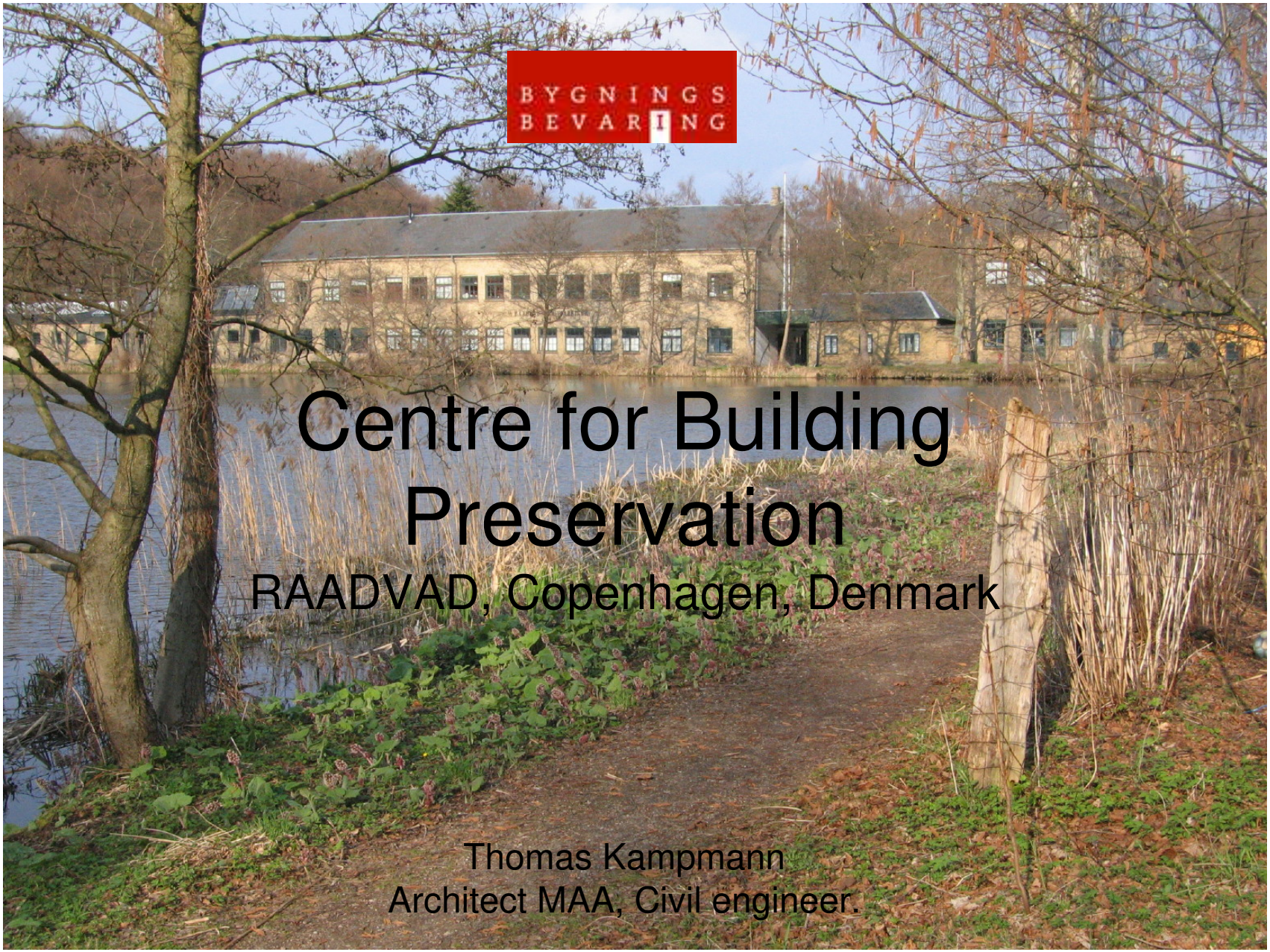


Centre for Building Preservation

RAADVAD, Copenhagen, Denmark

Thomas Kampmann
Architect MAA, Civil engineer.

