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From an unfinished subdivision to a place for an Energy Community in Terrasini, Palermo, Italy

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Abstract. This thesis consists of a design exercise in which the subject is a residential lot located in Terrasini, Palermo, Italy originally intended for government-funded residential buildings, whose construction has remained partially unfinished. For this lot, which has been in a state of neglect for about ten years, the project envisages the completion of the buildings (maintaining their original residential use) and the redevelopment of the whole district, generating communal spaces and services, in order to create an "Energy Community". The choice of this theme was dictated by the awareness of the need for a timely action to concretely stem the effects of climate change as the architectural project can play a crucial role in the change in production models that is necessary to achieve true sustainability. For this reason, the intervention on this abandoned, unfinished lot is conceived as a test bed for the "energy community" paradigm, still scarcely known in Italy [1], as a potential engine of renewal and information tool for users about the need to take an active and conscious part in the energy transition. The project takes place within an agreement between the Palermo Department of Architecture and the Municipality of Terrasini, with Arch. Ph.D. Maria Luisa Germana, Full Professor of Architectural Technology at Università di Palermo, serving as scientific director and promoter, which brought to the production of three master's degree theses in Architecture before.

Keywords: Energy Community / exoskeleton / renewable energy / retrofit

1 Objective

The main objectives of the design concern the completion of the unfinished buildings and the redevelopment of the area (Fig. 1), through the inclusion of vegetation and community services, without occupying any more unused land For over a decade, DARCH UNIPA has been actively researching on unfinished architecture, within the field of technological architectural design [1, 2, 3]. The project also pursues the goal of making the area a 'manifesto' of the "energy community" model (Fig. 2), through design solutions aimed at maximizing the environmental and economic sustainability of the intervention [4], but also by incorporating exhibition spaces (Fig. 3) that, as part of a broader cultural path, could spread awareness about sustainable energy among the local community and visitors.

2 Content of the thesis

The report accompanying the sheets opens with an introduction to the concept of "energy communities", introduced in Italian legislation shortly before the thesis was developed [5], illustrating its potential through the analysis of a selection of case studies in Italy [6, 7] and worldwide [8, 9]. The definition of the Energy Community model can be briefly summarized as the possibility to share, among a community of users, the energy produced on site from renewable sources [10]. However, this transcends the limits of simply being a technical model relating to the production of energy on site, assuming instead an active involvement of citizens, with a preliminary accurate recognition of the needs and interests of all the involved subjects, starting from the end users, up to local authorities and energy service providers, with the aim of a synergistic multiscale action, to achieve economic, environmental and social sustainability.

The second part introduces the 11 000 m^2 project area, framing its current state, that presents two unfinished buildings (buildings A and B), the foundations of a third one that was never built (Building C) and neglected urban infrastructures.

Finally, the third part focuses on design solutions defined through the analyses that were carried out within the thesis.

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Fig. 1. General overlook of the project area. The 11 000 m^2 project area is located in the municipality of Terrasini, about 35 km west of Palermo. The renders above show an overlook at different scales of the public residential plan that was left unfinished and has been in a state of neglect for over 10 years.

Fig. 2. Render showing part of the area, with building A and B, before and after the proposed project.

Fig. 3. Renders of the redeveloped green area with exhibition spaces.

