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A set of reference buildings for energy performance calculation studies

The choice of the building geometry is often one of the first determinations during comparison studies of national energy performance requirements. Experiences with realised intercomparisons show that the results are influenced already by this choice as they can depend on the type of the building and because of different calculations methods for floor and envelope areas also on the building geometry. A European project has collected possible reference buildings from various EU Member States which are presented in this paper.

1 > The influence of reference buildings on intercomparison studies of energy performance requirements

As explained in P65 "Comparing energy performance requirements over Europe" [1] earlier intercomparison studies have shown that already the calculation of floor areas, envelope areas etc. lead to different results when national calculation standards of several European Member States have to be followed. In most cases one or several representative buildings for the country that launched the study have been used for the comparison. As many influence factors are related to the floor area, other areas or volumes (e.g. default values for internal gains or the ventilation losses), this can produce the first differences regarding the energy performance results. Also the results of the comparison can be quite dependent on the type of building that has been chosen as reference building. This is valid for different types of dwellings (single-family house vs. multi-family house) as well as for residential vs. non-residential buildings.

The IEE ASIEPI project (Assessment and Improvement of the EPBD Impact (for new buildings and building renovation)) has collected possible reference buildings from various EU Member States. As the main task of ASIEPI in the field of intercomparison is to develop an instrument for making meaningful comparisons of minimum EP requirements in the individual Member States and to test this instrument, the collection of reference buildings had to be limited. The project concentrated therefore on presenting an exemplary collection of representative single-family houses. However the authors of this information paper suggest to mirror the intercomparison results achieved with single-family houses in the future with corresponding calculations for other building types such as:



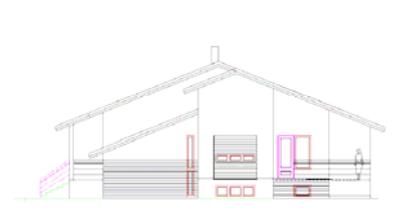
Belgium



Czech Republic



Denmark



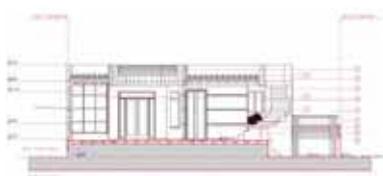
Finland



France



Germany



Greece

Views of the collected national representative single-family houses of 7 EU Member States.

- > multi-family houses
 - > office buildings
 - > schools
 - > hospitals
- and if possible even more.

2 > Overview on the collected national representative single-family houses

The single-family houses collected in the project and documented in more detail in the report "Reference buildings for EP calculation studies" [2] cover examples from the following EU Member States:

Country	Single-family house type
1 Belgium	Semi-detached house
2 Czech Republic	Detached house
3 Denmark	Detached house
4 Finland	Semi-detached house
5 France	Semi-detached house
6 Germany	Semi-detached house
7 Greece	Detached house
8 Italy	Detached house
9 The Netherlands	Row house
10 Norway	Detached house
11 Poland	Detached house
12 Spain	Row house

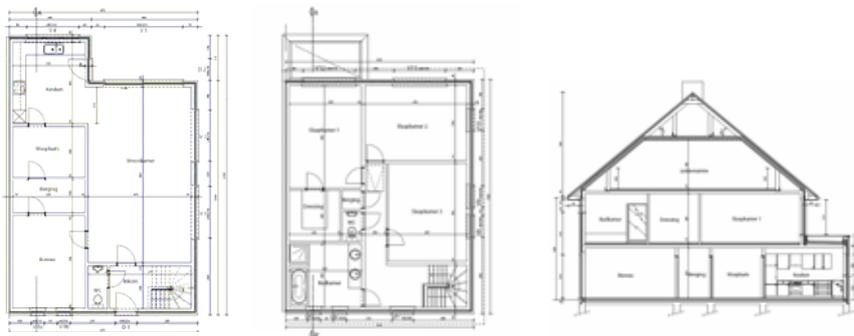
The views of the national representative buildings show already how different these buildings can be, not only in being detached, semi-detached or row houses, but also in size, height, roof type, with or without cellar, garage or attic. As representative buildings they are also dependent on national building traditions.

3 > Comparison of the Belgian, German and Dutch representative single-family houses

Three neighbour countries have been chosen for a first comparison of their single-family reference houses.

Belgium

The Belgian representative single-family house is semi-detached and has a volume of more than 700 m³ and a net floor area of more than 200 m². This corresponds closely to the average of new single-family construction in Belgium. The attic is part of the heated volume.



Floor plans and cross section of the Belgian single-family house.

