PassREg

Guideline and synthesis for Implementation of passive house requirements in municipal regulation for buildings (e.g. *Regolamento edilizio*)

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Content

Introduction

Passive house strategies and standard mean a clear set of quantitative requirements, which can lead design and construction activities to reach actual nearly zero energy buildings, proved by a complete quality control procedure and on-field tests. Many monitoring campaigns of energy and comfort performances of certified passive house all over the world demonstrate quantitatively the high performances and the very low energy demand, which passive houses really reach as estimated in the design phase. This made passive house requirements a very useful and important opportunity to be requested in local policy decision acts, local energy plans and building codes. Passive house requirements are clear, completed, quantitative and measurable, from technical point of view they can easily insert in local regulation documents, directly as they are or with intermediate steps.

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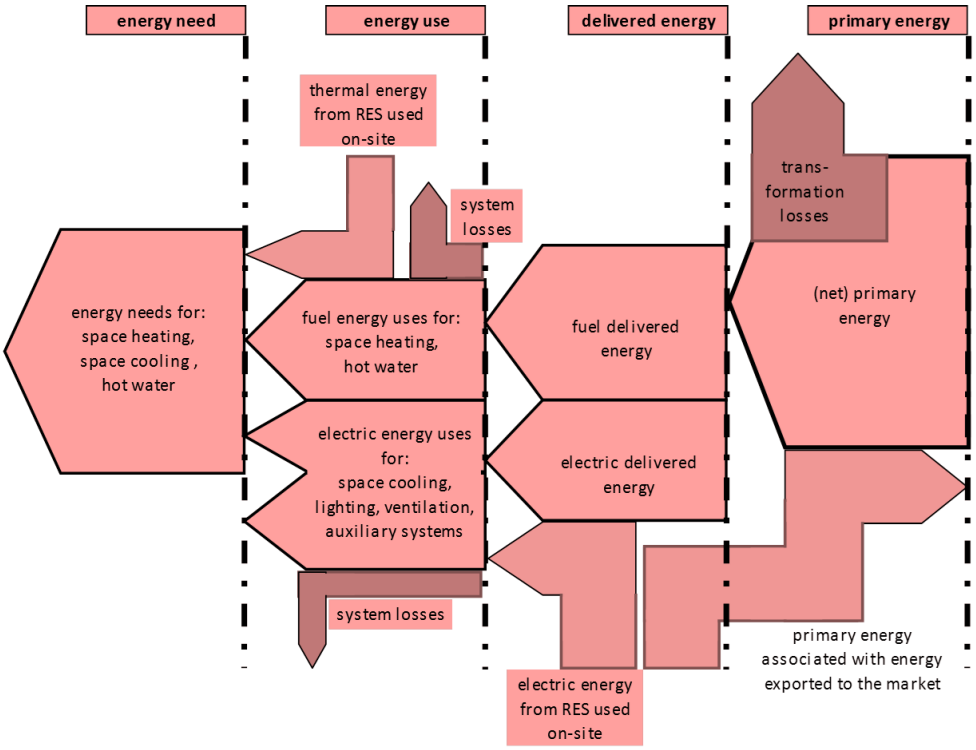
Technical requirements for Passive House targets

Passive house strategy is based on the following quantitative requirements on the energy and comfort performances of building. These are also closely linked to the technical features of building components and systems described below.

- **Energy need for heating**: the space heating energy demand is not to exceed 15 kWh per square meter of net living space (treated floor area) per year or 10 W per square meter for thermal power peak demand for space heating.
- **Energy need for cooling**: in climates where active cooling is needed, the space cooling energy demand requirement roughly matches the heat demand requirements above: ≤ 15 kWh/(m^2y), (with a slight additional allowance for dehumidification).
- The total **primary energy demand**, for all energy uses (heating, hot water and domestic electricity - all uses) must not exceed 120 kWh per square meter of treated floor area per year.
- A**irtightness** performance of the building envelope, a maximum of 0,6 air changes per hour at 50 Pascals pressure (n_{50}), as verified with an onsite pressure test (in both pressurized and depressurized states).
- **Thermal comfort** must be met for all living areas during winter as well as in summer, with not more than 10 % of the hours in a given year over a reference indoor temperature of 25 °C.

For these requirements, the following scheme on energy levels have to be kept in mind.



