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Lone Feifer · Marco Imperadori
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Active House: Smart Nearly Zero Energy Buildings



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Lone Feifer
Active House Alliance
Brussels
Belgium

Marco Imperadori
Department of ABC
Politecnico di Milano
Milan
Italy

Graziano Salvalai
Department of ABC
Politecnico di Milano
Milan
Italy

Arianna Brambilla
School of Architecture,
Design and Planning
University of Sydney
Sydney, NSW
Australia

Federica Brunone
Department of ABC
Politecnico di Milano
Milan
Italy

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Preface

After some years of presence in the Active House (AH) Alliance, being the only professor representing Politecnico di Milano and also the Mediterranean climatic zones, I decided to propose this book in order to fix a milestone after previous years of activities and evolution and also to show the direct approach that my team has given to AH in the South European climatic zone.

Lone Feifer, current General Secretary of the Alliance and also a great expert about innovative approaches to sustainability in the field of constructions, has immediately accepted with enthusiasm this challenge in order to share and spread in the Academic community all the best practices that AH has clearly collected in recent years.

Therefore, the book will show what an Active House is and why we should go “beyond” a passive approach and imagine that the buildings of the future, smart and innovative, are in many cases already existing.

“People first!” are the magic words that sustain this approach where three main domains are studied at the same time: Comfort, Energy, and Environment.

I would like to tell that for me, being also a designer since almost 25 years, “sustainability” has been always a key issue and a *conditio sine qua non* of every architecture. With AH approach, we could imagine that our goal is also “Planet Earth first!” where humans are part of a delicate eco-system. Designers, clients, developers, etc., should be harmoniously part of it because the place where they live and that they transform must have *empathy* and *equilibrium* instead of the classic approach of *extraction* and *consume*.

This is clearly a different philosophical approach where buildings, new or renovated, can be balanced with natural, renewable energies and become “concentrators-distributors” of energies instead of being aggressive consumers of ground and resources.

Will it work?

As a matter of fact, it is already working and the shown case studies—some of them on the market and some of them experimental—give a clear answer, different by climatic zone: different approaches from the *status quo* are possible, and a turning point, a change, has been set and the alliance, among designers,

institutions, industries, academies, is bringing new fresh air to the world of construction.

Architecture and aesthetic itself are very much sustained in AH where the environmental constraints are not penalizing the forms but the morphology and shapes are the result of a continuous and iterative process, which has a central role to give occupants comfort and respect natural resources.

So, reducing houses' impact on the Planet can be achieved without reducing our comfort.

Let's see how it works, be Active!

Milan, Italy

Marco Imperadori

Acknowledgements

This book is the result of an intense cooperation among researchers, architects, engineers, designers, and experts from Active House Alliance and Politecnico di Milano. We are glad and proud of this outcome, whose purpose was to witness years of activities and high-profile design practices, inspired by a holist approach for high energy efficiency, sustainability, and human well-being.

Our thanks go to Active House Alliance, its founding partners and its Advisory board: Grundfos, Verband Fenster + Fassade, Danish Technological University, VELUX Group, and Great Gulf Homes; Aalborg University, Reinberg Architects, and Cenergia. In particular, we especially appreciate the collaboration of designers and industrial partners for the data sharing of the selected case history.

In the end, we would like to acknowledge all the graduating students and trainees that have been involved in the analysis, development, and construction of the Active House prototypes of Politecnico di Milano.

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Chapter 1

What Is an Active House? A Vision Beyond 2020



Abstract International standards and constantly smarter practices are everyday more addressing the issue of a sustainable development. However, this virtuous approach has to involve the final users, in a newer and wider perspective: People First. This is the aim of the Active House Alliance, proposing a new vision for the future of the construction sector. Indoor comfort and occupants' wellbeing, energy efficiency and renewable sources exploitation, eco-friendly approaches are integrated into new guidelines and technical prescriptions, to help designers in developing the active buildings of the future.