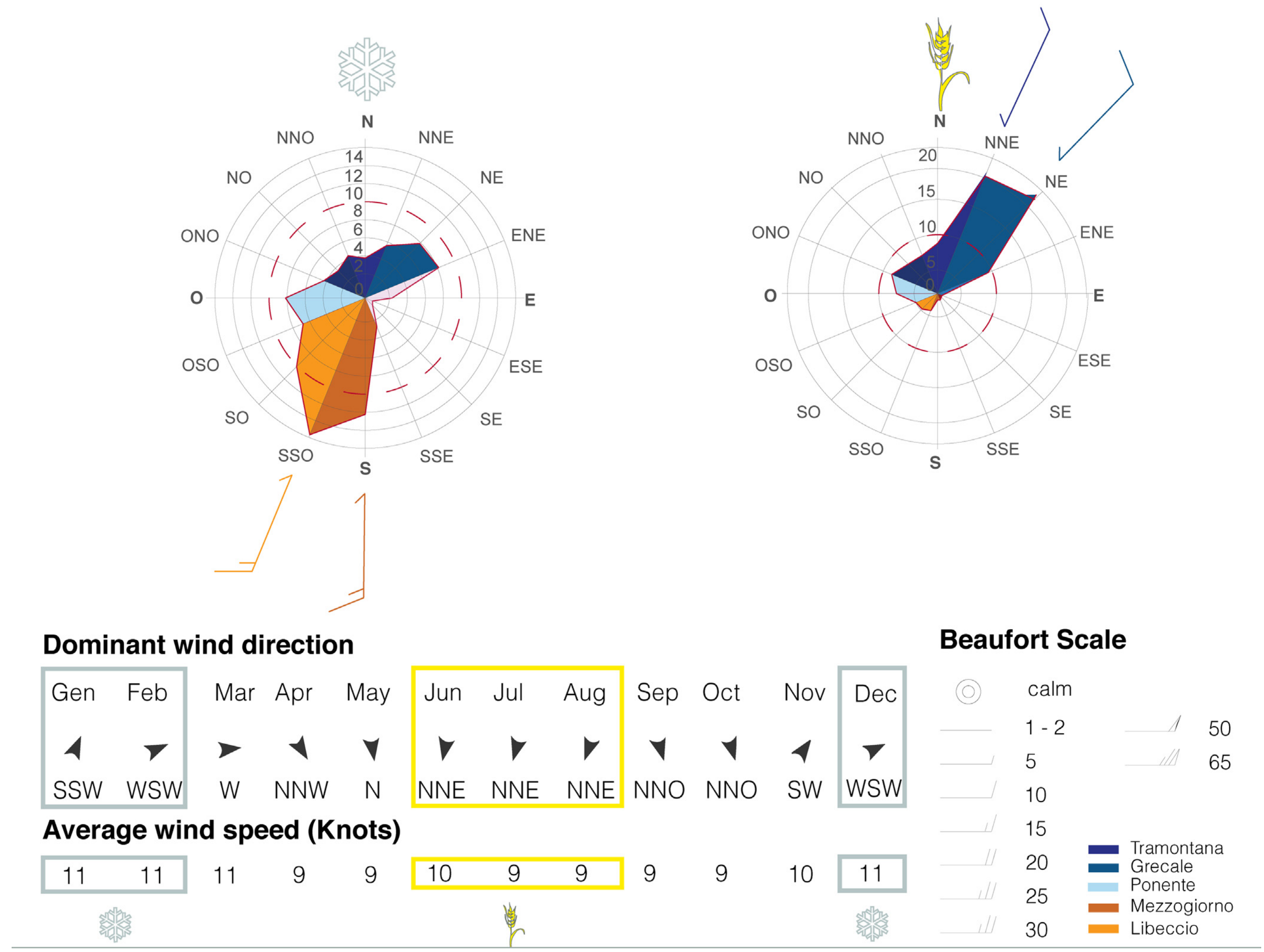

Fig. 4. Example of acquired wind analysis data.

3 Methodology

The systemic approach to the architectural project scale is conceived in a bioclimatic key [11], providing passive solutions that minimize the use of energy-intensive systems for cooling, ventilation, heating and lighting, aiming at the integration of renewable energy sources in the design of the building envelope and arrangement of outdoor spaces, within a multiscale approach that involves both the whole district and individual buildings. The design methodology is therefore necessarily preceded by a preliminary analytical phase relating to anthropic and environmental contextual aspects at different scales. Therefore, statistics relating to prevailing winds and breezes for the project area were investigated, acquiring data from the nearest weather station, located in the Municipality of Cinisi, in the locality of Punta Raisi, within the perimeter of the Falcone-Borsellino airport. This station is located about 3 km away from the project area, at the same altitude and without any noteworthy obstacle. These premises allowed us to assimilate the obtained data to the conditions on the intervention site. The methodology consists in evaluating the direction, probability and intensity of the dominant wind in the three months adopted as a reference for the winter season, and in doing the same for three reference months for the summer season [12]. We have chosen to adopt a threshold value of 10% probability, above which winds are taken into account (Fig. 4). The acquired data were used to determine how to improve passive ventilation, especially during summer months.

