# CLIMATICA

*Forma urbis*

n°2

Giovanni Marco Chiri
with texts and images of Ilaria Giovagnorio
Foreword by Mosé Ricci

My initial idea was for this book series to be in one way or another “essential”. My opinion was that I could have guided it and developed at least a few of the topics covered in it, only on the condition that it would be truly useful. But useful to whom? Who would really feel the urge to read these short, printed texts? Certainly I didn’t, and still don’t, have the ambition to contribute substantially to the theory of the project nor to elaborate on themes that are so eccentric that they raise the interest and curiosity of only a few academics in the field. On the other hand, I admit that the mere idea of writing one – or more – strictly educational texts bored me.
Returning to the basis of the discipline and using them to rebuild a way of working has, in a way, a fundamental value and – though this may seem audacious – is highly exciting.

GmC

back to basics

CLIMATICA. City form
by Giovanni Marco Chiri

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# 1

CHAPTER
**ONE**

"Why should I care
about future generations?
What have they have
ever done for me?"

Groucho Marx



# Sustainability

The year is 2035.

*"In New York, palm trees line the Hudson River from 125th Street to the Midtown exit. Phoenix is in its third week of temperatures over 130 degrees C and the project to cover the city with air-conditioned domes is still unfinished. Holland is under water. Bangladesh has ceased to exist. Torrential rains and rising seas there have killed several million people and forced the remaining population into makeshift refugee camps on higher ground in Pakistan and India. In central Europe and the America Midwest, decades of drought have turned once fertile agricultural lands into parched deserts. Tens of millions of people continue to trek northward the greatest mass migration in recorded history. Canada's population swells from 20 million to 200 million in less than 4 decades. Forest fires rage out of control over millions of acres in the Pacific Northwest, while the Mississippi River, closed to commercial traffic earlier in the century, becomes a vast earthen plain, allowing people to cross over by foot for the first time in human memory. The ozone layer continues to shrink causing a pandemic of cancer deaths. Hundreds of millions of people are exposed to dangerous levels of ultraviolet radiation that compromise their immune system and millions more become vulnerable to a series of new and strange diseases sprouted on irreparable failures and the eradication of the entire ecosystem all over the planet. Welcome to the world of the twenty-first-century greenhouse effect."*

Jeremy Rifkin – Entropy

Contemporary literature is now full of more or less imaginative or apocalyptic references to global climate change and its consequences on the world and its civilizations. Despite the resistance of some large countries, the global community has now accepted global warning, at least in general terms, and has agreed to introduce measures to stop (or at least slow down) the devastating effects of climate change on the Earth's ecosystem.

There is, therefore, no need to add much more to the descriptions offered over the years on the subject or to highlight the importance of a paradigm shift in land use and consumption. There is, however, space for thinking that is still profound and sufficiently wide-ranging concerning the way in which architecture (and in particular the design of cities) can interact with on-going climate processes. However, the topic must be segmented into "scales." The "macro" scale of urban and regional planning aims to trace the major strategic orientations for the

development of metropolises by working on a number of aspects. The economy, society, transportation, industry, and energy are all matters of paramount importance but they do not say anything to us about the smaller scale “fine grain” of cities. At the other extreme, technology and the construction industry are experimenting with innovative solutions for saving energy in buildings, for reducing costs of the thermoregulation of homes, and limiting the ecological footprint of the materials used. At the heart of the question is a dynamic and mostly unexplored space in which urban form and architecture largely determine the quality of urban life from a climatic point of view and contribute significantly to overall ecological performance. Unfortunately, government attention is meaningfully oriented toward the two extremes of the issue while the options that include the design of the built environment seem less debated. Of course, I do not refer to single virtuous cases but rather to massive and systematic urban planning for new construction according to principles of modern microclimatology.

In policies regarding the effects of energy and climate control on the built heritage, it is necessary to move from a conception of the city as a sum of single buildings to one that corresponds more to its formal and typological characteristics. The scientific literature has primarily proven the effects of urban design on the dynamics of fluids and thus on how the temperature is distributed and humidity is a function of ventilation, just as the awareness of the role of solar orientation is well-established in evaluating the environmental quality of the city. While not lacking the theoretical and technical bases for a shift in scale, it still seems far from being achieved especially in those contexts where the consolidated fabric of the historic city does not allow, except to a very small degree, those reforming large-scale interventions like those undertaken the second half of the nineteenth century in relation to the issue of urban hygiene.