Energy Efficiency in Historic buildings

- Climate changes and reliability of supply are at the centre of many political initiatives these years, including more stringent energy efficiency requirements.
- The Danish Cultural Heritage Agency wishes to contribute to developing methods that can improve energy efficiency in historical buildings while respecting their historical qualities.
- The Agency has therefore initiated a survey of experience with and knowledge of energy improvements in European buildings protected by law due to their historical or architectural qualities.
- The purpose of the survey is to gain an overview of practice and experience in relation to energy improvements.

The questionnaire.

Answers from 11 members of the European Heritage Head Forum

The questionnaire consisted of 11 questions primarily on these issues:

-what the heritage authorities have done in their own country to reduce energy consumption

-are there exceptions in the building legislation for listed buildings and buildings worthy of preservation

-are there an increased need for new research an tools into achieving substantial energy savings without compromising fundamental preservation interests

In addition there was specific questions on the most important parts of a building like roof, outer walls, windows, doors, ground deck, heating, ventilation, cooling…

What have the heritage authorities done in their own country

- Energy savings, including energy improvements in listed buildings and buildings worthy of preservation in Europe on the buildings' terms, is a top priority of antiquities authorities in Europe.
- Only few countries have taken the initiative to set specific goals and draw up proper action plans in this area.
- Great Britain and Sweden have allocated or contemplate allocating large sums to obtain improved knowledge in the area.

Building legislation provide exemptions for Historic buildings

- The survey shows that, to a wide extent, historic buildings are exempt from the rigorous energy requirements that apply to new construction and renovation, but even so, the energy requirements under the building regulations tend to rub off when the owners want to renovate or refurbish old buildings.

- Obviously, owners of old buildings, like all other house owners, want to save as much as possible on the heating bill, and they want the buildings to include modern comforts.

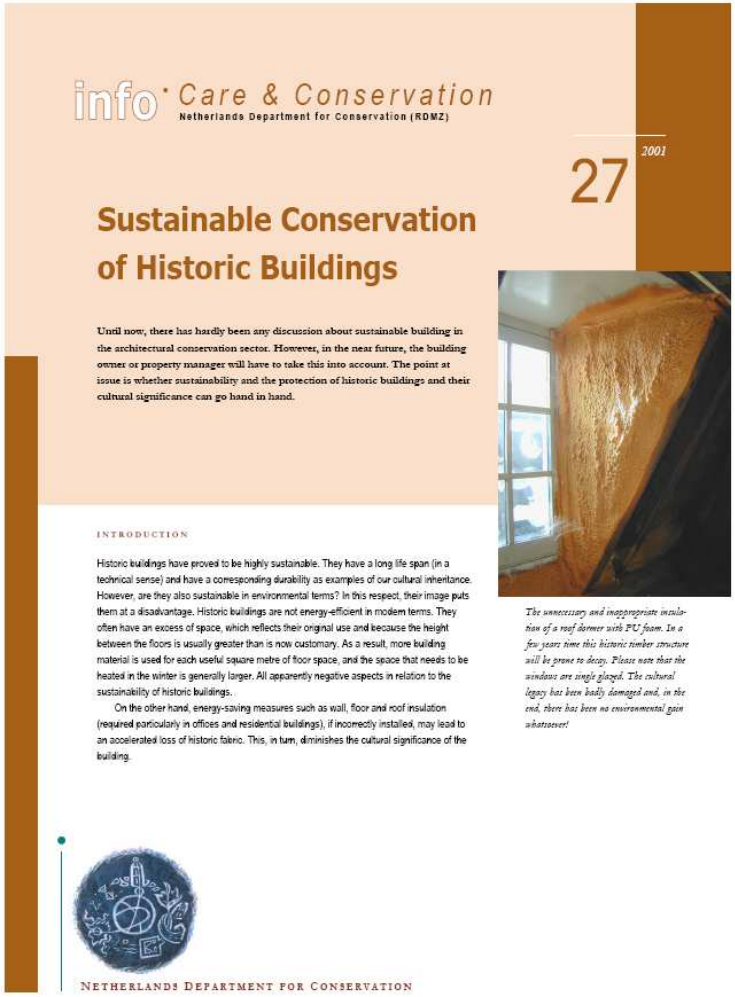
- Only to a very modest degree are historic buildings subject to regulatory requirements in terms of accounting for total energy performance, life cycle analysis, CO_2 calculation or indoor climate.

