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PASSIVE WOODEN HOUSE

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ABSTRACT
Sustainable development means that any encroachment into the ecosystem must be done in such a manner that the survival of future generations is not threatened in any way.
Biologically correct building describes a method of building which respect nature and biological processes. Other terms often used to describe ecologically appropriate building practices include „sustainable design" or „green building". Green building means using natural materials to construct a building that places the health and general well-being of the occupants first. The most important criterion would be probably to choose only renewable materials (such as wood, natural insulating materials or unbaked clay) that have not been treated with toxic, health threatening substances.
Keywords: natural building material, sustainable construction, environmental optimatization, life cycle of the building, wood, recommendation

1. INTRODUCTION

The Passive House concept is winning admirers, who argue that its simple approach to low-energy building is far more practical than the Code for Sustainable Homes or BER approach. Expensive renewable technologies do not figure in a Passive house because energy use is cut to a minimum by simply building a super-insulated, airtight envelope. This, coupled with a degree of solar gain, reduces the need for a heating system to the absolute minimum.
Passive houses are designed to maximize free heat gains, with comfort levels maintained year round at a steady 20 degrees, a small heating system, often no bigger than a toaster element delivers heat through the ventilation system, using no more than 15 [kWh/m^2/yr] for space heating. For example the Viking house can tailor solutions for you site and budget, delivering options from near-passive to energy plus. For many budgets great performance can be achieved using the passive concept to built a house that runs on 20-25 [kwh/m^2/yr] (the equivalent of 2 liters of oil per meter square) for heat with less than 2 liters for hot water.
Principles of sustainable buildings bring new loads in the sphere of development of building materials. From this point of view new materials and constructions are evolved according to actual environmental criterions. At the same time it is necessary to ensure the same requirements of efficiency, quality, dependability and durability of the structures and structural materials as by using common building technologies. Their use brought new views on the architecture and they affect changes of building technologies. One of the most important tasks of environmental assessment is to balance the amount of energy in life cycle of the building.. The notion of sustainable building and urban development refers to the effect of buildings on the environment in all their phases from the production of building materials to the use of ecologically sound and non-toxic substances in building and finally to the eventual demolition of the buildings.
Research project - a program of the European Union Cost Ef. Cient Passive Houses as European Standards (Cepheus) was confirmed by extensive scientific monitoring Energy and economic

efficiency of such architectures and Construction on 250 cases in Germany, France, Austria and Switzerland, and the passive house standard as proposed construction of residential architecture, and general construction all types not only functional architecture.
The achieved energy efficiency and proven good Investment profitability have developed new forms of stimulation of such a relevant change in the concept of long-term energy strategies in the EU.