Keywords Active house · People first · Guideline · AH specification
AH radar tool · Comfort · Energy · Environment

1.1 The Need for a New Perspective

What do Winston Churchill and Immanuel Kant have in common? They both offer us guidance for a new perspective on user-centric building design: *We shape our buildings; thereafter they shape us* said Churchill, and Kant's famous quote about reasoning: *All our knowledge begins with the senses, proceeds then to the understanding, and ends with reason* reminds us that buildings must be conceived as user centric. The question is: do we today design and evaluate buildings by how they function including users? Planners rarely get a chance to go back to a building after hand-over and learn from the users if their ideas worked in practice. Clients prescribe building programmes, yet how much knowledge do they possess about the building in operation?

The value of a building emerges through the user interaction and must be valued accordingly. The valuation should not primarily be by how it is taken apart after its service life, not primarily by how little energy is lost during the winter months, but primarily by its ability to support user health and wellbeing. Sensibility matters all year round—summer, spring, autumn, day and night.

This chapter is authored by Lone Feifer and Marco Imperadori.

Can we make sense of sensibility without turning it into rocket science? Are we able to monitor buildings in use, including the user component and flexible demands without an engineering exam and a costly investment?

Indeed, we can; tools, competences, approaches and principles are here today. We can programme daylight, thermal comfort, air quality and acoustics without compromising the energy demand and environmental footprint. The key is to make these parameters tangible and thus measurable.

The Active House approach to buildings is to create healthier and more comfortable lives for the occupants, while minimising the climate impact. The design DNA is recognizable in the three principles: Energy—Environment—Comfort. The first Active House ideas emerged in 2007, followed by the first round table, held in Copenhagen in 2009. Since then, 75 Active Houses around the globe have been tested in use, researched, and documented in more than 50 peer reviewed scientific papers. The combined results and feedback from users clearly prove that we today have the products, the technology and the competences needed to build energy efficient buildings that positively affect our personal health and wellbeing.

1.1.1 People First

In 2017, the Nobel Prize in Medicine went to three researchers who have done ground-breaking research on the circadian rhythm, the biological clock for living organisms, including humans. Previously well-known from jet lag situations, these scientific revelations just after the millennial turn have dramatically affected our understanding of human circadian rhythms and our approach to tangible attributes of buildings, e.g. design for daylight. The daylight passing through the eye is 90% used for vision, and 10% affects the ganglion cells and has a direct impact on our health and wellbeing. This ground-breaking research will define a new point of departure for how we think about, plan, use and in the end, value buildings.

We are today the indoor generation, who have only recently recognized the need to design buildings for people. It is crucial to stay curious and to apply an innovation-based mindset, where you learn from what did not work as expected. We must leave behind the prejudice that users are disturbing the engineering order and forecast of a building's performance, by making people the first priority. Put people first.

1.1.2 Active Beyond Passive

There has been an intensive focus on the energy dimension of buildings for years on end, perhaps since the energy-in-buildings awareness was brought to life in the early 1970s, with the oil crisis having brought about regulatory demands concerning energy for heating. The technical and calculative approach to building to address the issue of heating efficiency was pioneered by the forward-thinking PassiveHaus

pioneers. From the epicenter in the “LänderDreiEck” in the boundary area of Germany, Switzerland and Austria, they established an ideology about how good design with clever engineering tools, in combination with competent craftsmanship, could address the challenge of excessive heating demand in buildings. For decades the techniques and tools have been developed further and tested and evaluated in practice.

Nowadays, the need for visions focus always more on users rather than just on energy waste and its economy value is increasing. This is the core of Active House vision.

The Active House builds upon the knowledge and competences in the PassivHaus principles, making the next development step towards the user-centric focus. Still maximizing the use of passive technologies, such as natural ventilation, solar gains and quality craftsmanship, the Active House principle Comfort adds the sensory aspects of Daylight, Thermal Comfort and Air Quality. The Acoustic aspect is in the specifications, as well, as it is a very important aspect for completing the sensory approach of seeing, feeling, breathing and hearing.

Most importantly, the all seasons approach is introduced. Several regulatory approaches in Europe demand only specifications (buildings and components) for the winter season. However, on a cold winter day, a warm jacket is a good friend, but the jacket (a.k.a. the climate envelope) must be dynamic and flexible so that it can be adapted to suit the user’s needs over a whole year and be adjusted to different users’ tastes and desired temperatures.