Another important phase of the site analysis is the study of the solar path, determined by the geographical coordinates of the site, which plays a fundamental role in evaluating the amount of solar radiation absorbed by the surfaces of buildings, in addition to quality and amount of natural light available during each season. We obtained the polar diagram from the Sunearthtools.com website, relative to the geographic coordinates of the project site, containing the projection of the solar path on the celestial vault for each month of the year. Then, the existing buildings were analyzed through computer simulations (Fig. 5) to determine which facades would need shielding

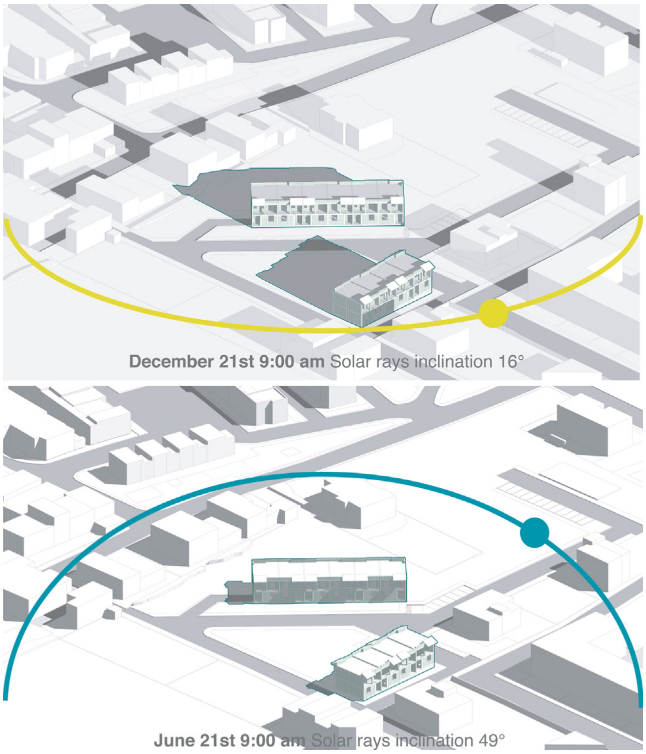

Fig. 5. Example of how the acquired sun path data were used to simulate the conditions at the project site during different seasons.

Fig. 6. Active exoskeleton with photovoltaic glass panels and green shielding on building B.

Fig. 7. Passive exoskeleton with green wind-walls made with deciduous climber plants.

from excessive solar gain and the orientation that would be most suitable for the integration of photovoltaic panels, also taking into account shadows generated from the surrounding environment throughout the year.

The collected data were used as part of a bioclimatic intervention [13], to achieve optimal technological quality of the completed buildings on the architectural scale. The goals of the project are pursued through the implementation of an exoskeleton [14] with a self-supporting structure in galvanized steel, the application of which was designed through the analysis of environmental variables at the site coordinates. To adapt to different purposes on differently exposed facades of the existing buildings, these integrated structures were differentiated as two variants of active or passive exoskeleton [15]. The first one (Fig. 6), on facades facing south, designed to perform at the same time as a shield and to integrate semi-transparent photovoltaic panels and modular green panels, to allow the growth of climbing plants raised from the ground. The second type of exoskeleton (Fig. 7) was conceived to incorporate wind-walls where necessary (Fig. 8), to capture cool summer winds and improve passive ventilation during the hottest months. Both kinds of exoskeleton provide new living spaces, as a buffer between private and public areas.

4 Accomplished results

The implemented design solutions aim towards the hypothesis of a micro-district/energy community in continuity with the existing urban fabric (Fig. 9), which integrates services, residences, cultural and recreational