Although the relationship between urban form and climate has been confirmed by the foremost international organizations (ONU, European Commission, etc.) that indicated urban design as one of the preferred tools for creating the future ‘sustainable city’, today real actions are still very few. The reason for this difficulty can also be attributed to the meaning of ‘sustainability’ itself and the way it has been pursued in practice. Today, the prevailing approach is a holistic one that views the city as an ecosystem interrelated with its environment.

According to a metabolic approach, urban metabolism is achieved by reaching a perfect balance between energy input and output. It is a necessary condition for labeling a city “sustainable.” Even the use of renewable sources can contribute to creating

the required balance; nevertheless, it must be accompanied by an appropriate energy consumption policy. The current strategy is based on the large-scale use of renewable energy sources in buildings and massive use of technology. This approach, the current mainstream, has several drawbacks.

1. The city (as well as the mega-cities of several million inhabitants) is not a stand-alone system; in other words, it is not isolated, so that each process influences the whole planet. It means that city X can obtain a perfect balance for itself through a large use of technology, nevertheless the overall costs of production, transportation, and maintenance of that solution is usually not responsible for the balance of that city or of that nation;
2. The brutal use of technology to provide cities with low-cost "green" energy is radically changing the face of the city. Roofs, facades, walls, and roads change their configuration to adapt to the new devices. Sometimes this is a big issue;
3. The amount of green areas has become a kind of unit for measuring urban quality, a powerful weapon to control carbon dioxide emissions and sometimes just a fashionable way to make an iconic building. Urban parks and garden design, as codified in the past, have been transformed into must-have companions to development;
4. The model does not take in account the planner's mistakes in urban design, whose costs in term of energy consumption and comfort affect the city and must be counterbalanced over time by use of technologies with massive consequences on global energy consumption.

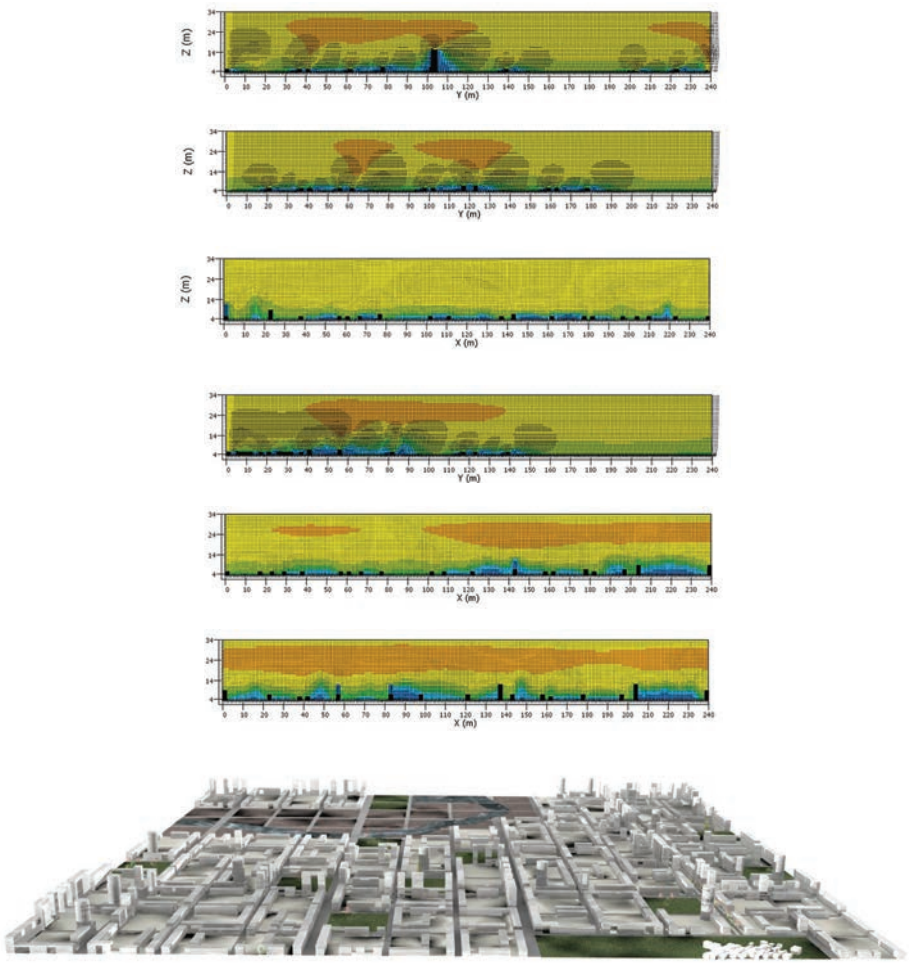
Thus, even if the metabolic approach has focused attention on the macro and micro scales, it does not take into account the intermediate one; in other words, it does not consider the morphology of urban form and its relation to climate on the ground level. Following the rude awakening from the incorrect belief in hydrocarbon's limitless availability, current policy is mainly geared toward increasing efficiency of buildings; nevertheless, this point does not affect urban form.

