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Building best practice in the Baltic States

Status quo and recommendations

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1. Introduction

This paper intends to give guidance on energy efficient housing in the Baltic States. It wants to compare a German example with the current situation in Baltic States. It shall serve as an illustration to identify differences in the building processes and give recommendations for more energy efficiency particularly in new buildings.

This paper assumes that a passive house (annual heat demanf of 15kWh/(m^2a)) is existing best practice[1]. Of course, there are numerous details to a passive house, but this paper does not intend to tackle technical solutions in details. Rather it wants to outline some of the problems that hinder the construction of such a house and it wants to make proposals how to overcome these barriers, which solutions can be transferred directly and which can be transferred but with necessary adaption to the local conditions.

There have been debates whether a passive house with such a low energy standard of 15 kWh/(m^2a) is possible in the Baltic States. However, even if the climate conditions might be unfavourable in some parts of the countries, such houses exist in Norway under similar climatic conditions. Besides, it shall be stressed, that it is maybe not essential to achieve the critical threshold that divides passive houses from non-passive houses. Even with an energy consumption of 25-40 kWh/(m^2a) (low energy house), any house would be exceptionally energy saving compared to currently constructed houses. However knowledge on particular technologies (e.g., very good insulation and ventilation) used in passive houses is very beneficial even for building a low energy house.

Finally, we want to stress that energy efficiency or a passive house is not exclusively a question of the technical implementation but also of a number of other factors, such as right incentives, right behaviour in the readily constructed house, administrative support and finally also the correct technical implementation on the construction site. As we will see, a lack of experience sure requires additional efforts; however it does not make the construction of a passive house impossible.

1 For further information see: http://www.passivehouse.com and annex

2. Initiators

The example used throughout the text is a project that has been realised by a group of citizens who decided to realise a common residential project of 18 apartments in an empty lot in the densely built-up district of Eimsbüttel in Hamburg. This lot is situated amidst this 19th century district in Telemann Street with its mix of infrastructure: flats, working places, shops, restaurants, places and cafes to meet, a lot of places of interest within a few minutes walk. Furthermore the metro station is close by.

The reason for living together in one building was mainly to counteract the felt anonymity of the big city. Furthermore, the future inhabitants were able to influence the architecture by themselves and to create as much individuality as possible. Additionally, a higher-then-average energy standard was chosen (15 kWh/(m^2a)). In 2003, the project was completed; this multi-storey passive house project was one of the pilot projects in Hamburg. Interestingly, neither the architects nor the group itself had any experience in constructing passive houses or living in it.

Consequently, there was a bundle of questions that demanded an answer. How does it feel like to live in a house without a "normal" heating? Eventually the decision was taken in favour of a passive house with 23 to 5 votes. Before that, the group undertook a study visit to a passive house construction site in Kassel (350 km south), sought advice from the passive house advisory company (Passivhaus Dienstleistungs GmbH, see: www.passivhaus-info.de) and well experienced technical advisors. Finally the additional costs were calculated. However, also those who voted against the passive house standard stayed in the group.

It was agreed that during the building process that all decisions would be taken by the group with a two third majority. Each household would have one vote.

The legal form that was chosen was the "building cooperative" (Baugenossenschaft). This legal form is based on a law that lay down the applying regulations. They enable the building cooperative to apply for loans and judging from experience, among the projects implemented by cooperatives there is a higher-than-average share of energy efficient buildings.

In the Baltic States that initiator is classically either the later house owner himself or a company that is later going to sell the constructed houses. Organised groups, such as in the German example, are not acting as constructor at all. In the case of an investor who is selling the ready product, often standard solutions are built without any major influence from the later client. Consequently, energy standards higher than legally required are no priority and *easily neglected mainly because of higher initial financial investments needed. Individual house constructors are badly informed about energy efficient alternatives and assumptions prevail. As a consequence, also private constructors build their houses rather energy-inefficient. In the Baltic States, so-called cooperatives come into play only in existing privatised multi-flat buildings where they voluntarily can take over the responsibility of maintenance to a certain extent.*

First passive houses are under construction but not yet in use in the Baltic States. However, at the time of publication of this article, a passive house is under construction in Lithuania. This passive house is being built by the German-Lithuanian company Passivhaus (e-mail: info@passivhaus.lt; http://passivhaus.lt) with consultancy of German experts.