2. PASSIVE HOUSE

Passive house is a building where no active heating or air conditioning system achieves a pleasant room temperature in the winter and summer period. Provides increased comfort while housing needs for thermal energy does not exceed 15 [kWh/m²]. The realization of passive houses set high demands on the quality of the applied components of the building. All the external elements of buildings, except for glass surfaces, should be thermally insulated so well that the heat transfer coefficient U (k less) is not greater than 0,15 [W/m^{2}K].
It is an important and proper orientation in relation to the world. Large window area on the south side should not be shaded to passive solar gains were optimal and windows so the heat contributed to the stability of the house. The smallest deviation in relation to the south allows maximum exploitation of the winter sun radiation window, and prevents overheating of the rooms in summer due to solar radiation from the west in the afternoon. Highly efficient restore heat to the ventilation system by taking advantage of more than 75 percent is achieved at low energy consumption.
The passive houses must be prevented from uncontrolled changes inside and outside air. External structures should provide complete tightness so that together form a kind of wind resistant mantle. Joints of structural elements and the installation duct penetrations must be carefully executed to achieve the required level wind resistant. Thus a well built structure not only avoids the appearance of draft and thus losing energy, but due to the reduced intake of moisture in the structure, significantly reduces the likelihood of damage to structural elements of the building.
Unlike all other constructions, the passive house you can not shape the reconstruction and adaptation of the classic home. With specific layout, where they are most exposed to the warmest sunlight, the house has a separate ventilation system. To ensure the supply of fresh air ventilation system is controlled by that heat, where the output of spent air from the interior at higher temperatures may transfer up to 80% of its heat to incoming air. In other words, if the air in the room is 20 degrees Celsius and the ambient temperature is zero degrees, the temperature of inlet air can be lifted to 16 degrees Celsius. The process is reversed in the summer months, so that the output of the air over the heat intake air, while maintaining a comfortable temperature in a room without the need for air-conditioning.
As for the passive house insulation, its thickness should be at 25-40 cm underpinned by installing windows with triple glazing and doors, which retain heat well can be achieved to a significant portion of the heat stays in the house.
Is the passive house standard is met to examine the "Blower - Door - Test". All the external elements of buildings, except for glass surfaces, should be thermally insulated so well that the heat transfer coefficient U (k less) is not greater than 0,15 [W / (m^{2}K]. The passive house - the most sophisticated form of energy-efficient building.
Studies have shown that the construction of passive houses require additional investment of only 10-15 percent can be paid for approximately ten years.
The roof structure of the house with a loft consists of: tile, bars, roof sheeting or cardboard, board 22 mm, horn 120/160 mm, mineral wool 160 mm, mineral wool 50 mm, slat 30/50 mm and gypsum-cardboard plates 12.5 mm. The ceiling structure of the house with a loft consists of: flooring, sound insulation, ironing 2.2 cm , bearing timber structures, thermal insulation 10 cm, foil and bars. External wall - System "MEGA" consists of: decorative facade layer 2 mm, render the arm. 4 mm mesh , hard facade Styrofoam (mineral wool) 100 mm, glue 3 mm, plaster-fiber (Betonyp) plate 12 mm , wooden bearing structure 60/160 mm, mineral wool 160 mm, plaster-fiber plates or 12 mm Betonyp, wooden structure 50 mm - Installation space, mineral wool 50 mm and 12.5 mm plasterboard. The total wall thickness = 35.5 cm and heat transfer coefficient: U = 0.111 [W / m² K]. Internal partition wall consists of: 12.5 mm plasterboard, plaster-fiber (Betonyp) plate 12 mm, wooden bearing structure 60/120 mm (60/100 mm), mineral wool 60 mm, plaster-fiber plates or 12 mm Betonyp and 12.5 mm

plasterboard. The floor and foundation consists of: flooring, thermal insulation of 120 mm, waterproofing, concrete slab, buffer gravel and bursting ground

3. WOOD MATERIALS FOR PASSIVE HOUSE

Timber is the classic example of regrowable building material. It stores energy and CO_2 and requires very little production (embedded) energy. It is, therefore, the ideal sustainable material. Wood can have the edge on other materials, especially as it is also a renewable material and therefore ecologically sound.

The exterior wall of a wood construction can be two-third thinner than a typical solid masonry wall with the identical heat loss coefficient, what means that the identical floor area will offer 10% more space for the occupants. The materials for a wooden house are on average 10% cheaper than those for a house built with other materials. Modern manufacturing enable even to prefabricate the various wood components, which will reduce construction time and further increase savings.

Roof/Ceiling starting from the interior consists of : 13 mm plaster board, 18x100 cross battens, vapour control membrane, 175x45 or 150x50 mm rafters and 450mm layer of Blown Cellulose. **Attic Roof** starting from the outside consists of. ceramic roof tiles or slates, 38x54 mm battens, 50 mm ventilation gap, 38x45 mm cross batten, external breather membrane (not pulled tight), 225x45 mm rafters, 30 mm Paroc wind protection, 150 or 175 mm Paroc insulation , vapour barrier (joints taped) , 45x45 mm cross battens , 42 mm Paroc insulation perpindicular and 13 mm Fermacell.

4. RECOMMENDATION FOR PASSIVE HOUSE

Improving the overall efficiency of a nation's housing stock by insisting new buildings reach the impressive passive house standard can mean a 90% energy saving and a high level of thermal comfort.

In many central European countries energy consumption for heating and domestic hot water causes around one third of national CO2 emissions. For this reason the reduction of energy demand from buildings plays an important role in efforts to control anthropogenic greenhouse gas emissions.

Family house in Austria has an specific space heat demand of 75 [kWh/m^2] of treated floor area.

