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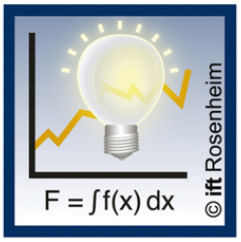
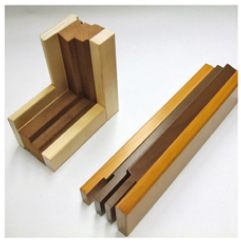
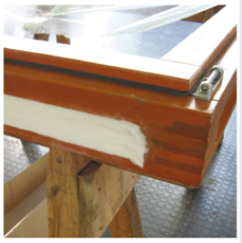
Short report

Sustainable optimisation of timber window profiles to achieve compliance with the requirements of the EnEV 2012

June 2011







Short Report
Timber windows 2012

Topic	Sustainable optimisation of timber window profiles to achieve compliance with the requirements of the EnEV 2012
Short title	Timber windows 2012
Project funding	The research project based on this report was sponsored by funds of the research initiative "Zukunft Bau" of the Bundesamt für Bauwesen und Raumordnung (Federal Office for Building and Regional Planning). (File number: Z6-10.08.18.7-08.30/II2-F20-08-49). The responsibility for the content of this report remains with the authors.
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Rosenheim, June 2011

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1 Motivation and objective of the project

On-going and future specifications of the Energy Savings Ordinance (EnEV), [1], rising energy costs and additional incentives provided by government sponsored measures [2] constantly call for construction techniques that are more energy-efficient. Since this results in the requirements of individual construction products becoming increasingly stringent, both for new structures and in the segment of energy-related refurbishment of buildings, elements of windows and exterior doors, too, must keep pace with this development and there must be an improvement in the values of heat transfer coefficients (U values) of these constructions (see Figure 1). The increasing stringencies in future will require considerable improvement in the heat transfer coefficients of window frames (U_f value), in addition to improvements in the field of glazing..

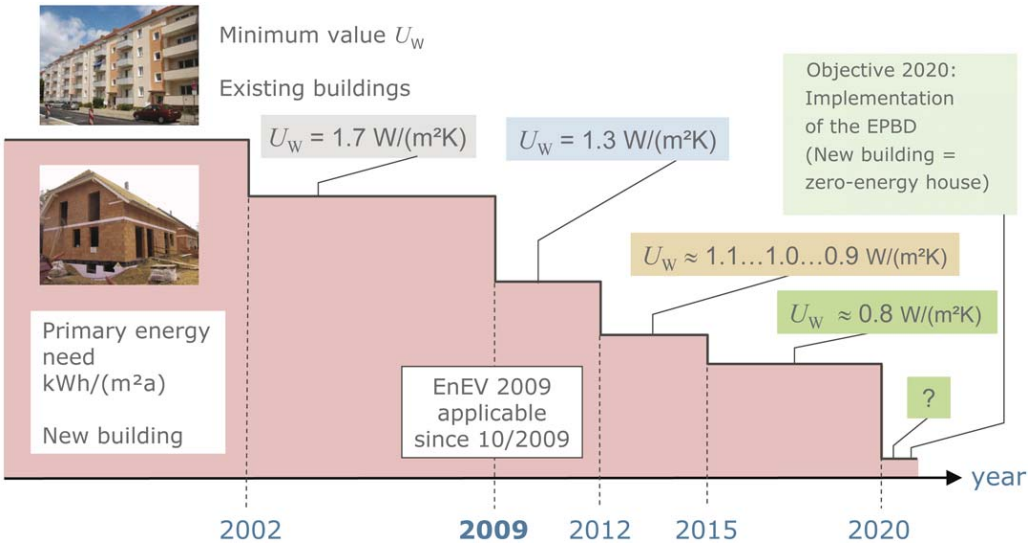


Figure 1 Development of the level of requirements of the EnEV [1] [3] [4]

Therefore, aim of the planned research project was to formulate concepts for optimising the thermal protection of timber window profiles as well as suggestions how to meet the increasing requirements related to design while taking all window-relevant specifications into account.