Also in Estonia a kindergarten in Valga is being reconstructed according to the passive house standards. The University of Tartu is providing consultancy: University of Tartu, Institute of Technology, Energy Efficient Building Core Laboratory (Tõnu Mauring: e-mail - tonu.mauring.001@ut.ee, mobile: +372 55 566 988).

Unfortunately, passive houses are not built yet in Latvia; however plans exist to build one. One single family house with a very low energy consumption of 28 kWh/(m2a) has been completed but is not sold yet. The executing company is able to provide further consultancy if needed ("Artiva" Ltd. Artūrs Gredzens mob: +371 29252882, www.artiva.lv). Consultancy can be obtained also from experts of the Riga Technical University, "Ekodoma" www.ekodoma.lv

Recommendations

- **Increase the market demand** in the Baltic States by raising awareness of customers, developers and municipal authorities on passive and low energy house technologies; on costs and benefits for e.g., energy savings in comparison to traditionally built houses; peculiarities of their applicability in different climate conditions:

- Giving the possibility for various stakeholders to visit passive house example projects (model houses) in the Baltic States, Germany and Scandinavian countries;

- Info materials for future inhabitants of passive houses concerning cost calculations for construction and maintenance in comparison to traditional houses;

- Involving media (TV, press) in public info process;

- Promote results of the EU funded investment projects constructing low energy houses e.g., REBECEE.

- Info days / exhibitions for developers (architects, engineers and investors) to learn from western European experience on construction of passive houses – e.g., not only technologies, materials but also how to approach clients
- The initiative should come from local administrative bodies. They can introduce higher energy efficiency standards to the criteria of procurement procedures for the construction of public buildings such as kindergartens, schools, hospitals, etc.
- Prepare information for inhabitants in order to overcome "myths" related to living and performing in a passive house, e.g. to demonstrate that it is possible to open windows, and to show that there are only various architectural designs available and that passive houses can only be made of various materials and not only wood.

3. Financing options

As indicated in chapter one, the legal form of the cooperative[2] was chosen for the described project in Germany. The clients realised the project under the roof of the cooperative "Wohnungsbaugenossenschaft Schanze e.G." in the frame setting for social residential housing requirements. The members of the group brought in 12% of the costs. The remaining part was financed by special loans given by the Hamburg branch of the KfW bank (Wohnungbaukreditanstalt) and will be paid back as rent by the tenants during 35 years. The KfW offers several financing schemes with low-interest rates depending on the energy standard of the house (passive house, KfW40, KfW60).

The costs for the passive house project were approx 150 EUR higher per square metre of living space compared with an eligible project in the subsidised housing sectors. The Hamburg building authority was interested in this pilot project and offered additionally 75 EUR/m² living space as an additional grant.

Financing schemes for the construction sector vary in the Baltic States. Besides usual bank loans, low-interest loans ("green home loan" or also called "passive house loans") are available in Estonia. They are given by the Estonian branch of Swedbank and they are meant for people who want to build a passive house for themselves. When the passive house or low-energy house has been built, according to the submission of a certificate (that can be given to a passive house in Estonia only by the Energy Efficient Building Core Laboratory

2 For further information about cooperatives as legal form for joint building processes in Germany, see e.g.: http://www.fgwa.de/fileadmin/pdf/Beiträge%20Vorstand%20etc./Toellner_Genossenschaft.pdf

of the University of Tartu) Swedbank ensures a lowered interest rate of 0,1 per cent less compared to usual loans until the end of the loan period (in 2008). No lower interest rate loans for building more energy efficient houses are until now available in Latvia or Lithuania.