Need for new research an tools into achieving substantial energy savings

- Altogether, the European antiquities authorities have already taken a number of initiatives to inform house owners of good practice, but they agree that further knowledge is needed in this field.

- Great Britain and Holland have published proper directions for the introduction of energy savings in listed buildings and buildings worthy of preservation. On the part of Great Britain, this includes a website describing how to forestall the consequences of climate changes, e.g. flood control in the local community.

Published material from Holland



info · Care & Conservation
Netherlands Department for Conservation (RDMZ)

27 2001

Sustainable Conservation of Historic Buildings

Until now, there has hardly been any discussion about sustainable building in the architectural conservation sector. However, in the near future, the building owner or property manager will have to take this into account. The point at issue is whether sustainability and the protection of historic buildings and their cultural significance can go hand in hand.

INTRODUCTION

Historic buildings have proved to be highly sustainable. They have a long life span (in a technical sense) and have a corresponding durability as examples of our cultural inheritance. However, are they also sustainable in environmental terms? In this respect, their image puts them at a disadvantage. Historic buildings are not energy-efficient in modern terms. They often have an excess of space, which reflects their original use and because the height between the floors is usually greater than is now customary. As a result, more building material is used for each useful square metre of floor space, and the space that needs to be heated in the winter is generally larger. All apparently negative aspects in relation to the sustainability of historic buildings.

On the other hand, energy-saving measures such as wall, floor and roof insulation (required particularly in offices and residential buildings), if incorrectly installed, may lead to an accelerated loss of historic fabric. This, in turn, diminishes the cultural significance of the building.

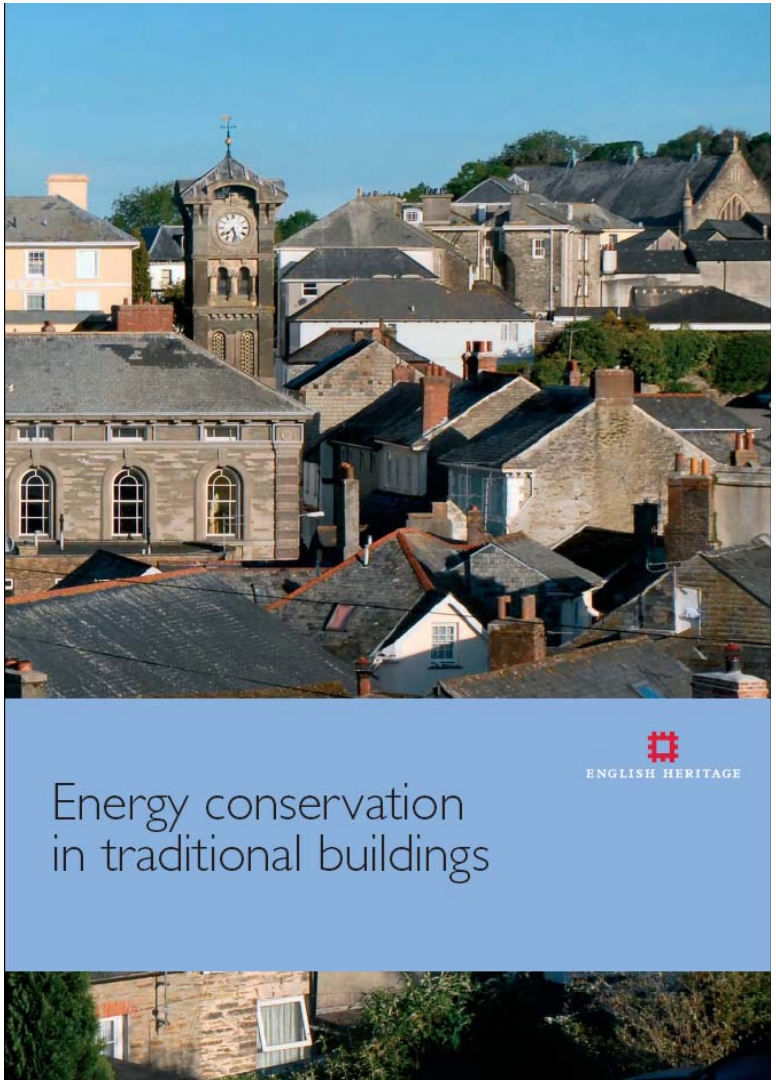
The unnecessary and inappropriate insulation of a roof dormer with PU foam. In a few years time this historic timber structure will be prone to decay. Please note that the windows are single glazed. The cultural legacy has been badly damaged and, in the end, there has been no environmental gain whatsoever!

