Guideline and synthesis for Implementation of passive house requirements in TENDERS for design and construction activities

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Content

Introduction

Passive house concept is quite easy to be understood both by experts and buildings end-users. Passive house standard as comprehensive set of quantitative requirements and quality assurance methods represents also a useful way to ask for high performances and nearly zero energy buildings in public procurement procedures and in private market, in order to give reliable guarantees to clients and buildings occupants.

Public tenders requesting passive house projects could be useful to increase the capacities and the opportunities for this market. And on the other hand this could provide local administrations with high quality buildings with lower (and also much lower) operation costs for energy bills, leading to an overall savings for the local public bodies.

Many examples of public buildings built according the Passive House standard are described as beacon projects in PassREg (http://passreg.eu/index.php?page_id=70). For examples we can see kindergartens, day-care centers, schools, social housing buildings, cultural centers.

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Implementation of passive house requirements in public and private tenders

Documents (main texts and related technical annexes) of public and private tenders are suitable to be easily integrated with overall passive house requirements. They can be expressed both as energy performances (energy need for heating and cooling, total primary energy demand, etc.) and comfort requirements both as limits on building components and systems (envelope thermal transmittances, glazed surfaces properties, airtightness level, efficiency ratio of heat recovery, electrical specific fan power or energy demand for the mechanical ventilation system, etc.).

Also the passive house calculation method and the quality assurance procedures can be easily required in the tenders specifications. All the performances and technical features of Passive Houses can be requested asking for numerical and quantitative performances and limits typical of the standard and / or asking directly that the Passivhaus certification label have to be reached.

The Passive House process is affordable also in order to ask actual actions for quality assurance and check tests on field (e.g. intermediate and final blower door test to check the airtightness level of the building envelope, in-situ controls to calibrate airflow rates of the mechanical ventilation systems, etc.).

Example of passive house school building built with public tender

An interesting example of a public building which was designed and built according the Passive House principles is the public school "Raldon" of the Municipality of San Giovanni Lupatoto (Verona). This school building, after it was designed and built according public tenders developed by the Municipality, reached the Passivhaus certification. Some references are available here:

- http://passreg.eu/beaconProjectDetails.php?beacon_id=58&ref=beaconlist
- http://www.passivhausprojekte.de/index.php#d_4150
- http://www.architetto.info/la-scuola-media-passiva-di-raldon_speciale_x_845.html

Proved experience in passive buildings design and construction

In tenders it could be possible to ask for proved knowledge and expertise in design, construction and actual quality assurance for passive house buildings. Criteria and additional scores for the evaluation of the participants could be inserted in the tenders texts as:

- **proved participation** to development process of built passive house projects,
- official qualification as **certified passive house designer** according the training and examination process developed by Passive House Institute and provided by the official examination providers, as ZEPHIR in Italy (http://www.passivhausplaner.eu/index.php?lang=en-GB)
- official qualification as **certified passive house tradesperson** according the training and examination process developed by Passive House Institute and provided by the official examination providers, as ZEPHIR in Italy (http://www.passivehouse-trades.org/)

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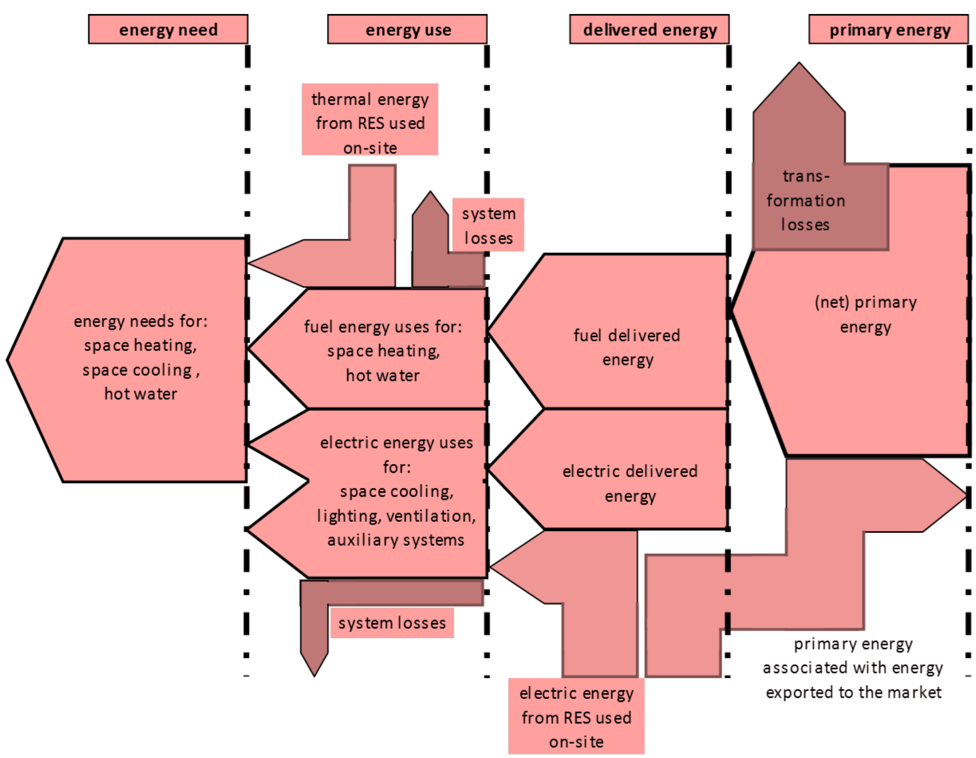
Technical requirements for Passive House targets

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).

