the two architectural configurations. Figure 3 shows the differences of air potential temperature at 1.20 meter for different hours between the new (2013) and old (2007) Minghetti square layout.

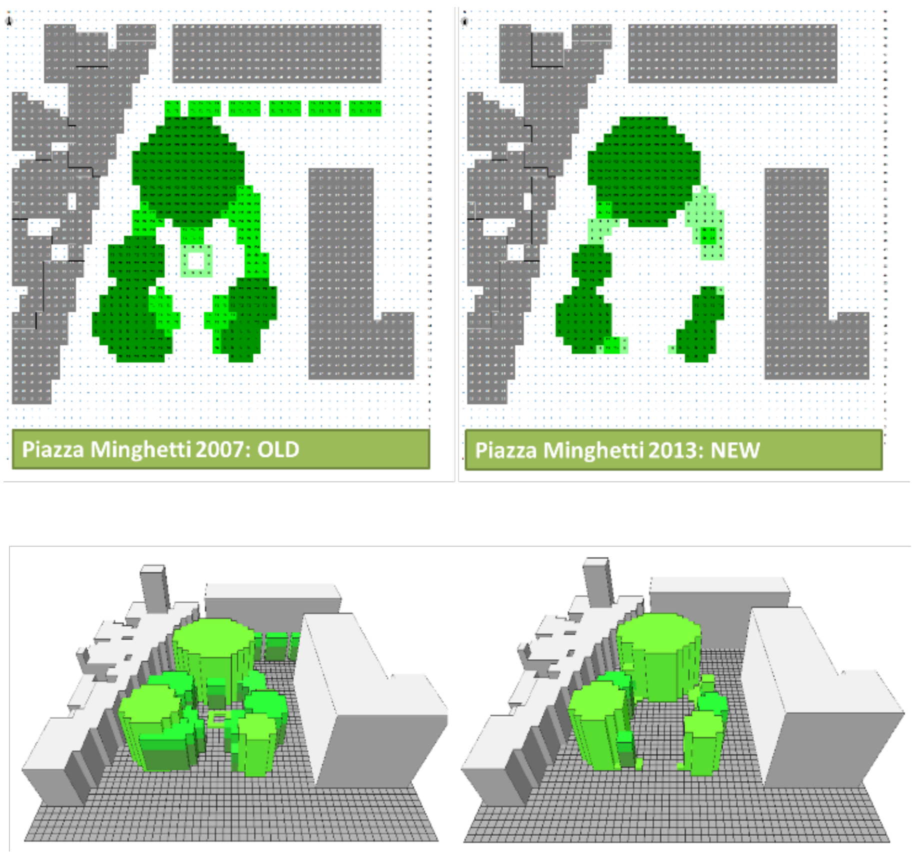


**Figure 2.** Pictures of Minghetti Square before modernization and in 2013

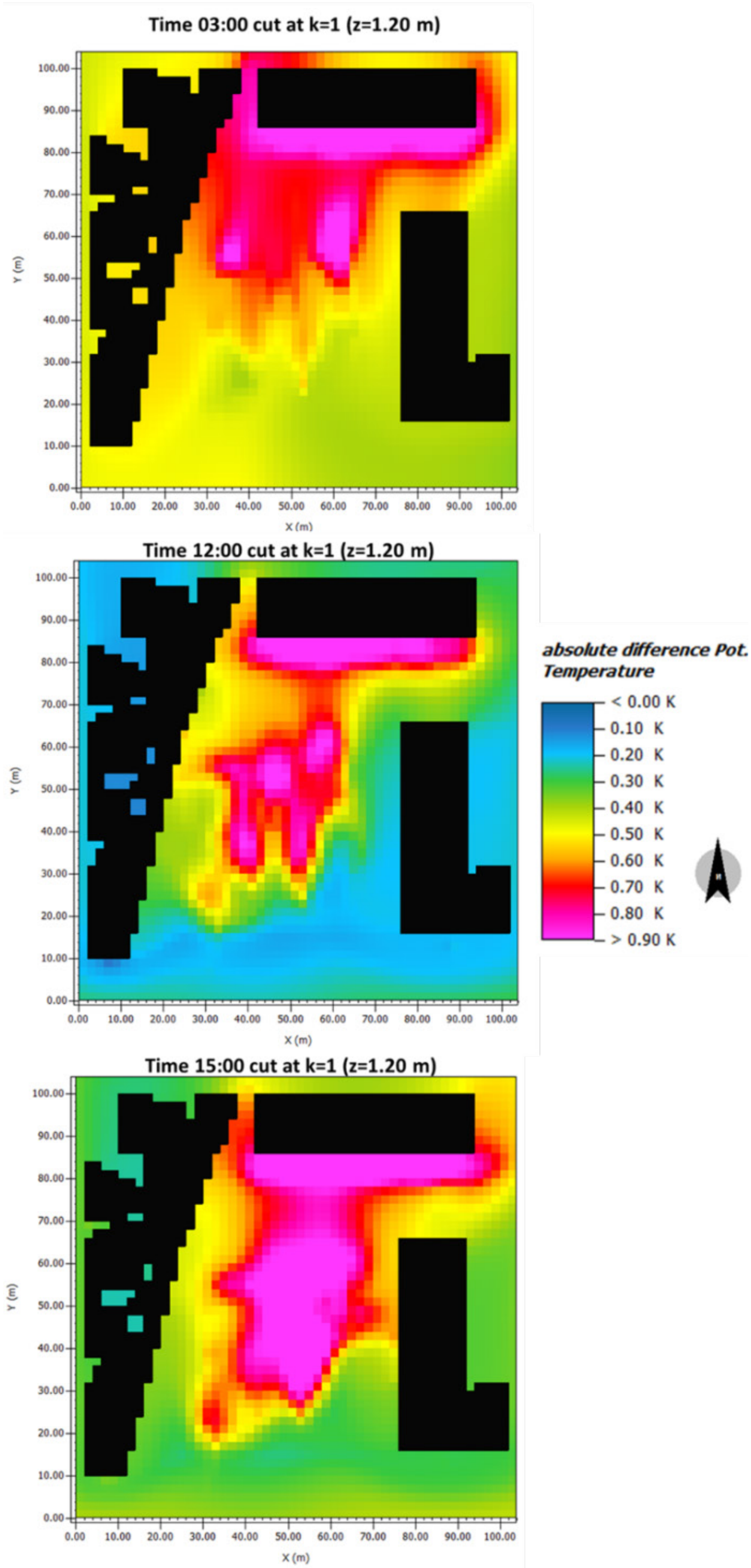


**Figure 3.** Differences of air potential temperature between new (2013) and old (2007) Minghetti square architectural layout at 3:00, 12:00 and 15:00 of the simulation day

**Figure 4.** Differences of PMV (Predicted Mean Vote) between new (2013) and old (2007) Minghetti square architectural layout at 14:00. On the right is reported the PMV scale.

The results shows a difference in the air potential temperature close to 1 °C in some areas especially at 15:00 when the largest surface warming is present (especially in areas where pavement or concrete have taken the place of flowerbeds and hedges).The patterns show how the entire square is warmer after the renovation. Surely the choice of materials for the square floor could be on no water-resistant pavements, and on materials with a surface albedo as not to create surface overheating.

The predicted mean vote differences at 14:00 reaches value of 2.50 that really shifts the wellbeing for the residential population (Figure 4). The surprise is that the square center where the people usually stop and sit is the area with the worst thermal comfort conditions.

This result suggests that planners have absolutely no considered the climatic conditions in their restructuring, but the but the well-being of the people in those areas is highly deteriorated demonstrating that combine climate change with architectural design is not sufficient, it is necessary to improve our knowledge and planning methodologies.

## 4. Conclusions

The modernization of Minghetti square shows a worsening of environmental conditions during the summer. The renovation of the square was performed taking into account only the architectural aspects and not environmental ones.

The idea of making the square a meeting and socializing point for locals is as fail during the warmer months of the year.

Surely, the aesthetic and architectural design aspect is important during a renovation but this work shows that we cannot fail to take environmental issues into account. This work wants to be an input for designers and to give a methodology for future restructuring which may be taken into account as mitigation, urban heat island and thermal comfort.

The methodology proposed here can be used in future reorganization of common urban spaces to design resilient and sustainable cities.

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