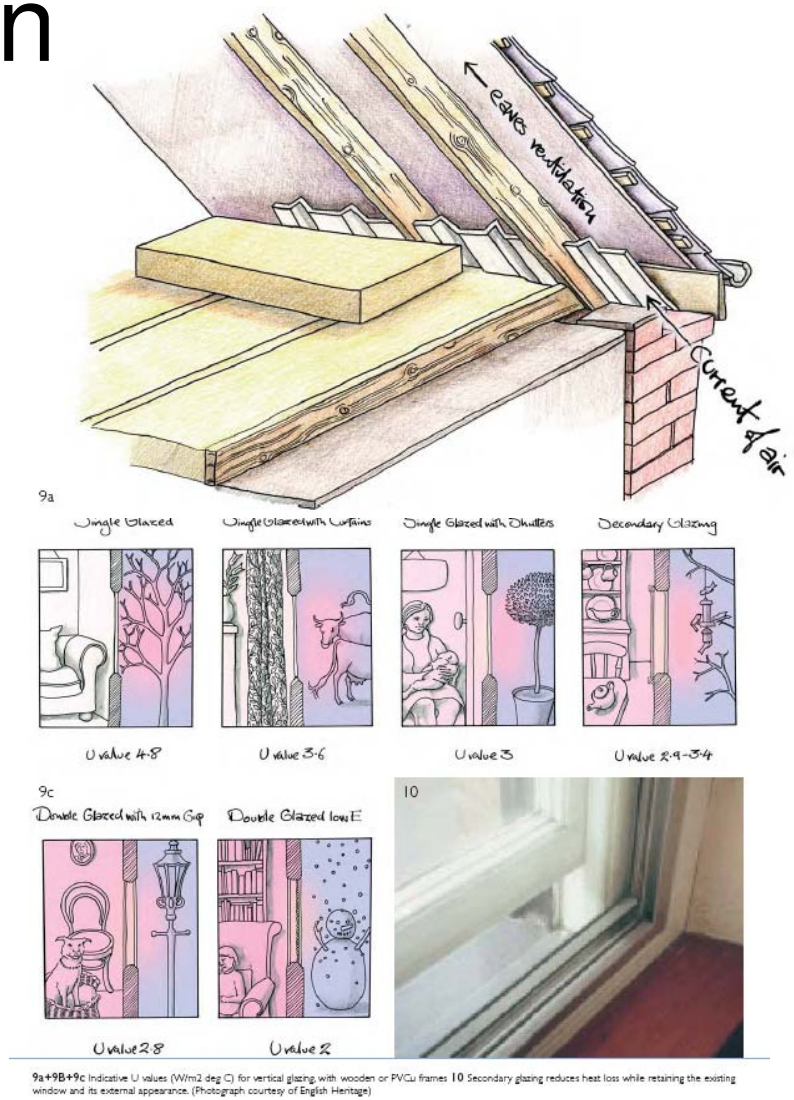
NETHERLANDS DEPARTMENT FOR CONSERVATION

Shutters and venetian blinds can play an important role in controlling the indoor climate. A 19th-century example of louvred blinds.

Centre for Building Preservation,
Denmark

Published material from Great Britain





9a+9B+9c Indicative U values (W/m2 deg C) for vertical glazing with wooden or PVCu frames **10** Secondary glazing reduces heat loss while retaining the existing window and its external appearance. (Photograph courtesy of English Heritage)

Centre for Building Preservation,
Denmark

Great Britain, website and a energy renovated house

Centre for Building Preservation, Denmark

Questions on energy loss through different part of a building

- Insulating roofs has been widely used
- Windows is an very important issue, should they be replaced with new ones or should the old windows be renovated so they are more energy efficient
- Many countries are working with how to produce the energy from alternative sources
- Air-condition uses a lot of energy – with better insulating this will also decrease

New tools for calculating on historic buildings

- The antiquities authorities generally call for energy calculation and life cycle analysis tools for historic buildings, particularly with a view to assessing energy-saving potentials.