Recommendations

- First initiatives to support the construction of energy efficient houses (energy-standard of 40 or 60 kWh/(m^2a) or better) (not only renovation) should come from state:
- Reduced or 0% VAT for e.g., insulation materials, energy efficient construction or renovation (already partly practiced in Lithuania)
- Banks should reconsider their loan policy – giving loans with lower interest rates for the construction of energy efficient houses recognising the higher future value of energy efficient houses in comparison to conventional ones.

4. Planning, design and permitting

The character of the outlined German example was determined by the question how to adapt this new building to its art noveau-type neighbours. Their compact structures demanded that also a new building must be designed in a compact way as well. Furthermore, the urban development plan (Bebauungsplan) for spatial planning was a binding basis. Despite the orientation to the northwest and southeast that was given by mentioned circumstances, a first pre-calculation showed, that it was nonetheless possible to realise the building as a passive house construction. Shadows of existing buildings and trees were already taken into account in this early stage.

Besides some general requirements such as barrier-free access, the next steps were the adjustments to the passive house standard. First, the heated volume was defined; it was kept as small as possible while keeping a compact building structure. The result of this optimisation process was that the stair case and the cellar were excluded from the heated volumes. This procedure follows the passive house rule to minimise losses first and then to maximise wins. As a next step, the openings and their orientation were optimised. Although there was no margin to change the orientation of the building, the openings were optimized as follows: no or small openings to the north, big openings to the south-eastern side. Balconies and some other construction elements serve as shadow elements for heat protection in summer. Last but not least, thermal bridges were identified at the connecting points. Subsequently,

Passive house in Hamburg, Telemannstraße

also the balconies were separated from the heated volume and have no connection to the outer wall. Due to the special requirements of the ventilation system, all pipes had to be located within the heated volume. To optimise the system, a central air-to-air heat exchanger was located on the roof. Once again, it shall be mentioned that the implementing architect had no previous experiences with passive house technology. Consultancy was sought for special requirements of this design, done by: Passivhaus Dienstleistung GmbH[3] and the technical advisors of Innova Tec, Kassel, who calculated and designed the ventilation system.

The permitting procedure was done according the legal requirements. Only binding legal standards on energy efficiency were checked. Any additional requirements such as for the certification of the passive house standard are no element of the legal procedure and they are certified separately by non-state institutions. In the case of the example presented here, the certificate was issued by Passivhaus Dienstleistung

3 The Passivhaus Dienstleistung GmbH , (www.passivhaus-info.de) is responsible for consultancy and certification for common types of passive houses not only in Germany, but in all countries, where no certification institution is situated. The Passivhaus Institut is the main research institution for passive houses. They give consultancy for very specialised types of buildings and general information about passive house technology. See: www.passiv.de

GmbH whereby a fee of 2.500 EUR arose. Additional documents were necessary for the passive house standard certification, such as a site location plan containing the height of the neighbour buildings and trees, a description (technical data) of the window construction, (glass, frame etc…), detailed plans of connecting points: such as the landing of the stair case and the insulated wall. Last but not least a description of technical equipment was required.

Planning and permitting follows legal standards in all three Baltic States. The permitting system is well established and permits are issued in standard procedures according to national requirements that do not foresee any noteworthy energy efficiency standards. A slight exception is Lithuania where minimum energy performance requirements for new buildings (not less than class C) are mandatory, including a mandatory energy performance certification.

Concerning the design and the energy standard it is again up to the developer or the client until stricter legally binding standards are put into place. This means that the owner or developer decide what and how they want the house to look like, what construction materials to use, what technical equipment to install. Stricter requirements are for construction design of new houses in city centres in the Baltic States. They must suit and fit to the style of the surrounding area, however not stating anything on energy aspects.