F. 1. Scheme on energy levels: energy needs, delivered energy and primary energy demand (according standard EN 15603).

All of the above criteria are achieved through intelligent design and implementation of the **5 Passive House principles**, which ask to have care in the design and construction phases to have

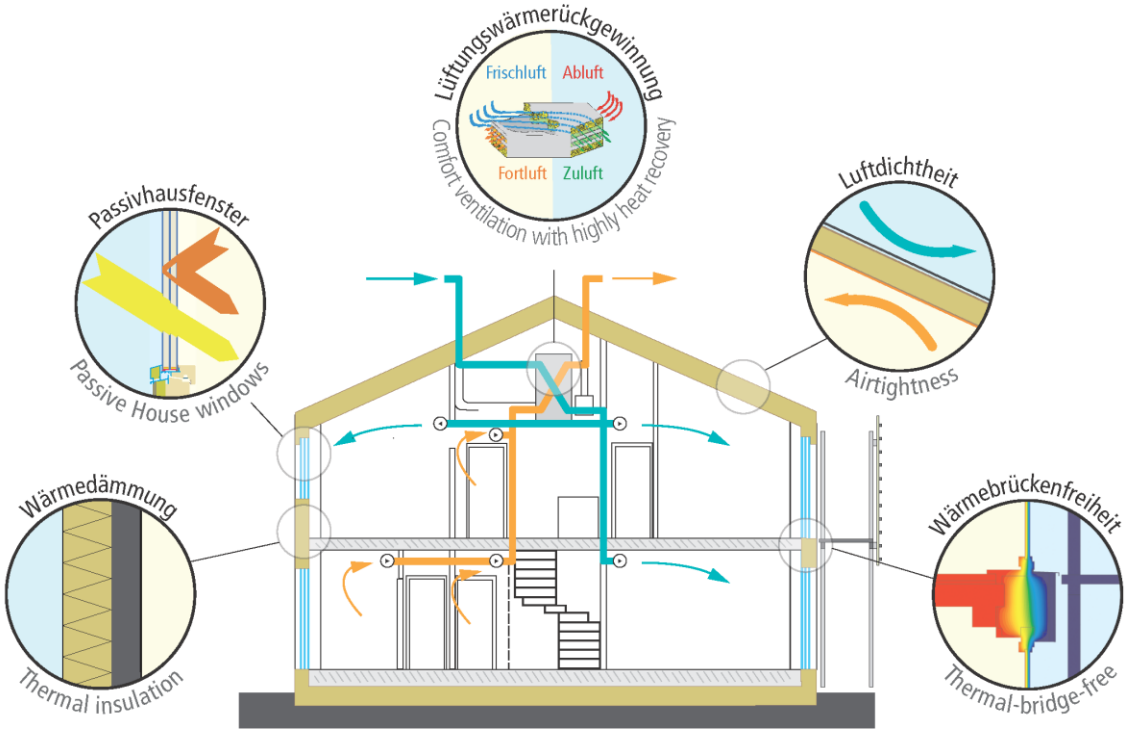
- thermal bridge free design
- windows with adequate thermal, visual and airtightness features
- ventilation systems with heat recovery
- quality insulation and airtight construction

In climates like Italian and in general Mediterranean ones, the following aspects are also important

- installation of external movable solar shading devices for the control of solar gains in warm seasons,
- adoption of nigh-time ventilation (natural and/or mechanical) to have benefits from free-cooling when outdoor temperatures allow it.

These principles can be also expressed as quantitative requirements with the values presented below and in the next page.

The following basic principles apply for the construction of Passive Houses:



F. 2. Schematic view of the 5 Passive House principles.

Thermal insulation

All opaque building components of the exterior envelope of the house must be very well-insulated. For most cool-temperate climates, this means a thermal transmittance (U-value) of 0,15 W/(m²K) or lower.

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Windows

The window frames must be well insulated and fitted with low-e glazings filled with argon or krypton to prevent heat transfer. For most cool-temperate climates, this means a U-value for the whole window (frames + glazings) of 0,80 W/(m²K) or less, with g-values around 50% (where g-value is the total solar transmittance, proportion of the solar energy available for the room).

