PROJECT: VERGE, STÄDTISCHE VERDICHTUNG UND ENERGIE VERHALTEN DER BESTEHENDEN GEBÄUDE

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INTRODUCTION

Urban densification process could be a positive example of sustainability and as a parameter of an environmentally and socially sustainable development, nowadays it is a very common discussion topic and matter of research [1]. In Switzerland and other EU countries, this concept has been supported and emphasized through strategies and regulations at a national and federal level [2]. However, some aspects regarding solar rights [3] and especially the possible impacts to the cultural heritage existing in the area drastically modified by the densification process, has not been fully taken into account yet. Dense and compact urban settlements provide a complex environment, where solar access and daylight availability can become a scarce commodity with also implications in the urban microclimate. This is mainly related to the complex dynamic shadowing effects on building surfaces as a consequence of modifying the sky factor when the number of high-rise buildings increases. The need to accurately quantifying these effects is a key factor for predicting reductions in solar availability for solar gains, renewable energy or daylighting. In this development process, special cases are the cultural protected monuments, unchanged and immutable through time, protected by the regulatory plans and bounded by preservation needs and constraints that cannot benefit from a rapid urban development. At this point it is necessary to wonder for the impact of this urban transformation and about the real influence on building energy aspects (especially historical heritage) and their surrounding micro-climate. Moreover the impact on solar energy availability on existing buildings (in particular historical buildings) during urban transformation is not yet well understood and is a matter of research. This reason also motivates the recent decision of the International Energy Agency (IEA Solar Heating and Cooling programme) to set up a working group on “Solar energy in urban planning” aimed at monitoring progresses in such issues, proving the innovation of our research. [4]

VerGe project: The case studio of Lugano Paradiso

The VerGe project “Städtische Verdichtung und Energie Verhalten der Bestehenden Gebäude” [5-9], investigated how urban modifications, in particular urban densification policies, can influence the energy demand and the solar availability of pre-existing buildings. The research presents the case study of Paradiso municipality, part of Lugano's settlement, in Tessin, Switerzland. It is a district that is undergoing a very fast urban densification process, by changing the open urban sprawl towards infill with closed and compact urban fabrics, as defined in the new master plan regulation (Figure 1). This case study has been used to understand and quantify the energy impacts of the future urban development on the existing protected building in the area (Figure 2). For this reason different key factors, such as the reduction of solar irradiation and potential for solar passive strategies, daylighting and sky view factor reduction, the energy demand and human comfort modifications, have been analyzed also considering the solar potential and the visual effects of the possible integration of renewable energy sources in the area. A constant discussion with stakeholders, municipalities and international experts has been settled since the beginning of the project in order to monitor the achievements and results on each stage of the research process.

The process go through a careful analysis of the important parameters affecting both the preservation and the energy demand of the historical protected buildings identified in this area in order to investigate the impact of the different urban densification scenarios for the refinement of new urban solutions on a conceptual mode. To investigate these aspects simulation tools and photographic diagnosis analysis have been used. Based on this initial insight, the project recognize, understand and investigate different urban densification scenarios (current and future urban status), working with the massing of the buildings, in order to identify and propose simple methods to assess solar radiation, daylighting availability, human comfort and Sky-View Factor (SVF) modifications using a combination of numerical methods, 3D simulations programs with photo processing image methods (Figure 3).

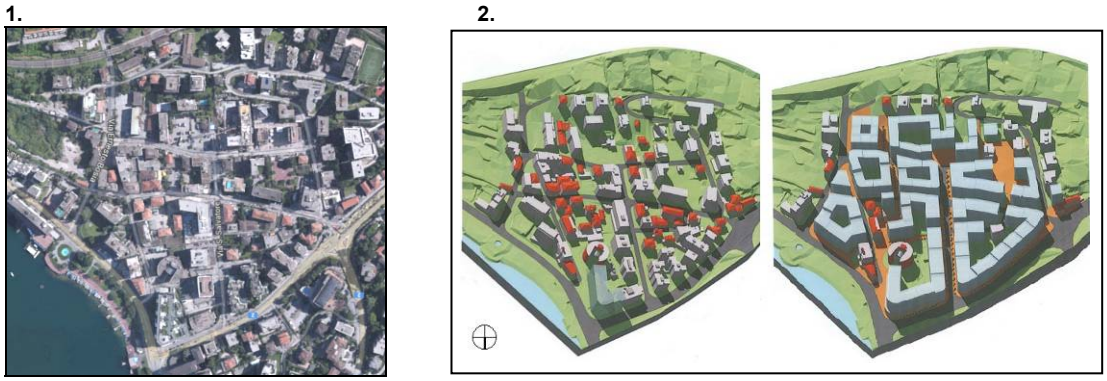

Figure 1: Lugano Paradiso development, actual urban configuration and new Master plan regulation (2013). (Photo source: 1) Google Earth; 2) Courtesy of Paradiso municipality and Planidea SA, December 2014).