A possible good solution is currently under development in Estonia. With the help of Tallinn Technical University one Estonian company (Yoga LCC) has developed the so-called Yoga Intelligent Building System which is meant for residential homes and apartments, business offices, factories, etc. It is a computer guided system that controls everything from lighting to climate, alarm system to equipment. The technical description of the system can be found in English on the following web page: http://www.yoga.ee/doc/doku.php?id=intelligent_building_system_technical_data

There is no practical experience with this system yet however an apartment building using this system should be ready in spring 2009 as well as one office building.

Certification of passive-houses is a complicated issue in the Baltic States. Besides the already mentioned department of the Tartu University, there is currently no provider who could certify a passive house in the Latvia and Lithuania. However, in case of interest, there is a possibility to get consultancy and certification by e.g., the Tartu University, Estonia and Passivhaus Dienstleistung GmbH, Germany.

Recommendations

- Capacity building for professional stakeholders – trainings, study trips for architects, engineers, energy consultants and constructors

- Improvement of curricula of higher and vocational school programmes: Introduce a mandatory module on energy-efficient construction paying special attention to low energy houses and passive house constructions
- Introduction of higher energy efficiency standards for construction of public buildings in national legislation

5. Construction phase and technical details

This chapter shall outline some of the technical details that where included in the here presented passive house example in Germany. First of all a ventilation system with heat recovery (91 per cent recovery through a central heat exchanger) was situated on top of the building. Fresh air can thus be warmed up to 19 °C. Each apartment has one individual heating element to further warm-up the pre-heated air. By simple thermostats in each flat, the temperature can be varied between 19 and 23°C and the degree of ventilation can be switched to either low or medium or high. Warm water is supplied by a central gas boiler. The pipe system was installed during construction phase.

An additional heating system with conventional radiators is used, to heat the bathrooms more cosy than 19 °C.

The house is constructed with brickwork walls with 30-35 cm insulation and finishing, providing an U-value of 0,113 W/(m^2K). The ceiling of cellar is approximately 30 cm thick, yielding an U-value of 0,116 W/(m^2K). The roof was also equipped with 30 cm insulation, U-value: 0,094 W/(m^2K).

The windows as a central element of a passive house are triple glazed and provide a U-value of 0,77 W/(m^2K) and for the frame 0,87 W/(m^2K).

No special renewable materials were used.

The execution was done by one general contractor which was tendered. The tender documents contained all necessary requirements for the passive houses standard, such as the obligation to keep the maximum energy consumption per square metre living space/year below the threshold of 15 kWh/(m^2a) and to pass the blower door tests. None of the general contractors taking part in the tender had prior experience in multi storey passive houses; nonetheless, the contracted company was able to achieve good results in the blower door test for the passive house certification procedures.

Technical installations, passive house in Hamburg, Telemannstraße

The company, which installed the sophisticated ventilation system with its central heat exchange system and its individual requirements, had no previous experience as well. There was little technical advice during the construction process and no direct advice available at place. Some mistakes were made which were discovered only during the exploitation (e.g., improper instalment of individual heating elements warming up the preheated air; weak noise insulation of ventilation system); however the client asked the technical advisor for the regulation of mistakes and they were corrected. By law, warranty claims for buildings can be submitted up to 4 or 5 years from construction. Its common practice to keep a share of the outstanding sum until the warranty period is over. The passive house certificate was given, the blower door test was passed albeit the mistakes made in the construction process.

After the finalisation of the building, the need for maintenance contracts for the heavy passive house doors and – windows became necessary. They are maintained once a year, the filters of ventilation system twice a year. All other maintenance needs are comparable to a non-passive house.

There are no special legal requirements for construction of passive / low energy houses in the Baltic States – currently there are just minimum energy performance requirements for construction of new buildings set recently according to the Directive 2002/91/EC on the energy performance of buildings. Links to relevant national legislation and regulations and/or building standards can be found in the annex.

Construction and insulation materials meeting passive house standards can be obtained also in the Baltic States although not common. If a customer knows what he wants, insists on that when approaching a constructing company then the company will deliver the requested product. This company should have contacts with a relevant company e .g. in Germany.

