Santamouris, M. (2007). Heat island research in Europe – State of the art. *Advances in Building Energy Research, 1*, 123–150.
Samonà, G. (1980). Come ricominciare. Il territorio della città in estensione secondo una nuova forma di pianificazione urbanistica [How to start over. The extended city area according to a new form of urban planning]. *Parametro, 90*, 15–16.
Shahmohamadi, P., Cubasch, U., Sodoudi, S., & Che-Ani, A. I. (2012). Mitigating the Urban Heat Island. Effects in Teheran Metropolitan Area, Chapter 11, pp. 282–283. In *Air pollution – A comprehensive prospective.* Intech.
Selicato, F., & Rotondo, F. (2010). *Progettazione Urbanistica Teorie e Tecniche* [Urban design theories and techniques]. Milan: McGraw-Hill.
Heat Island effect in the Teheran metropolitan area, Ch. 11 of Air pollution – A comprehensive perspective. Croatia, Edited by Budi Haryanto.
Wong, N. H., & Chen, Y. (2009). Tropical Urban Heat Island: Climate, buildings and greenery. London/New York: Taylor & Francis Press.

Focus A: Energy and Urban Form

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Nowadays, the population which can be considered an urban population exceeds 50 % of the total with areas where the percentage reaches 80 %. This process of urbanization of the population, combined with the potential impacts of climate change induced by the anthropogenic component (IPCC 2007), provides a new impetus to efforts to understand how the forms, functions and resources interact within urban environments. In some cities, energy consumption per capita has grown at approximately the same rate as spatial growth (Baynes and Bai 2009). From a point of view of urban metabolism, energy therefore represents one of the most critical resource flows for the life of a city, since it is a primary factor in supporting physical and economic systems (Alberti 1994). Considering then that the growing global contribution to GHG emissions of cities (Bai 2007), addressing global climate change bringing it down to an urban level acquires strategic interest, as it provides greater effectiveness of intervention: energy consumption, urban form, density and morphology if correctly associated, may provide the opportunity to address the issue of climate locally. Much of the literature available, for example, Williams et al. (2000), Jenks and Burgess (2000) and Foley (2005), Oke (2006),

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focus on the issue of mitigation considering it a driver of urban sustainability. Better planning, better design of spaces and urban forms, should be able to both mitigate climate change, and ensure a gradual process of adaptation to reduce the direct and indirect impacts of climate change on cities.

The approach to mitigation carried out so far to reduce GHG emissions, has been focused primarily on the production of energy from renewable sources, energy savings of buildings, "green" technologies for industrial production, alternative fuels with a higher efficiency for vehicles, and an increase in public transport. It has focused less on the study of urban form and the role it plays in an energy strategy for the conservation and efficient use of this resource.

The globalization of the construction industry and the total delegation of the indoor systems and plants has in fact determined, in the last century, an increasingly pervasive realization of approved buildings and urban structures barely related to their climatic context, cultural material. "The same buildings can be found from Stockholm to Nairobi, from Shanghai to Sao Paulo, with age-old design principles simply eliminated" (Butera 2004): a challenge for nature set by man, to prove that he can live indifferently in any context and in any climate.

If we take a broader view, which embraces and considers the territory as a geometric area of energy consumption (Olgyay 1951), we must consider that urban planning aimed at energy saving and sustainability must be sensitive to local conditions and able to exploit the resources that the environment provides. The end result of this approach is expressed naturally in architectural forms and urban structures, contextualized by morphology, type, use of materials. This does not necessarily mean that they should be vernacular or traditional, given that typological, morphological and technical-constructive solutions evolve over time as new requirements emerge and new materials and new building systems are introduced. We must also take into account on the fact that the use (and waste) of energy does not only depend on the use of the individual buildings and their systems, but often on the way in which these have been designed and arranged in relation to each other. For example, the layout of a building on the land, its position in relation to the prevailing winds, the path of the sun and the reciprocal relationship with other surrounding buildings can prevent the sunlight needed from reaching it, creating barriers to hot winds and vice versa channelling the cold winds, leading to an inefficient use of energy. It is very rare that building regulations or urban-building standards for the implementation of planning regulations contain directives aimed at ensuring environmental conditions which are conducive to energy saving for temperature regulations.

