

POLITECNICO DI TORINO
FIRST SCHOOL OF ARCHITECTURE
Master of Science in Architecture Construction City
Honors theses

Affordable housing. Principles, tools and sustainability certification systems

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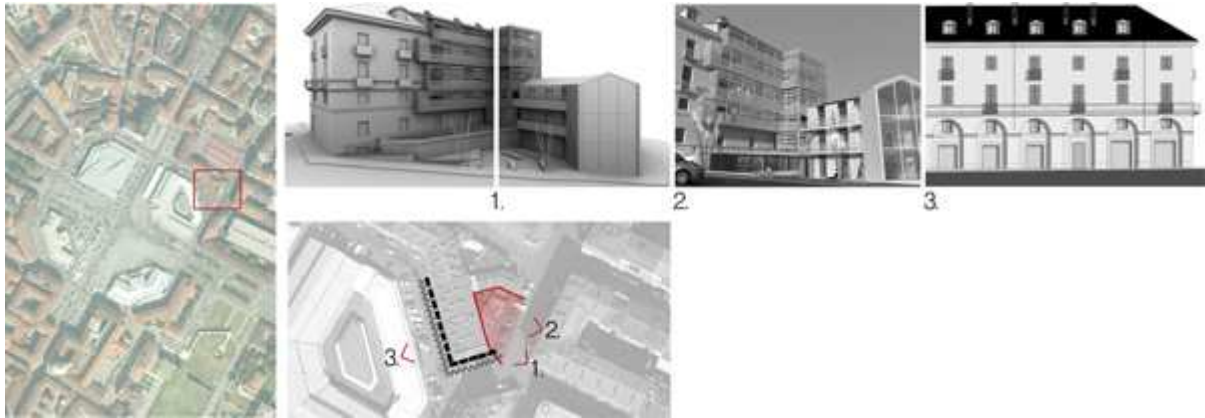
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The demand. Over the last few years general rise in housing prices and relatively small growth of family income made increasing segments of the population unable to satisfy their housing demand on the market. A more widespread housing stress is affecting lower-middle classes in addition to the “traditional” poverty, due to the drastic contraction in the purchasing power experienced by families in a context of economic recession.

The offer. Italian public policies reduce their provision of housing to the most deprived social segments eligible for Public Housing (Edilizia Residenziale Pubblica - ERP). The only response to the housing demand of medium-to-low income groups, unable to afford market rates but who do not fulfil the strict conditions requested by ERP allowances, is represented by synergies driven by public and private partnership.

The project. The architect acts between the housing demand and supply side. In light of a greater awareness of new housing needs, economic limits and an increasing concern for the environment come into play. Stimulating challenges catalyse renewed interest to the “house” topic, and financial straits intrinsic in affordable housing lead to rediscovering the hard mediation between quality, costs and benefits of a design choice. New parameters and landmarks become key factors in order to define an integrated approach to design: sustainability certification systems represent new guide lines to ensure high quality standards.

The guide. Sustainability concept requires the conciliation of environmental, social and economic domains – the so called “triple bottom line”. Voluntary certification systems have been introduced aiming to control these three variables, each one characterised by specific problems. At state of the art main rating systems on the market deepen energetic issues neglecting social aspects. In light of these consideration, two different rating systems – *LEED Italia for New Construction and Renovations 2009* and *ITACA Synthetic Protocol 2009 Piedmont* – have been applied to evaluate the renovation of a building that will become an affordable Temporary Residence in Turin - piazza della Repubblica 14.



The case study

The performance. According to ITACA rating, the case study performs an acceptable improvement over the current practice. On the other hand LEED performances are not enough to achieve certification. With the purpose of getting the extra-points propaedeutic to reach LEED minimum certified level, a different calculation method has been implemented to satisfy LEED Credit Energy and Atmosphere (EA-1): *Optimize Energy Performance*. Instead of documenting the energy performance in compliance with prescriptive measures (1-3 points), the selected path is a dynamic energy simulation (1-19 points). Based on the Appendix G of ANSI/ASHRAE/IESNA Standard 90.1-2007 – *Performance Rating Method*, it requires to quantify the energy percentage improvement over a baseline building performance.

Tipo	Proposed building		Baseline building		Percentage improvement	
	Source energy [kWh]	Energy cost [€/year]	Source energy [kWh]	Energy cost [€/year]	Energy [%]	Cost [%]
Electricity	585,017	€ 45,747	554,415	€ 43,354	-6%	-6%
Natural gas	132,204	€ 10,576	259,752	€ 20,780	49%	49%
Total non-renewable	717,221	€ 56,323	814,167	€ 64,134	12%	12%
	Proposed building		Baseline building			
Solar thermal system	17,256	€ 1,380				
PV system	5,000	€ 850				
Total	694,965	€ 54,092	814,167	€ 64,134	15%	16%
Total per conditioned area	322	€ 25	377	€ 30		

Proposed Building Performance

 Baseline Building Performance

Performance Rating Method outcomes. According to the whole building energy simulation, carried out by means of the EnergyPlus code, the yearly energy savings of the proposed design amount to 15% compared to the baseline building performance. The case study gathers 4 LEED EA-1 points

The trade-off. As known, energy efficiency measures are set with a view to cost-effectiveness, which lies in the cost-optimal balance between the investments allocated and the energy costs saved throughout the whole lifespan of the building. A better LEED or ITACA ranking is not necessarily correlated with cost feasibility: in order to assess this trade-off, alternative energy-saving envelope technologies and increasing on-site renewable energy self-supply have been estimated by means of energetic and economic evaluation to define the relationship between construction costs and best rankings achievable by the case study.



Assessment of the extra-cost required to reach the case study LEED Silver ranking

The proposal. In affordable housing built aspects represent merely one of the elements within an holistic integrated approach where the project is not a simple sum of its parts but an organic whole where each part is strictly connected to the others. These suggestions converge towards the virtual section of a rating system more oriented to the social dimension of sustainability.

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