- The energy calculation and life cycle analysis tools are developed for new buildings but should be adapted for use in connection with historic buildings.

- Scattered surveys and initiatives have already been implemented in the various countries. They have different aims, however, and they often originate in specific cases requiring specific solutions.

- The responses indicate that there has not yet been any large-scale exchange of knowledge and research results across national boundaries and between the relevant authorities.

Overall subjects

- The older building stock contributes substantially to the total man-made CO_2 emissions.
- Older buildings erected before 1950 make a significant contribution to the reduction of energy, CO_2 and resource consumption through the use of traditional materials, the life-span of those materials and renovation rather than demolition.
- Old houses have a comfortable indoor climate with few or no toxic substances. A holistic approach should therefore be taken to energy savings in buildings.
- As a result, there is a need to consider building preservation, energy, noise, indoor climate, allergies, life-cycle analyses, etc. together when it comes to making historic buildings more energy-efficient.
- Reinsulation may lead to the replacement of original building parts (windows, doors, roof, etc.). It may also cause building details to be covered up, and it may create technical problems.
- It is important to draw up guidelines on how to effectively and carefully implement energy improvements in historic buildings without damaging assets worthy of preservation.

Recommendations I

- Recommendations for the development of special tools and calculation methods aimed at historic buildings.

- Recommendations for an overall assessment of energy-saving potentials with the emphasis on preservation values prior to making final decisions on energy improvements in historic buildings.

- Recommendations to the effect that energy consultants should have special qualifications in relation to historic buildings.

Recommendations II

- That the existing research-based knowledge on energy improvements in historic buildings in the European countries should be exchanged, shared and coordinated. This would result in major savings in terms of money and resources.

- That an overview of knowledge in terms of who knows what, should be easily accessible.

- That shared new knowledge should be developed in special-priority areas.

- European antiquities authorities should take the initiative to establish a network through modern digital communication and through relevant specialist conferences

- The European antiquities authorities should consider whether there is a need to launch European collaborative projects in this relation.

- Two specific projects have been suggested:
- A: A project about preservation and energy improvement of windows
- B: Exchange of experience on the reinsulation of older buildings

Energy Project Villa

Before energy renovation

After energy renovation

Reducing energy consumption with more than 50 %

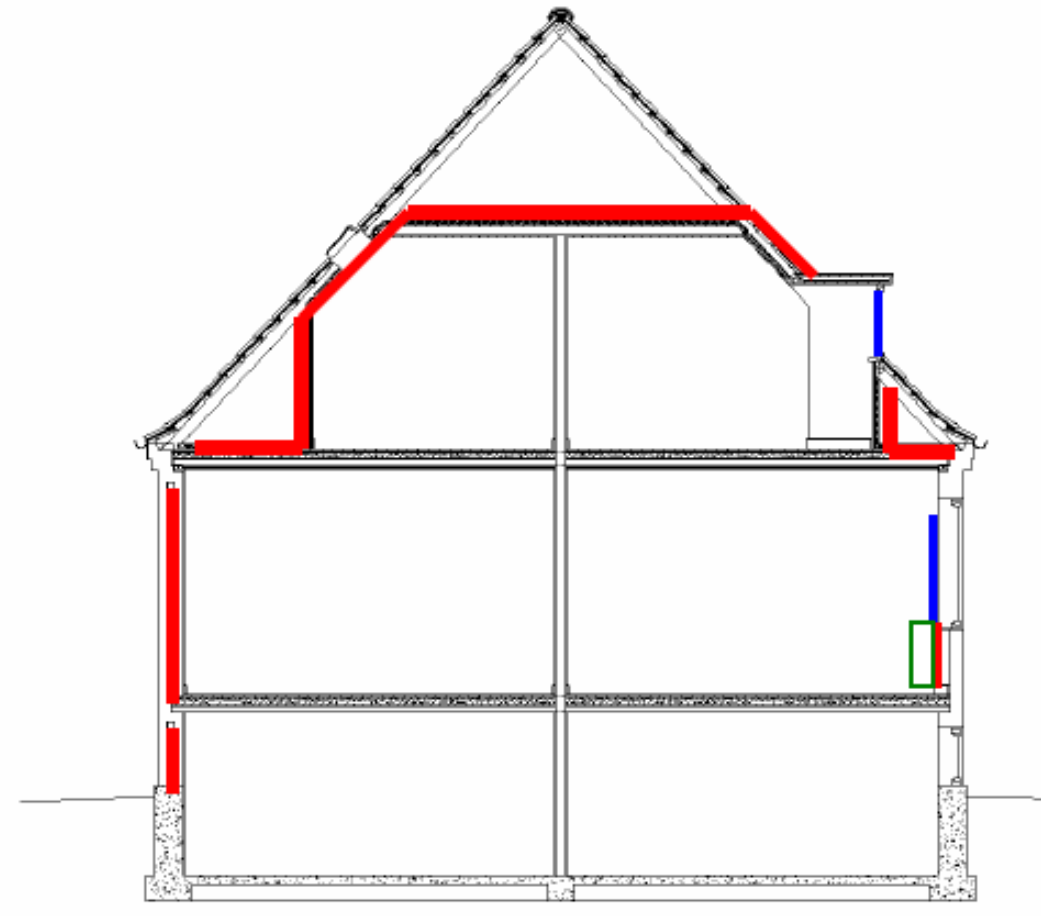
Centre for Building Preservation,
Denmark