Recommendations

- Increase knowledge and capacity of construction workers on construction of energy efficient houses avoiding thermal bridges, increasing preciseness and accuracy
- Increase tenants' knowledge on quality and usage standards of passive / low energy houses
- Recommend intermediate audits or quality check during the construction to ensure the energy performance of the building and to prevent mistakes (this should also be considered when stetting up the financial planning)
- Check qualification, recommendations of a construction company, e.g. potential ability to built a house that passes blower door test; perform intermediate and final construction quality check by external energy auditor
- More stringent warranty requirements are needed to be set on a state level (in a civil law) – recommendation to have a warranty for 5 years (German law - civil code) for repairing of faults in the construction, later discovered during usage.

6. Living in the energy efficient building

In general, the inhabitants are satisfied with the building in the outlined German example. None of them decided to leave the house. Some minor defects connected to the heating system are still not finally solved, but the inhabitants confirm to live in a cosy building without any cold areas in the flats, no noise disturbance. The inhabitants were surprised how sound-proof the construction is. However, some inhabitants were dissatisfied with the indoor air which they find too dry.

It is worthwhile to mention, that the house needs constant maintenance, such as changing the ventilation filters twice a year. Furthermore, the inhabitants need to change their habits living in such a house in order to reach a high energy performance of the house in total. This means taking care to keep the entrance doors shut, keeping windows closed during the winter time. It is recommended to use energy efficient light bulbs and electric devices.

The performance of buildings is not yet actual, however as the performance of some refurbished houses (changes in energy consumption in kWh/(m²a), evaluation of inhabitants) is monitored in Latvia and Estonia, the methodology is available to carry out monitoring also in a future passive house.

Recommendations

- Provide information to tenants on how to perform living in an energy-efficient house and maintain it – inhabitants have to be ready to change their behaviour.
- Provide information about materials that can be used indoors which provide a good and pleasant interior climate

Annex 1: What is a passive house

Source: passive house institute, http://www.passivehouse.com/English/PassiveH.HTM

A passive house is a building in which a comfortable interior climate can be maintained without active heating and cooling systems (Adamson 1987 and Feist 1988). The house heats and cools itself, hence “passive”.

For European passive construction, prerequisite to this capability is an annual heating requirement that is less than 15 kWh/(m^2a), not to be attained at the cost of an increase in use of energy for other purposes (e.g., electricity). Furthermore, the combined primary energy consumption of living area of a European passive house may not exceed 120 kWh/(m^2a) for heat, hot water and household electricity.

With this as a starting point, additional energy requirements may be completely covered by using renewable energy sources.

This means that the combined energy consumption of a passive house is less than the average new European home requires for household electricity and hot water alone. The combined end energy consumed by a passive house is therefore less than a quarter of the energy consumed by the average new construction that complies with applicable national energy regulations.

A passive house is cost-effective when the combined capitalized costs (construction, including design and installed equipment, plus operating costs for 30 years) do not exceed those of an average new home.

Following are the basic features that distinguish passive house construction:

Compact form and good insulation:	All components of the exterior shell of the house are insulated to achieve a U-factor that does not exceed 0.15 W/(m^2K).
Southern orientation and shade considerations:	Passive use of solar energy is a significant factor in passive house design.
Energy-efficient window glazing and frames:	Windows (glazing and frames, combined) should have U-factors not exceeding 0.80 W/(m^2K), with solar heat-gain coefficients around 50%.
Building envelope air-tightness:	Air leakage through unsealed joints must be less than 0.6 times the house volume per hour.

Passive preheating of fresh air:	Fresh air may be brought into the house through underground ducts that exchange heat with the soil. This preheats fresh air to a temperature above 5 °C, even on cold winter days.
Highly efficient heat recovery from exhaust air using an air-to-air heat exchanger:	Most of the perceptible heat in the exhaust air is transferred to the incoming fresh air (heat recovery rate over 80%).
Hot water supply using regenerative energy sources:	Solar collectors or heat pumps provide energy for hot water.
Energy-saving household appliances:	Low energy refrigerators, stoves, freezers, lamps, washers, dryers, etc. are indispensable in a passive house.