Ventilation heat recovery

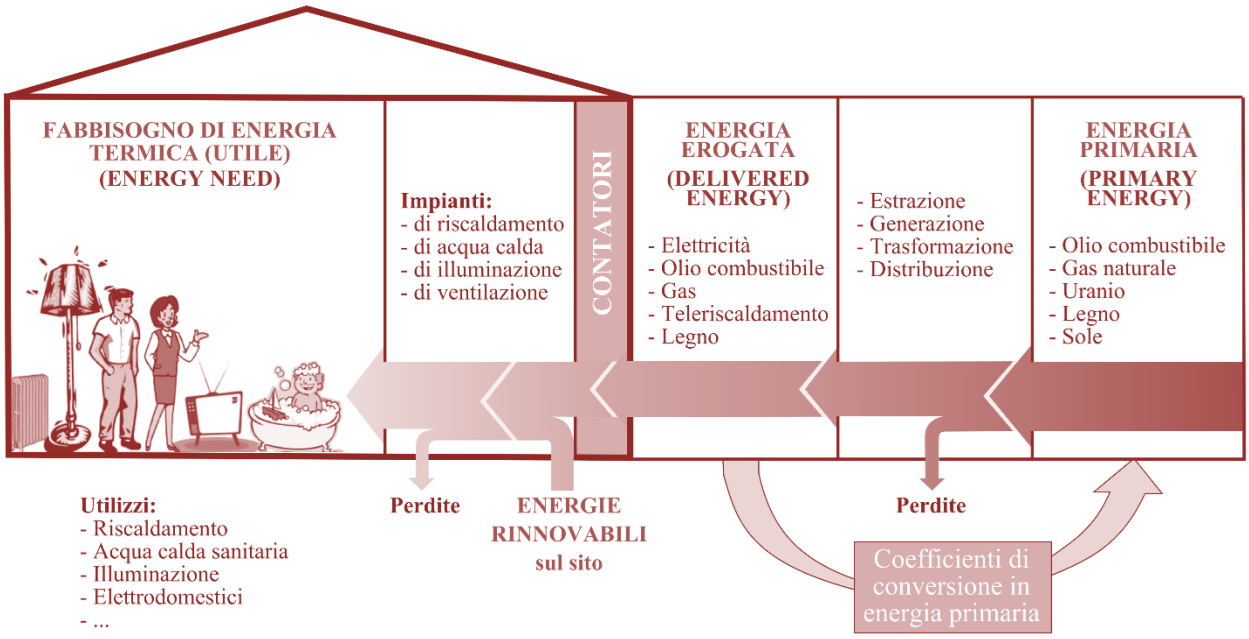
Efficient heat recovery ventilation is key, allowing for a good indoor air quality and saving energy. In Passive House, at least 75% of the heat from the exhaust air is transferred to the fresh air again by means of a heat exchanger.

Airtightness of the building

Uncontrolled leakage through gaps must be smaller than 0,6 of the total house volume per hour during a pressure test at 50 Pascal (both pressurised and depressurised).

Absence of thermal bridges

All edges, corners, connections and penetrations must be planned and executed with great care, so that thermal bridges can be avoided. Thermal bridges which cannot be avoided must be minimised as far as possible.



F. 3. Synthetic scheme on energy levels: energy needs, delivered energy and primary energy demand.

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Achieving the Passive House Standard in refurbishments of existing buildings is not always a realistic goal, for instance because one of the reasons being that basement walls remain as barely avoidable thermal bridges even after refurbishment.
For such buildings, the Passive House Institute has developed EnerPHit for certified energy retrofits with Passive House Components. This requires either a maximum energy need for heating of 25 kWh/(m²a) or alternatively the consistent use of Passive House components in accordance with the requirements for PHI certification of components and in general with quantitative performances we presented above.

More detailed references are available here at these links

- http://www.passiv.de/en/02_informations/02_passive-house-requirements/02_passive-house-requirements.htm
- http://passiv.de/en/03_certification/02_certification_buildings/02_certification_buildings.htm

Optimized opportunities for Renewable Energy Sources

Passive House principles can be the base for an **optimal integration** of renewable energy sources systems. Passive Houses have **very low energy demand**, which can be cover completely and in easier way by the on-site integration of RES systems.
So dimensions and components of RES systems can be optimized with an easier integration to reach the **nZEB targets**.
Passive House strategies allow to adopt the way indicated by the EPBD recast, which asks for "*energy efficiency first*" and then to cover the remaining small energy demand thank to on-site RESs.