What was done

- Insulation the cavity walls of the facades
- Retrofitting of sloped wall
- Retrofitting of loft
- 6 new radiators with thermostats and pump
- New storm windows with energy glass

The energy loos felt from 53.400 kWh/year
to 22.600 kWh/year after the energy improvements

More than 58 % reduction of energy consumptions.



Conclusion on project Villa

Documented energy savings in typical family house build before 1950 of 58 %

Energy renovation without compromising fundamental preservation interests

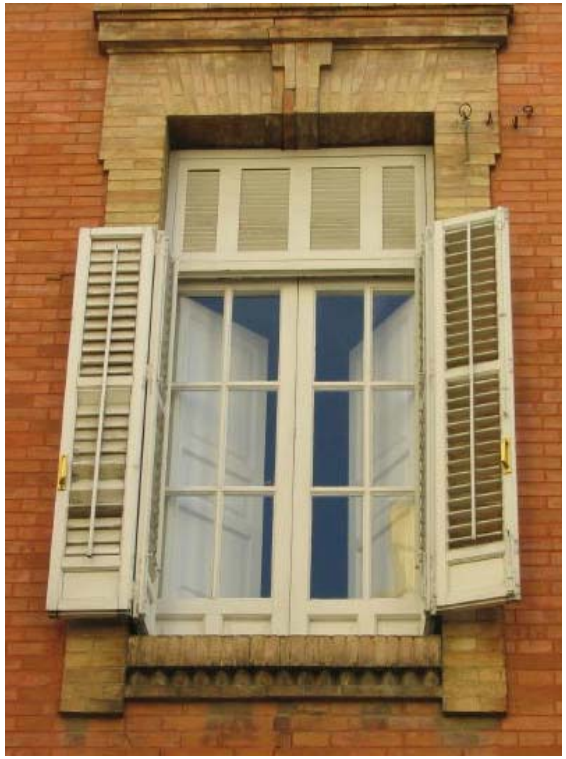
The work was carried out by professional contractors for a total cost of € 21.000

The energy savings resulted in an economic benefit, after financing the energy improvements, of €1005 the first year