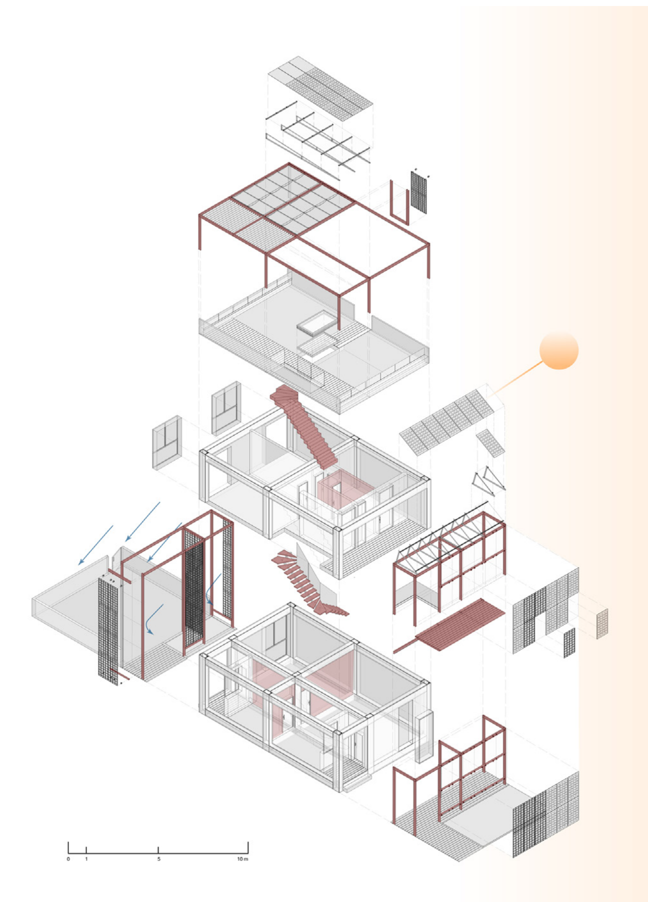

Fig. 8. Exploded axonometric showing one living unit, with both active and passive exoskeleton.

Fig. 9. Volumetric masterplan, area section, cultural path.

infrastructures as a model of sustainable settlement principle for the future, which brings electricity production from a centralized model to one that spreads across the territory and is managed by the consumers themselves.

Assuming an average producibility of $1000\,\mathrm{kW/h\,m^2}$ (compared to a real average of about $1600\,\mathrm{kW/h\,m^2}$ for the site coordinates), and according to a rough estimate, the panels integrated in the buildings and urban furniture produce an average of 79 000 kWh per year, sufficient to cover the energy needs of about 25 homes, as opposed to the 10 involved in this thesis project area. This allows us to hypothesize the application of a well-established protocol in other European countries, that's to say the possibility for the final user to take part in the change of production models without actually having to install any new system in their home, but simply by entering into a contract.

The proposed solutions for the buildings are incorporated within a new layout of the appurtenant external spaces, integrated with the public areas (Fig.10), for whose connection with relevant points of the urban context around the intervention area is proposed through differentiated routes.

Starting from the nearby Natural History Museum located inside Palazzo d'Aumale, an educational trail is planned to lead the visitor to the Energy Community, through a series of installations and interactive banners aimed at attracting the visitor and guiding them through the fishing village to end the route in a perspective escape that culminates at the entrance to the new green area (Figs. 11 and 12), with outdoor exhibition spaces. The intent is to transform the district into an open venue to host events of various kinds, as a part of a broader museum and cultural itinerary. The banners and interactive panels will also display real-time data from *worldometer.com* about the world's energy balance, including days remaining before the planet's resources of fossil fuels will run out, with the intent of letting the visitor know how finite these amounts are, and other data to stimulate participation in the energy transition.

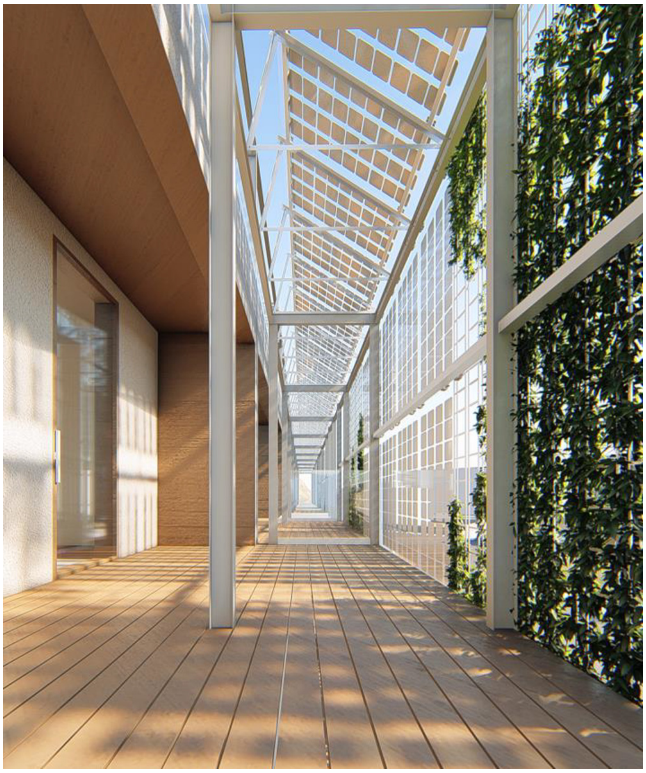

Fig. 10. New living spaces created between the added exoskeleton and the existing buildings.