2 Procedure

Within the framework of this project, first, substantial performance specifications have been provided. Next to the requirements regarding the technical characteristics, construction details and aspects of design have been scrutinised as well to derive specifications for the "timber windows 2012".

The limitations of solid timber constructions as well as the possibilities of the integration of insulation materials were shown, using a broad range of calculations and a variation of the critical parameters, (see Figure 2) in the course of further work. The performance characteristics of new timber window systems which are currently being developed as well as their performance characteristics after artificial ageing have been examined.

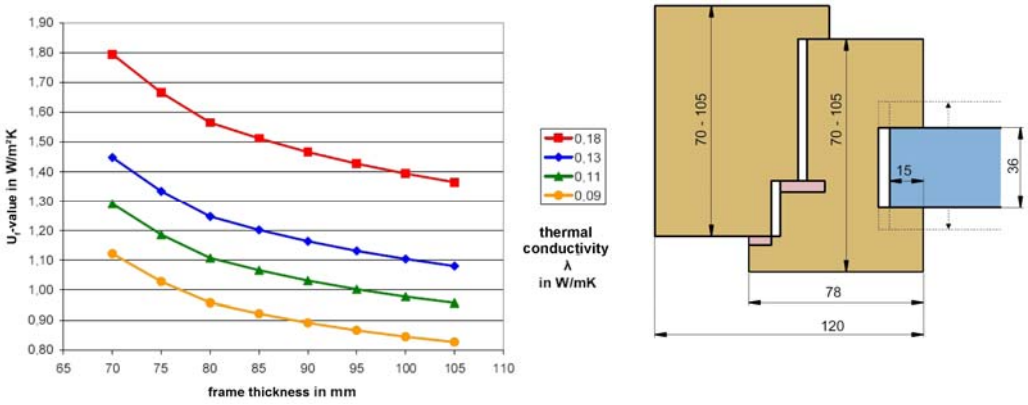


Figure 2 Thermal calculations

In addition, certain concepts and approaches have been analysed in greater depth to achieve greater developments related to thermal insulation. In the process, improvements, among others, by using modified types of wood have also been taken into consideration, apart from proposals and recommendations for implementing the integration of insulating materials. The impact on the suitability of use and performance characteristics of window constructions as well as the properties critical for use in timber window manufacture, have also been scrutinised for this purpose.

Apart from improvements that could be achieved in popular and proven construction variants of windows, the project also took innovative construction variants into consideration. Further investigations and calculations within the framework of this project were carried out with respect to a manufactured prototype.

3 Summary and Outlook

Based on the findings and insights gained from the research project, the outcome was that the requirements of the next stage of the Energy Savings Ordinance (EnEV) and of the current requirements of KfW [2] can be achieved with timber windows. Frame thicknesses of at least 90 mm in conjunction with triple-layer insulating glass can already be perceived today as the “new standard” or “state-of-the-art technology”.

Profile geometries with a thickness of 90 mm at present, reduced casement cross-sections and triple-layer MIG (Multi-layer Insulation Glass) can also work in this case with large elements. It is important while developing such systems to have on-going coordination with the manufacturers of hardware fittings, sealing profiles and tools and with all other relevant suppliers as early as possible during the development phase itself.

To take aspects of design into account and to enable clear demarcation with respect to other materials used in the frame, timber windows should have timber surfaces on the interior and exterior sides. Other constructions such as wood-aluminium windows, other mixed systems and also other frame materials, continue to have a promising outlook, however, they should be clearly demarcated from the timber window as a product.

We may reach excellent thermal insulation with casement window and coupled window constructions; in addition, it is easier to integrate technical components such as ventilation and solar shading systems. Apart from the more cumbersome and expensive production, and the unfavourable user-friendliness of such systems, they can undergo further development successfully for use in compatible construction projects in future.