Germany

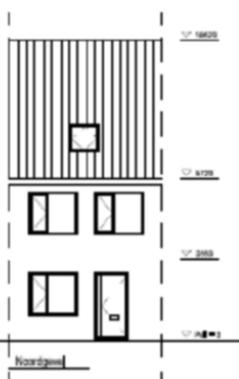
More than 35 % of the existing houses in Germany are either double houses, row houses or two family houses according to the building statistic of the German Federal Office for Statistics. The chosen reference building with about 170 m² floor area covers two types: double house and end of row house. Sloped roofs and brick constructions are quite common. The attic is included in the heated volume.



Italy



Floor plans and cross section of the German representative single-family house.



The Netherlands

The Netherlands

Almost 50 % of the newly built houses in the Netherlands are row houses. The average floor area of these row houses is 125 m². There is a variety of designs of row houses, including different types with sloped or flat roofs. Sloped roofs are most typical. The attic is part of the heated zone.



Norway



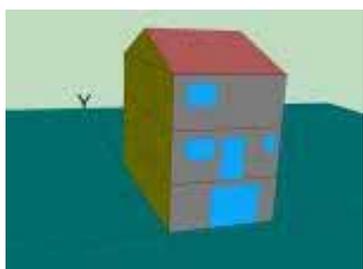
Floor plans and cross section of the Dutch representative single-family house.



Poland

The following table presents some of the geometrical characteristics of the three houses, calculated with heart to heart measures:

Characteristics	Belgian house	German house	Dutch house
General dimensions	8.6 m * 12.8 m	8.5 m * 11.7 m	5.4 m * 9.3 m
Total floor area	248 m ²	168 m ²	150 m ²
Floor height	2.65 m	2.8 m	2.8 m
Ground floor area	99 m ²	90 m ²	50 m ²
Total façade area (incl. windows)	159 m ²	139 m ²	60 m ²
Window area	40 m ²	36 m ²	24 m ²
Roof area	120 m ²	93 m ²	72 m ²
Total transmission loss area	378 m ²	322 m ²	182 m ²

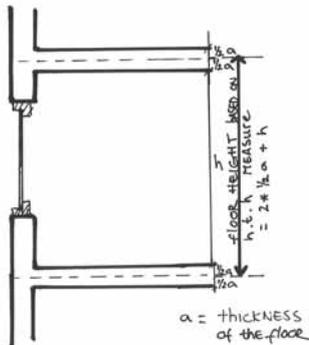
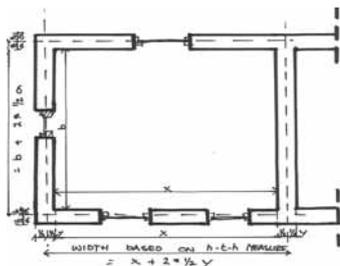


Spain

View of the collected national representative single-family houses of additional 5 EU Member States.

How to calculate with heart to heart measures is described in [2]. A scheme on the principle of heart to heart measures is shown on the next page. For lengths, widths and heights the centre of the building components is used as limit.

The differences in the presented values are quite large. The Belgian house is much bigger than the other two houses, both in floor area, but also in the transmission loss area. The total transmission loss area is more than



Principle of heart to heart measures.

double as high as for the Dutch building. On the other hand the comparison of the German and Dutch houses which have nearly the same total floor area shows that the facade area and the ground floor areas of the German house are much bigger. The quality of the U-values of these surface areas will therefore have a bigger relative influence on the energy balance of the German building than in the Dutch building.

The influence of the recalculation with heart to heart measures compared to the national foreseen method is shown for the example of Germany in the next table:

Characteristics	German semi-detached house	
	Calculated with heart to heart measures	Calculated with external dimensions (as foreseen in the German energy performance calculation standards)
General dimensions	8.5 m * 11.7 m	8.8 m * 12.1 m
Total floor area	168 m ²	169 m ² (=0.32*V _e)
Floor height	2.8 m	2.8 m
Ground floor area	90 m ²	97 m ²
Total façade area (incl. windows)	139 m ²	154 m ²
Window area	36 m ²	36 m ²
Roof area	93 m ²	101 m ²
Total transmission loss area	322 m ²	352 m ²

The impact of the different measurements for calculating the thermal loss areas can be quite significant. It is transferred directly to the thermal losses, but also via default values dependent on for example the floor area (e.g. internal gains and thermal bridge surcharges) on other energy balance parts.

4 > Summary

A collection of nationally representative single-family houses to be used in intercomparison studies on the energy performance requirements of different EU Member States was performed in the IEE ASIEPI project. 12 buildings varying from detached houses to row houses are presented in detail in a report soon to be available on the BUILD UP platform (www.buildup.eu). The paper at hand summarises the work but gives also information on how different the representative buildings look like and how this is expressed in characteristic geometrical values that have influence on the energy performance of buildings.

5 > References

1. Spiekman, M.; van Dijk, D.: "Comparing energy performance requirements over Europe." Information Paper P65 of the EPBD Buildings Platform (2008).
2. Spiekman, M. Westerlaken, N.: „Reference buildings for EP calculation studies. Report of ASIEPI WP2 (2009).

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