Good morphology of the urban fabric and the appropriate proportion of blocks dramatically reduce the need for extensive use of hi-technology in construction and its related costs. In fact, current research on the micro-climatic behavior of urban space clarifies the actual role of morphology both on energy balance and outdoor/indoor comfort, (see the writings of B. Givoni-2003). Furthermore, several studies have also demonstrated that the benefits of applying energy savings policies to the sum of the single buildings tend to level off.

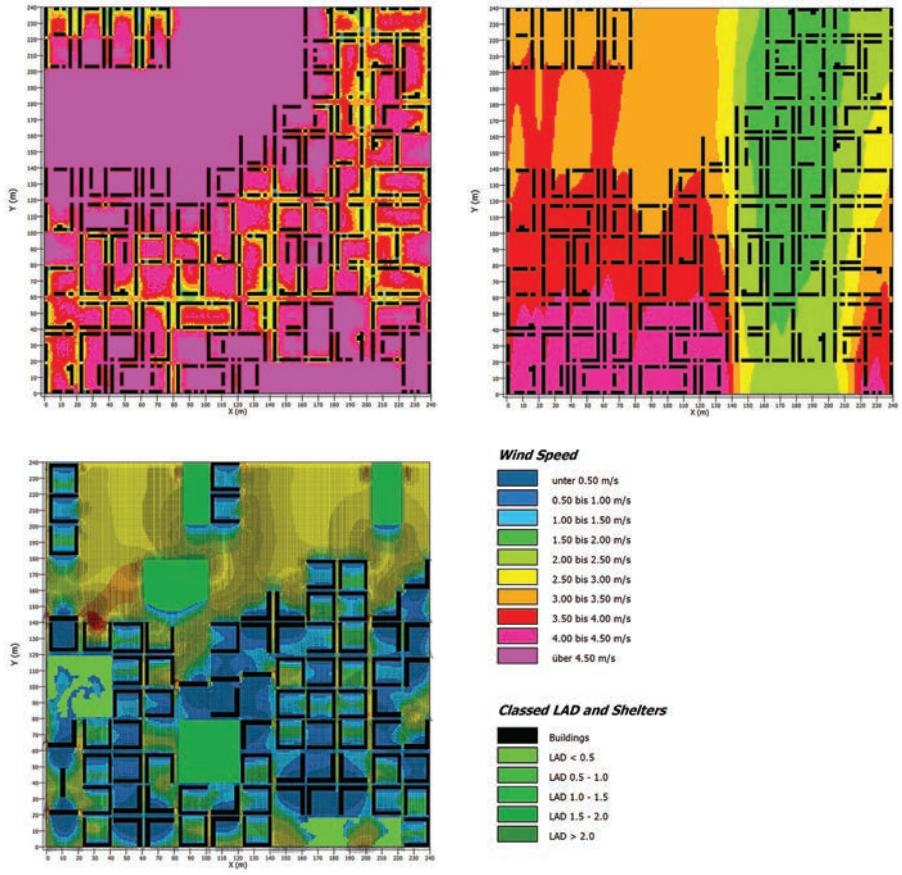
According to these studies, the possibility of decreasing consumption through singular undertakings will lose their effectiveness on the individual building in the long term, requiring a necessary change in scale of the size of the city (De Pascali, 2008). Consequently, the role and potential of the city in achieving these objectives is also gaining importance in the contemporary international debate. Because of the apparent limitations of the "relative eco-efficiency of the object" (Orlandi), the issue requires a shift toward the urban scale, intended as a set of buildings and open spaces and their mutual physical and topographic relations that regularly interact with climate. Thus, at a time when the world is still looking for a way to preserve its energy sources or is still in transition toward new alternative sources, reducing costs of energy consumption and quality of space, resulting from lack of attention to microclimatic behaviour in design, is dramatically crucial for everyday life.