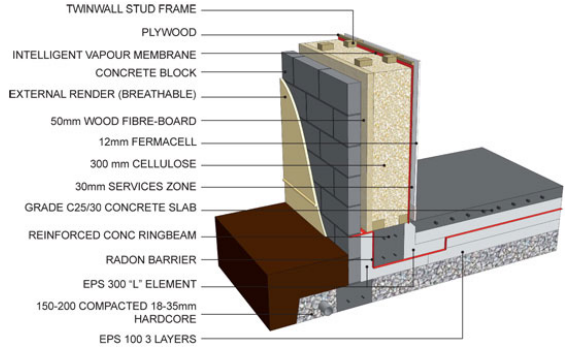

Figure 1. Viking Double L foundation element with a Timber Frame wall and a concrete block external leaf

Key parameters are a specific space heat demand maximum of 15 kWh/m2 TFA, a specific primary energy demand for space heating, cooling, domestic hot water, electricity for pumps and ventilation and household appliances at a maximum of 120 [kWh/m^2] TFA, a maximum heat load of 10 [W/m^2] TFA, and an airtightness of n50 0.6/h maximum.

Although the successful implementation of passive houses in new buildings plays an important role in the overall strategy to reduce greenhouse gas emissions, the improvement of the energetic quality of the existing building stock is of even bigger importance. In Austria, the yearly rate of new built apartments is about 1% of the existing building stock. Depending on age and building type, the specific space heat demand is 130–280 [kWh/m^2]. As only about 1%–1.5% of the building stock is retrofitted per year and this rate cannot be increased to much more than 2.5%, the improvement of the energetic quality of retrofits is essential in order to reach the national, European and international targets for the reduction of greenhouse gases.

In these projects, a specific heat demand after renovation of 15 [kWh/m^2]TFA, was achieved.

The main elements of the energy concept are typical passive house components:

- Excellent insulation level of opaque building elements: u-values range from 0.10 [W/m^{2}K] for walls and roof to 0.18 [W/m^{2}K] for basement ceilings.
- Triple glazed windows with adequate frames and an optimized installation.
- Thermal bridges reduced to a minimum.

- The airtightness was improved by a factor of 6–10, the limiting value for new passive houses was achieved.
- A ventilation system with highly efficient heat recovery installed.
- Thermal solar collectors installed covering up 60% of the annual energy demand for domestic hot water.
- Highly efficient condensing gas boilers were installed; where possible, ducts have been insulated to a very good level; in other projects biomass boilers have been successfully tested.

Austrian and German research has shown that for bigger apartment buildings renovations to passive house standard or very close to it cost about E450–600/m^2 TFA. The extra cost compared to a renovation up to national building code is in the range E80–150/m^2 TFA.
For comparison a new apartment building costs about E1600/m^2 TFA in western Austria.
Nontheless, detailed analyses show that most of the measures used in passive house retrofit are economically feasible, for example, the overall lifecycle cost for investment and energy is lower using the passive house insulation of 26 cm compared to the building code insulation of 12 cm.By 2020: Three times 20, 20% reduced overall energy consumption,20% reduction in greenhouse gas emissions,20% share of renewable energy sources.

5. CONCLUSION

1. **Comfort** – Contrary to the usual method of construction-especially good for heat isolation of temperature-side surface of housing approximately equally high and the temperature of the air: time cold walls become history. Ease of living and quality of a passive house because of the high quality of construction are much higher than in conventional houses.
2. **Fresh air** – Controlled irradiation of living space reaches a supply of fresh air draft-free and dust. In addition, you can install separate anti-filter pollen and other allergens.
3. **Economy** – Saving 80-90% of total energy costs. Slightly higher investment costs very quickly equalize through additional promotion and maintenance costs considerably less.
4. **Ecological aspects** – Passive houses have a very low need for energy for heating (HWB 15 [kWh/m] or 1.5 liters of fuel oil equivalent per year, they). Through to reduce, on the one hand, environmental burden as well as CO_2 emissions and carbon dioxide, and further environmental strain as the Global Warming Potential (GWP), primary energy, etc. On the other hand, passive house reduces energy consumption of resources by about 90% for the whole lifetime.
5. **Security in crisis** – Even with the energy crisis (natural gas and oil, etc.) passive house works.
6. **Architectural diversity** – There are all types of construction. Share glass surface should be optimized, not maximize. Heated volume passive house plan what compact.
7. New impulses and higher quality in construction
8. Advantage in international markets for certain companies that possess the appropriate knowledge
9. The technologies for efficient energy use therefore offer additional growth potential for national economies that use them consistently and effectively.
10. Improved in both cold and hot seasons.
11. Sustainable and micro-economically affordable.

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