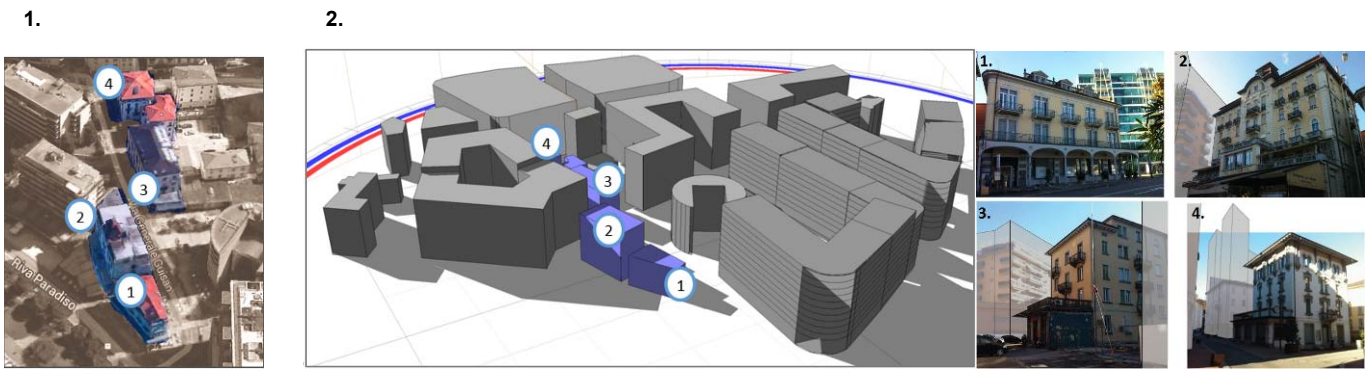

Figure 2: Case Study: Paradiso, Lugano, (CH) urban transformation towards densification: 1) current status; 2) 3D simulation, future status when new master plan will be fully implemented. The blue buildings and numbers (1-4) are the existing cultural monuments protected in the area (Building 1: Palace Riva Paradiso, A4905; Building 2: Hotel Victoria, A4906; Building 3: Palace Geretta street, A4907; Building 4: Posthotel Simplon, A4908). Source: Polo López C. S. ISAAC-SUPSI [2]

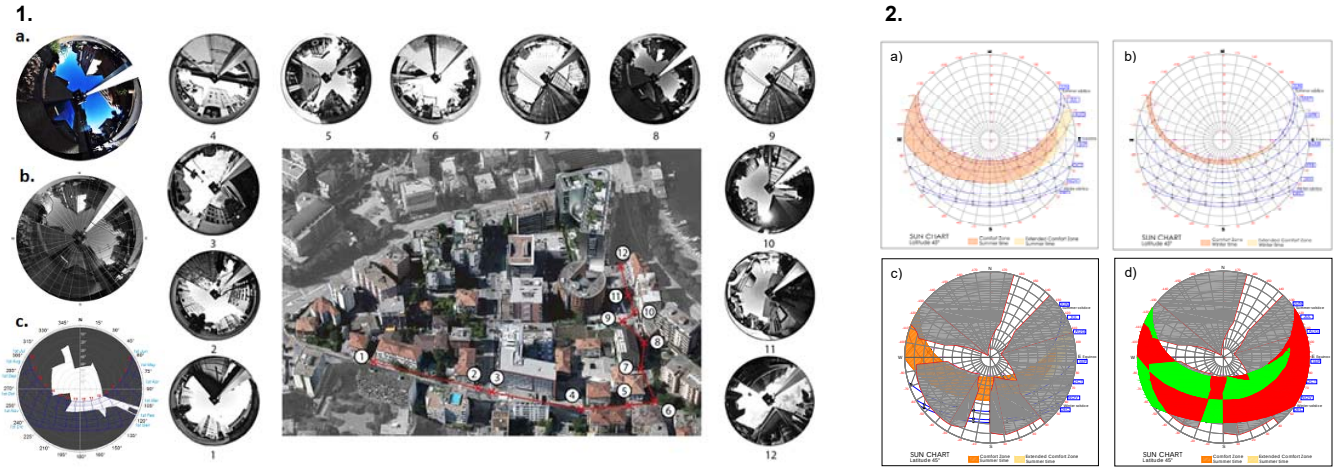

Figure 3: Simulation tools and photographic diagnosis analysis: 1) Sky-factor assessment through photographic method, different steps in the image processing: (a) Image modification in HDR format; (b) Image for the actual situation; (c) and software simulation for a possible design scenario; 2) Comfort zone calculated and represented in the solar polar sun-path diagram (stereographic projection) for Lugano area. Source: Polo López C. S. ISAAC-SUPSI [2]

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