Rethinking the urban design process in function of 'physical' and environmental parameters, which affect urban energy behaviour, can dramatically increase the energy efficiency of the entire system. If urban energy balance is profoundly influenced by spatial configurations resulting from the very first typo-morphological choices, then managing environmental data during the early stages of the design process can set the right perspective for the design right at the beginning. The microclimatological urban design (MCUD) approach proposed in these notes does not criticize the metabolic approach in itself but rather seeks to highlight the importance of focusing on the intermediate scale. Starting from an MCUD approach, architecture can deploy its total potential through the control of physical parameters of urban form that can interact with climatic phenomena. Many international studies are aimed at defining physical parameters upon which to act to improve the overall performance of space. In the conceptual framework regarding the deep relationship between urban morphology and microclimatic performance, much research has identified some macro-classes of physical parameters like urban density, H\W ratio, settlement form and size, orientation, etc. which are also-urban design parameters. Even if those classes of data are usually considered by engineers to be 'geometric' parameters that can affect the climate on the micro-scale, for urban designers they represent the material with which they work to shape the image of the city. Thus, placing urban design at the core of the sustainability debate prevents the risk of moving too brutally toward a deterministic approach. The required balance between energy savings and architectural and urban needs should be achieved by moving toward an integrated approach.

Today technology lets us forecast not only the weather meticulously but also the interaction between climate and urban form. Computers and advanced software can simulate the effect of the wind on buildings




Zhaoqing masterplan




Zhaoqing masterplan - climate simulations

but also on streets, courtyards, squares, and parks. Buildings and public space can be optimized to reach the perfect balance between energy consumption, comfort, and spatial quality. Even if this method is not widely applied in planning today, it is not new to urban design. The most important civilization on the planet has tried to expand its ability to forecast the weather not only to improve agriculture but also to preserve cities and settlements from disaster. Weather is also a powerful weapon on the battlefield. Generals gained the ability to use weather against their enemies to obtain their defeat or retreat due to environmental conditions. But meanwhile, architects and planners were able to draw some advantages from climate to improve the quality and safety of human settlements. Nevertheless, in the past, this kind of control was weak, due to the lack of proper technology. Furthermore, the re-reading of urban history can help us confirm a one-to-one relation between spatial configuration and microclimatic performance or between urban design and energy balance. The form of urban settlements in the Roman Empire was strongly influenced not only by the treatise of Vitruvio but also by the need to optimize the climatic 'efficiency' of the urban fabric. It demonstrates that the topic is not new, but it needs comprehensive study to be fully effective within the theoretical debate around urban design. In the following pages, we also discuss early attempts to organize a new discipline around microclimatic urban design. The contribution that the early pioneers made to the topic remain strong, but the will to establish a comprehensive approach linking architecture, planning, climatology and fluid dynamics still sounds futuristic and ambitious to us even today. This book does want to be a treatise on the topic; rather it opens a field of discussion and offers an opportunity to connect scholars from different fields of knowledge. Sometimes the text will appear overly technical, sometimes less, but in the end, the topic of MCUD will return to the stage providing architects and planners with the opportunity to contribute to solving the risks of our era.

This research project is primarily of a methodological nature and therefore does intend to have a direct impact on current urban design strategies; it is conceived to expand knowledge on advanced urban and architectural design tools, working on theoretical models as well as their experimental implementation through toolkits. The proposed approach is not intended to be the ultimate one, but can hopefully contribute to moving the focus of the current debate on the city to the microclimatic effects of urban form. This innovative point of view offers architects and politicians as well as administrators and competition juries increased awareness of the complicated relationships among climate, comfort, energy consumption and urban form. The primary application of the results will be in fields such as urban and architectural design; it will focus on education, starting from the consideration that the climatic aspects of a project need to be more thoroughly integrated into design teaching in architecture schools.

**CLIMATICA**
**City form**

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