Annex 2: National legislation

Lithuania

www.lrs.lt

Latvia

Links to the relevant national legislation - mainly in Latvian, some available also in English:
Law on the Energy performance of buildings (2008) – transposes the Directive 2002/91/EC
www.em.gov.lv/em/2nd/?cat=2673%20-%20125k (available also in English)
Related by-laws
• **Cabinet of Ministers Regulations Nr. 26 (13 January, 2009) on Energy auditors**
www.likumi.lv/doc.php?id=187068&from=off
• **Cabinet of Ministers Regulations Nr. 39 (13 January, 2009) on methodology for calculation of energy performance of buildings**
www.likumi.lv/doc.php?id=187240
• **Cabinet of Ministers Regulations Nr. 40 (13 January, 2009) on Energy certification of buildings**
www.likumi.lv/doc.php?id=187072&from=off

Construction Law (1995)
www.em.gov.lv/em/2nd/?cat=2673%20-%20125k (available also in English)

General Construction Regulations (1997)
www.em.gov.lv/em/2nd/?cat=2673%20-%20125k (available also in English)

Cabinet of Ministers Regulations Nr. 495 (2001) regarding Latvian Building Code LBN 002-01 „Thermal Performance of Building Envelope"
www.likumi.lv/tv_faili.php?doc_id=56049&get_file_id=5866

Estonia

Directive 2002/91/EC in Estonian
http://www.legaltext.ee/text/et/T70047.htm

Directive 2006/32/EC in Estonian
http://www.kokkuhoid.energia.ee/failid/Energiatohususe_direktiiv_2006_32_EU.pdf

Construction Act (Ehitusseadus)
http://www.riigiteataja.ee/ert/act.jsp?id=728982

Act on energy efficiency of equipment
Seadmete energiatõhususe seadus
http://www.riigiteataja.ee/ert/act.jsp?id=685576

Regulation regarding energy audit
Majandus- ja kommunikatsiooniministri 12.06.2008. a määrus nr48 „Energiaauditi ja ehitise ekspertiisi tegemise ning ehitusprojekti koostamise toetamise tingimused ja kord"
https://www.riigiteataja.ee/ert/act.jsp?id=13100751

Regulations regarding energy cerificate
Majandus- ja kommunikatsiooniministri 17. detsembri 2008. a määrus nr 107 „Energiamärgise vorm ja väljastamise kord"
https://www.riigiteataja.ee/ert/act.jsp?id=13094120

Vabariigi Valitsuse 30. detsembri 2008. a määrus nr 194 „Loetelu suurte rahvahulkade kogunemisega seotud üle 1000-ruutmeetrise kasuliku pinnaga sisekliima tagamisega hoonete liikidest, mille puhul on nõutav energiamärgise olemasolu"
https://www.riigiteataja.ee/ert/act.jsp?id=13119289

Regulation about energy efficiency minimum requirements
Vabariigi Valitsuse 20. detsembri 2007. a määrus nr 258 „Energiatõhususe miinimumnõuded"
https://www.riigiteataja.ee/ert/act.jsp?id=12903585

Regulations regarding building permit
Majandus- ja kommunikatsiooniministri 27. detsembri 2002. a määrus nr 70 „Nõuded ehitusloa taotlemisel esitatavale ehitusprojektile"
https://www.riigiteataja.ee/ert/act.jsp?id=234146

Majandus- ja kommunikatsiooniministri 24. detsembri 2002. a määrus nr 63 „Ehitusloa vorminõuded"
https://www.riigiteataja.ee/ert/act.jsp?id=233392

Majandus- ja kommunikatsiooniministri 24. detsembri 2002. a määrus nr 66 „Ehitusloa taotluse vorminõuded ja esitamise kord"
https://www.riigiteataja.ee/ert/act.jsp?id=233365

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