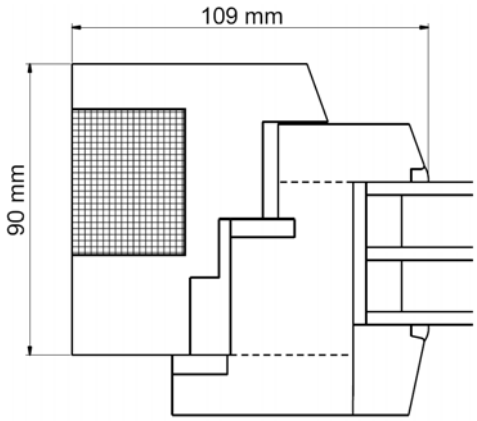
The integration of insulating materials in the window frame provides a simple, yet effective solution, and one that requires relatively little effort during manufacture, to improve the thermal characteristics of solid wood cross sections. If required, the insulating materials can be introduced into a groove from the outside regardless of the shape of the window (e.g. oblique, round etc.). The concept is highly flexible and can also be applied by manufacturers deploying manual production methods.

The corresponding solution provides casements without insulating material sections. In this case, these may be designed for the smallest possible cross-

section. The concept of “Insulation materials in the window frame” has a negligible impact on the design aspects and feasibility of different types of windows.

The use of modified wood types or those having low density and thermal conductivity, too, holds promising prospects for bringing about improvements in the thermal characteristics of timber windows. These could be used, for example, in the middle section of window edges, to improve the thermal characteristics. Dispensing with the use of plastics or insulating materials, in this case, results in advantages in construction, production and disposal. Furthermore, this has a negligible impact on the design aspects and feasibility of different types of windows. Over and above this, it is also possible to improve on all components of a window (e.g. mullion, dead bolt etc.).

A combination of the concepts of “insulation materials in window frames” and “modified wood” appears to be attractive in many segments (see Figure 3). The constructions with improvements in thermal characteristics that were analysed in the project showed only a minor impact on the critical performance characteristics of the windows.



* Highly simplified schematic illustration without relevant details of the solutions

Figure 3 Example of a timber window construction with a combination of a profile construction and the use of insulation material (U_w = 0.84 W/(m²K))

The properties of thermally modified wood (e.g. thermally modified poplar wood) are highly promising according to the findings of the relevant analyses conducted in the course of the research project. The outlook of success can also be expected conditionally from other thermally modified types of wood. Finally, to establish and verify the suitability for window manufacture, however, detailed tests and analyses must follow and the success of using the materials in practice must be verified.

A large potential for development is also perceived in innovative glazing systems or in constructions of integral windows. Integral solutions facilitate minimisation of the viewing widths, and thus, provide benefits with respect to both design and thermal characteristics.

The prototype manufactured and analysed in the course of the project work showed highly promising performance characteristics, adequate structural properties and excellent thermal characteristics. Simple and quick glazing of the finished construction is facilitated by using the multi-layer insulation glazing including the connecting frame as a delivered product. The limitations of such manufacturing variants arise in the constructional options or the constructions themselves. Solutions for profile windows often fail on account of compatible bonding agents, but they offer a great potential for development.

As a result of the findings and outcome of the research project, certain concepts are now available for the construction of timber window profiles having high levels of thermal insulation or for the “timber windows 2012”. These concepts can be applied by manufacturers of timber windows so that they can adapt their individual product portfolio to make it “fit” for the energy-related requirements of the future.

4 Acknowledgement

The research project based on this report was sponsored by funds of the research initiative "Zukunft Bau" of the Bundesamt für Bauwesen und Raumordnung (Federal Office for Building and Regional Planning). (File number: Z6-10.08.18.7-08.30/II2-F20-08-49). The responsibility for the content of this report remains with the authors.

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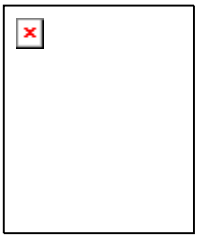

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