Therefore, urban planning policies that are sensitive to reducing energy consumption and comfort, related to the use of the spaces within a city, must be based on a bioclimatic approach, which aims to simultaneously control three interconnected levels: environmental-climatic, typological and

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technical-constructive which, if studied in sufficient detail, can provide the following information:

- with regards to the control of aspects relating to the relationship between a building and the environment, planning and architecture (especially that related to temperate climates) have always had to deal with a climate characterized by significant seasonal changes (temperature, humidity, wind, solar radiation) which therefore encourages and imposes solutions capable of adapting to these seasonal variations. In addition to the climate, individual buildings must also respond to the microclimate of the area, i.e. the specific features of individual sites also in relation to the shape of the urban constructions or landscape (which influence, and sometimes change, the typical climatic conditions such as temperature, humidity, wind speed and solar radiation, distinguishing a single context with local conditions).
- with regards to the control of the typological aspects, buildings must be characterized by a search for balance between a compact form in winter (based on the more advantageous ratio between surface and volume in relation to heat loss) and a more open form in the summer (based on the possibility of favouring natural ventilation), with "open-closed" structured spaces for winter/summer use (porches, balconies, patios, filter spaces). For example, the typical Mediterranean building is a home with a patio, compact but "porous" (Olgyay, 1998). The in-line or terraced type house is equally effective, allowing compactness to be favoured (seen as support-type housing), but also to identify two preferable exposures, namely south facing (so that sunlight can be exploited in the winter months) and north facing (to have a "cool" side in the summer triggering the natural ventilation throughout the building).
- for the control of the technical-constructive aspects, an urban structure must be characterized by the passive use of energy thanks to the exploitation of sunlight both directly (windows) or indirectly (heat storage units) and by the presence of an adequate capacitive mass (and thermal inertia) to retain heat and mitigate temperature peaks (reducing and off-setting the introduction of the thermal wave) in the summer. Therefore, building orientation, building shape and cladding characteristics are the aspects on which designers should focus more carefully. A building which exploits the characteristics surrounding it is defined as "passive", which should be distinguished from those buildings which artificially (and therefore "actively") construct comfort within the rooms (not to be confused with the term "*passivhaus*", which refers to an energy standard). A passive urban structure combines the ability to use favourable climatic factors (capturing solar energy in winter, directing air flows in the summer) with the ability to maintain favourable conditions (storing heat in winter and night-time cold in summer) and hamper unfavourable conditions without resorting to costly and energy-intensive additions to the system.

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It is therefore the designer and/or planner who, on different levels, who is called upon to deal with the issues related to the regulations, the shape of the urban structures, the orientation of the buildings, the cladding and systems, and therefore work towards reducing energy consumption and ensuring suitable living comfort.

Therefore, designing buildings today, with a climate which is changing constantly, means understanding the reasons related to the microclimate, resources and local materials. Planning in these geographical areas does not require a strict adherence to architectural shapes of traditional buildings, but rather an innovative reinterpretation of the reasons which have "naturally" driven construction for centuries.

Bibliography

Alberti, M., Solera, G., & Tsesti, V. (1994). La città sostenibile. Analisi, scenari e proposte per un'ecologia urbana in Europa, Franco Angeli, Milano.

Bai, X. M. (2007). Integrating global concerns into urban management: The scale and readiness arguments. *Journal of Industrial Ecology, 22*, 15–30.

Baynes, T., & Bai, X. M. (2009). Trajectories of change: Melbourne's population, urban development, energy supply and use 1960–2006 (GEA Working Paper).

Butera, F. M. (2004). Dalla caverna alla casa ecologica. Storia del comfort e dell'energia, Edizioni Ambiente, Milano.

Foley, J. A., & DeFries, R., et al. (2005). Global consequences of land use. *Science, 309*(5734), 570–574.

IPCC. (2007). *Summary for policymakers, climate change 2007: Synthesis report.* In S. Solomon, et al. (Eds.). Cambridge: Cambridge University Press.

IPCC. (2012). *Managing the risks of extreme events and disaster to advance climate change adaptation. Special Report.* In C. B. Field et al. (Eds.). Cambridge: Cambridge University Press.

Jenks, M., & Burgess, R. (Eds.). (2000). *Compact cities. Sustainable urban forms for developing countries*. London: Spon Press, Taylor and Francis Group.

Oke, T. R. (2006). Towards better scientific communication in urban climate. *Theorical and applied Climatology, 84*, 179–190.

Olgyay, V. (1998). Arquitectura y Clima. Manual de diseño bioclimático para arquitectos y urbanistas. Barcellona: Gustavo Gili.

London: Spon Press, Taylor and Francis Group.

Williams, K., Burton, E., & Jenks, M. (2000). Achieving sustainable urban form.

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