In addition this lead to RES systems which are easier to manage and with more favourable interactions with grids. Thanks to lower energy needs for all uses, the match between the RES energy production and the energy demand can be managed in easier and better way.

In Italy the requirements for RES systems to produce electricity and thermal energy in buildings are expressed by the ***Legislative Decree n. 28 of 3rd March 2011*** (also called *Decree Romani*). This national regulation requires a certain amount of electricity produce by photovoltaic and percentages of thermal energy demand cover by RES systems both for new and renovated buildings. The Decree is quite interesting and require the installation of an amount of RES systems quite ambitious, which increases following steps in the next years.
Often local authorities, designers and experts recognized that the limits requested by the Decree are quite ambitious and difficult to be reached in practice, if we consider common buildings.

Adopting the Passive House approach and performances allows to reach in easier way the RES coverage percentages requested by the Decree, making it really feasible and improving the projects compliance with the regulation.

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Suitable tools

According the Passive House Standard, results and values of energy and comfort performances have to be calculated using the comprehensive energy balance calculation tool *PHPP - Passive House Planning Package* (http://passiv.de/en/04_phpp/04_phpp.htm), which is based on recognized calculation methods and standards, as mainly on the EN ISO 13790 and other relevant ones. In general to have a direct comparison is crucial to consider the energy levels represented in figures F. 1 and F. 3 (like energy need for heating and cooling, primary energy demand, etc.).
Further quality assurance procedures and tests can be seen in the checklist available here at this link:
http://www.passipedia.org/basics/passive_house_checklist .

Adaptation to the Mediterranean and other climate contexts

Consolidated studies and **successful examples** show that Passive House Standard can be successfully adopted also in Mediterranean climates, reaching high energy performance and indoor comfort conditions. High solar radiation and moderate average air temperatures help also **effective performances of renewables** energies systems as solar thermal, photovoltaic ones and heat pumps, to reach real passive house building with integrated renewable energy towards nearly/Net Zero Energy Buildings.
Passive-On project is about the adaptation of the Passivhaus concept to **warm climates** (with the inclusion of explicit specification of summer comfort targets and cooling energy need limits, inclusion of shading, night ventilation and other summer comfort technologies) has been undertaken in the passive-on project coordinated by the end-use Efficiency Research Group of the Politecnico di Milano.
Passive-On aimed to build on the success of the Passivhaus concept by spreading the good word –and appropriate practice- towards southern and more moderate climates of Europe. Further information and links to the results are available at this link:
http://passregsos.passiv.de/wiki/Adaptation_to_mediterranean_climate .
Other comprehensive and valuable studies have been developed by the Passive House Institute ad "**Passive Houses in South West Europe**":
http://www.passiv.de/en/02_informations/05_ph-mediterranean/05_ph-mediterranean.htm .
The passive house principles are suitable worldwide. However, some adaptation in the suitable technological solutions can be considered also according the guidelines available at the following link where using an interactive map suggestion for solution for suitable regional Passivhaus components can be find, particularly on

- Building envelope elements
- Mechanical systems
- Renewable energy

(http://www.passipedia.org/passipedia_en/planning/component_guidelines_for_cost-optimal_passive_houses_and_enerphit_retrofits).

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Examples of municipal building code adopted in Italy

Some municipalities in Italy already implemented these, adopting the passive house targets in the local building codes (Regolamento Edilizio) as quantitative requirements needed to reach financial supports and construction taxes incentives. For example is the case of **Municipality of Muzzano** (Biella) and **Municipality of Botticino** (Brescia). In Muzzano, Certified Passive Houses are eligible for a 60% reduction in construction permitting fees (primary and secondary planning fees as well as a construction cost based fee) with a maximum discount of €20,000 for each building. In Botticino, Certified Passive Houses enjoy reduction up to 55% on primary and secondary planning fees. These represents first actual examples where the Passivhaus requirements and complete certification scheme have been implemented in the local buildings codes. Some relevant references are available here:

- Article titled "Italian cities subsidise Certified Passive Houses" at the following link: http://passreg.eu/index.php?page_id=76&y=2014
- Example from the Municipality of Muzzano (in Italian): http://www.comune.muzzano.bi.it/on-line/Home/IlComune/Regolamenticomunali/articolo31009133.html
- Example from the Municipality of Botticino (in Italian): http://www.comune.botticino.bs.it/regolamento/regolamento-edilizio-ed-allegato-energetico

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