The Active House concept places its gravity point at a combination of the human sensory, all seasons, and flexibility approaches. We must not fall for the temptation to make a one-eyed focus, on the altar of simplification. The professional competences, industrial products, and scientific proof are here today. We know that it is possible to build healthy buildings without compromising the energy demand or environmental footprint. We have moved on, and must keep looking ahead and develop further, building on the experiences of the past, while aiming at visions for the future.

We stand on the shoulders of giants, rather than behind them, so they do not block our line of vision to a holistic approach to sustainable building design.

1.2 The Alliance—A Global Conversation

In 2007 the first concept of how we could apply a holistic point of departure to the design of sustainable buildings was launched. In 2009, the first round table was held in Copenhagen, and the pioneer discussions mounted into the forming of a member-based alliance named the Active House Alliance in 2011.

The founding partners were: Grundfos, Verband Fenster+Fassade, Danish Technological University, VELUX Group, and Great Gulf Homes.

The first Advisory board: Aalborg University, Reinberg Architects, Great Gulf Homes, Grundfos, VELUX Group, Cenergia.

The first Board of directors: Hunter Douglas, 3h Architecture, VELUX Group, Verband Facade+Fenster, Danish Technological University, Jeld-Wen, FEMIB, Rockwool International.

Today the Alliance is a global partnership of more than 40 knowledge institutions, designers, engineers and industries and developers. The members have tested the Active House principles and specifications in full scale demonstration projects, more than 30 in 12 countries from 2009 to 17, and established an Active House label for the broad market on housing and smaller buildings (Fig. 1.1). Its borders are under an ongoing expansion, beyond Europe and towards other countries: two samples of Active House have been already validated in Canada (Chap. 5); in China, the Alliance's activities among industries and construction experts have started, and are giving the first results (Fig. 1.2), while the first dialogues are under development with the Australian institutions and stakeholders.

There have been a number of scientific studies into the Active House standard, including such areas as daylight design, the sociology of indoor comfort, and organizational partnerships for user-centered design. For example, Lara Anne Hale's Ph.D. dissertation entitled "Experimental Standards in Sustainability Transitions: Insights from the Building Sector" expounds her research on Active House in three articles, addressing: (1) the legitimation of comfort specifications in the building industry and among policy makers; (2) the awareness of sustainable design value brought to those who live in or work with Active Houses (Hale 2018); and (3) the need for user-centered design of technologies in smart buildings. According to Dr. Hale.

Active House is the next frontier in the built environment. Rising to challenges set forth in the United Nations Sustainable Development Goals, Active House presents sustainable building solutions that balance energy, environment and comfort, while centering design on the building users, us human beings. We as people have sustainability concerns, but we also deserve products and services that have taken our health and well-being into consideration. Such design innovations help us to orient our future visions to include social sustainability and interactive design and inspire people to take part in the shaping of their own future.

Today there are 75 Active Houses in 19 countries; 31 with radar, tested in use and 14 labelled projects (Fig. 1.3). The label was introduced in 2016. Verifiers of label passed diplomas in 2017.

There are seven national alliances, doubling the member crowd into a global community of partners who aim to scale sustainable cities—as per United Nations (UN) Sustainable Development Goal (SDG) 11 to make cities and human settlements inclusive, safe, resilient and sustainable, and via the SDG 17 for strengthening global partnerships for sustainable development (Fig. 1.4). Each member recognizes that together we can do more than we can do alone and achieve what otherwise can seem impossible, including:

- Multi-stakeholder partnerships that mobilize and share knowledge, expertise, technology and financial resources, to support the achievement of the sustainable development goals in all countries, in particular developing countries;
- Encouragement and promotion of effective public, public–private and civil society partnerships, building on the experience and re-sourcing strategies of partnerships.



Fig. 1.1 The Green Solution House is an example of Active House labelled projects; its design integrates Active House principles and applies Active House specifications, as shown by the Active House Radar of the project (Ph. Adam Mørk, AH Radar © Adam Mørk)