**Overall refurbishment plan for step-by-step retrofits to EnerPHit standard**

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* **Introduction**

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| **Figure 1: EnerPHit seal** |

When old buildings are renovated, it is often difficult to achieve Passive House standard. Typical reasons for this are unavoidable thermal bridges as well as a general building design, which was originally not optimized for compactness and solar gains. For such buildings, Passive House Institute (PHI) has introduced the EnerPHit standard in 2010. The basic principle is to modernize all relevant parts of the building with Passive House components. This way almost all advantages of the Passive House standard can be realized in retrofits, even if the heating and cooling demand is not reduced all the way down to Passive House level.

* **New Certification Scheme for step-by-step Retrofit**

The EnerPHit standard is currently applicable to complete renovations only. Buildings can be certified, once all relevant components have achieved the required efficiency level.

However, many buildings are renovated step by step, whenever one or several parts have reached the end of their lifetime. A frequent situation is that, the owner wants to insulate the facade, but the windows are still in good condition. In this case, most building owners won’t replace the windows together with the installation of the wall insulation, as they still have a considerable remaining value and lifetime.

For such renovation projects, an overall concept for all retrofit steps is of eminent importance. The concept should be worked out before the first step is implemented. It should clarify the order of the individual steps as well as the position of the airtightness layer and the insulation layer in all parts of the thermal envelope, including also all connection details. As an example with such a plan the connection detail of the wall insulation to the existing window can be designed in such a way that, many years later, it is easy to install a new window with airtight connections and minimal thermal bridging. Only with such an overall concept an optimal result for the whole building can expected when all retrofit steps have been completed.

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| **Figure 2: Step-by-step from old building to EnerPHit. Process scheme for Stepwise EnerPHit Retrofit** |

* **The challenge in step-by-step retrofits is to reach an optimal energy efficiency standard for the whole building after completion of all individual retrofit steps.**

In order to reach this aim, all steps need to follow a common master plan. Such a plan should be devised before the first step is tackled. It includes information about order and quality of all energy retrofit measures as well as general definitions of the position of the airtightness layer and the thermal insulation layer in each part of the building envelope. If of two adjacent parts one is modernized some years before the other, a technical connection detail that works well during all phases should be developed. Other types of interdependencies between energy efficiency measures should also be considered carefully. An example of this is when installing new airtight windows, a heat recovery ventilation system is advisable to be safe from overly humid air and mould growth.

A well-thought-out master plan is not only indispensable for good final result, it also helps keeping the overall costs low. Costly alteration works because of short-sighted earlier measure can be avoided and energy costs are gradually reduced to a minimum.

Development of the Certification criteria for stepwise EnerPHit retrofit has been financed by the European Union under the IEE project EuroPHit.

In EuroPHit a feasible approach for such a master plan has been elaborated: the so-called EnerPHit Retrofit Plan (ERP). The concept includes a template, a calculation tool, an online platform and an explanatory handbook amongst others. For energy consultants and architects the ERP is a great tool for efficient and well-structured planning of stepwise retrofits. The building owner receives a printout of the ERP to keep for future reference.

High-efficiency retrofit to EnerPHit Standard differs from standard retrofits in a higher quality of design, workmanship, and construction components. In order to ensure that the necessary quality is actually met, a third party check can be helpful. This is exactly what the Passive House Institute and its accredited certifiers offer with the EnerPHit precertification for step-by-step retrofit. Precertification includes a thorough check of the ERP as well as the detailed design documents for the first step. Once this first step is completed a preliminary EnerPHit certificate can be issued. An online platform facilitates and structures the data exchange between energy consultant and certifier. The precertification gives planners and building owners the certainty, that the desired energy standard will actually be achieved after the last step will have been completed. If a building is meant to achieve a specific target energy standard, an energy balance calculation tool is essential during the planning process. With such a tool, the easiest and most cost-effective way to reach this standard can be found.

The Passive House Planning Package (PHPP) is an easy-to-use tool for energetic planning of new buildings and retrofits. It has been continuously developed since the 1990s and is validated for high efficiency buildings as well as for evaluation of existing buildings with high energy consumption.

**Figure 3: Version 9 of the Passive House Planning Package includes new useful features for step-by-step retrofits**