Fig. 11. Renders of the redeveloped green area, with exhibition spaces.

Fig. 12. Communal spaces and outdoor gym.

5 Conclusions

The thesis illustrates that the adoption of the "energy community" model, as a paradigm for the redevelopment of unfinished architectural artifacts and abandoned areas, offers the opportunity to combine the targets of environmental and economic sustainability with the recovery of the existing. In addition, by focusing our attention on the role of citizens, who are often unaware of the importance of the environmental issues, benefits can be achieved, ranging from economic savings, environmental protection, up to the revitalization of the socio-economic fabric. This project was aimed at reaching these goals, integrating design solutions for bioclimatic comfort and, at the same time, promoting a cultural message of awareness of *sustainability.*

References

[1]. GDF Suez Italia, in collaboration with Politecnico di Milano,. Energy Community: Un nuovo, paradigma per l'innovazione energetica nel nostro paese, Final report of GDF Suez observatory, 2014

2. M.L. Germanà, F. Anania, Unfinished buildings. A new point of departure. Designing difference for a sustainable future in *Agathón - International Journal of Architecture, Art and Design*, 2020, pp. 148–159
3. M.L. Germanà, The suspended time of the interrupted process: beyond repression, a future for unfinished buildings, in *Techne. Journal of Technology for Architecture and Environment*, n. 20/2020, numero monografico, Tempo e Architettura, 2020, pp. 89–97
4. V. Olgyay, Design with Climate: Bioclimatic Approach to Architectural Regionalism, Princeton University Press, New Jersey, USA, 2015
5. Autorità di Regolazione per Energia Reti e Ambiente, Documento per la consultazione 112/2020/R/EEL, 2020
6. Agenzia Nazionale per le nuove tecnologie, l'energia e lo sviluppo economico, in collaborazione con il Consiglio Nazionale delle Ricerche, Decarbonizzazione dell'economia Italiana, Laboratorio tecnografico ENEA, Frascati, Italy, 2017
7. L. Tavazzi, P. Parma, Lo sviluppo delle Energy Community in italia e le implicazioni strategiche per il sistema paese, City Life Mag. **22**, 12–20 (2014)
8. J. Roberts, F. Bodman, R. Rybski, Community Power: Model Legal Frameworks for Citizen-owned Renewable Energy, ClientEarth, London, UK, 2014

9. D. Clark, M. Chadwick, The Rough Guide to Community Energy, Rough Guides ltd, London, UK, 2011
10. M. Grosso, Ventilazione naturale e raffrescamento passivo ventilativo negli edifici Corso Sostenibilità ambientale, eco-efficenza ed eco-compatibiità: azioni di sostegno e qualificazione per operatori del settore, Laboratori sperimentali e diffusione buone pratiche. Fase 1 Modena, Italy, 2006
11. M.L. Germanà, Architettura responsabile – Gli strumenti della tecnologia, Dario Flaccovio Editore, Palermo, Italy, 2005
12. M. L. Germanà, S. Vattano, A. Tavolante, Air movement representation as a tool for urban and architectural environmental quality, in *Burlando M. et al. (cur.) Proceedings International Conference on Urban Comfort and Environmental Quality URBANCEQ 28–29 September 2017, Genova University Press*, 2017, pp. 76–85
13. F. Guidolin, Dal facade refurbishment al sistema esoscheletro, CasaClima **04**, 12–26 (2013)
14. F. Guidolin, Sustainability and Innovation for the Future the Exoskeleton System as a Socio-technical Device. Coupling Technical Devices and Social Involvement in The Rehabilitation Process, contribution at 41st IAHS World Congress, Sustainability and Innovation for the Future, Albufeira, Algarve, Portugal, 2016
15. Insight_E, Energy poverty and vulnerable consumers in the energy sector across the EU: analysis of policies and measures, Think Tank of the EU Committee, 2015

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