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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

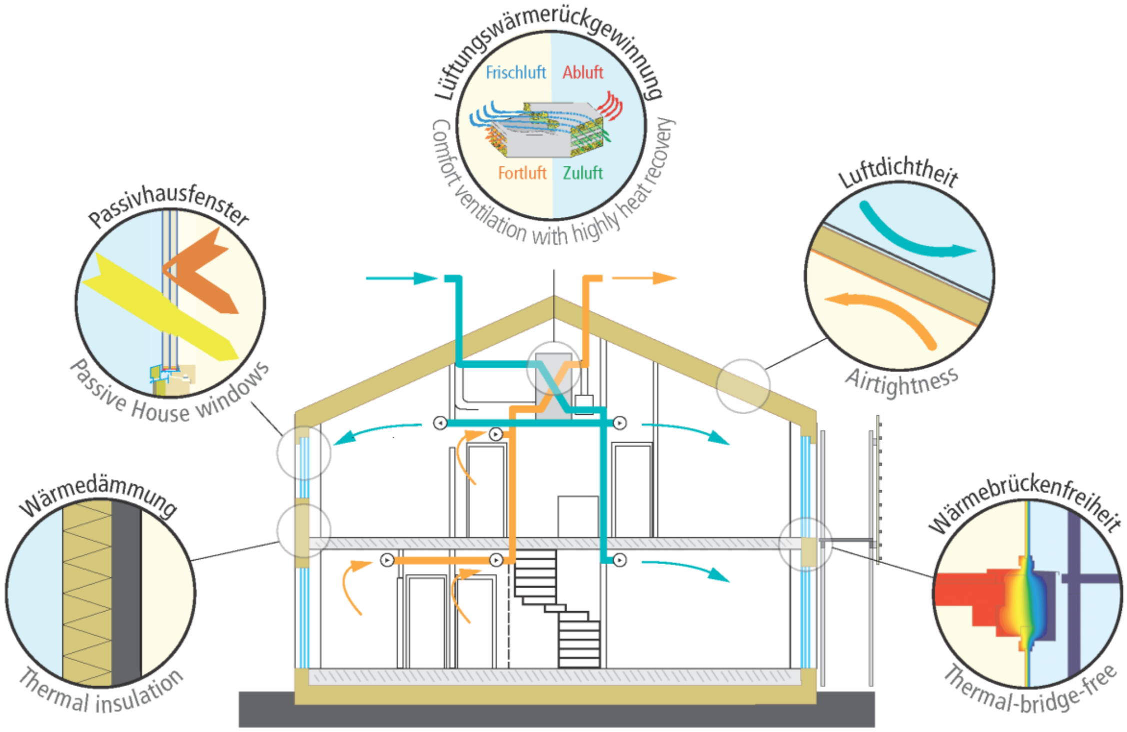
- thermal bridge free design
- windows with adequate thermal
- visual and airtightness feature
- ventilation with heat recovery
- quality insulation and airtight construction

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

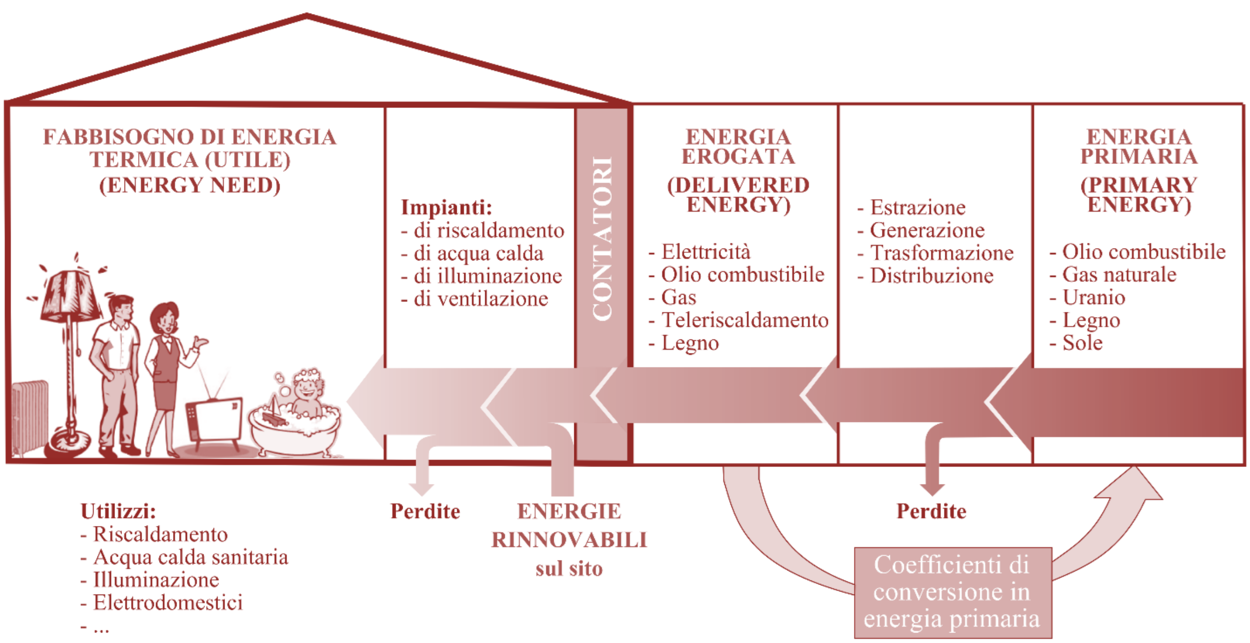
Efficient heat recovery ventilation is key, allowing for a good indoor air quality and saving energy. In Passive House, at least 75% of the heat from the exhaust air is transferred to the fresh air again by means of a heat exchanger.

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, 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.

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 and 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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