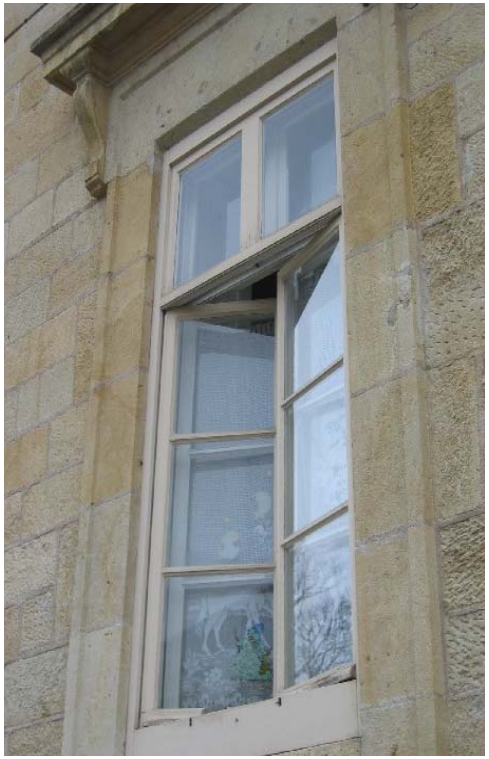
Seen over a 30 year period the total savings will be € 53.200

The comfort for the occupants has improved

Energy loss through windows



Spain



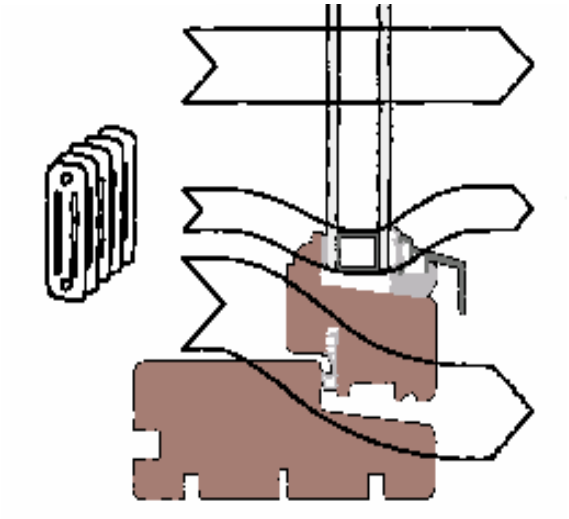
France

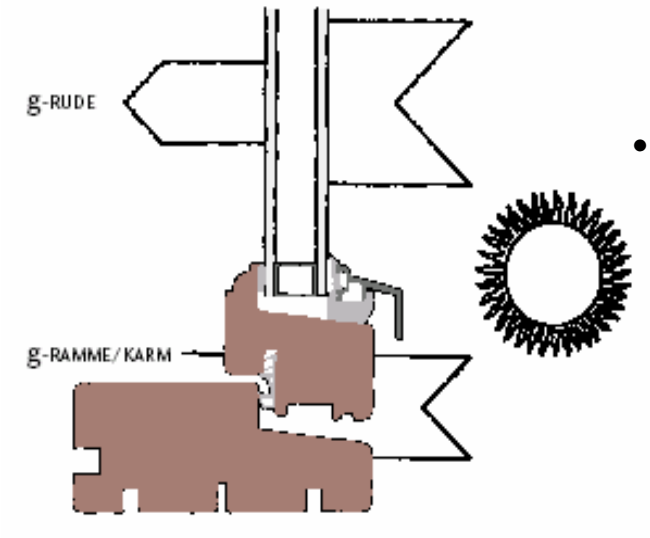
Denmark

Typical Danish double glazing

Centre for Building Preservation,
Denmark

Energy flow through windows

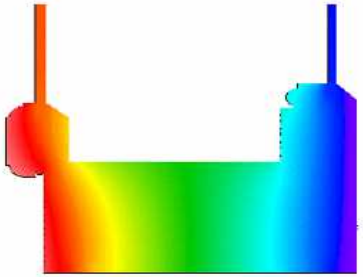




- Energy loss trough the hole window
- "Free" sun energy trough the panes in heating season
- Energy balance for the hole window

Inside Outside

Wood-aluminium window with double glazed low-e thermal panes 1.1 W/m²K
The green/azure colour indicates a thermal bridge



Old wooden window energy-improved with one inner secondary E-glass. There is red = warm temperature at the inside

Energy improvements of windows

1845: Traditional wooden window with one layers of standard glass.

U-window: 4,5

Energy-loss: ÷300 kWh/m²/year

Noise reduction R_w: 22 dB

1845/1960: Traditional window with two layers of standard glass.

U-window: 2,3

Energy-loss: ÷118 kWh/m²/year

Noise reduction R_w: 37 dB

2008: Modern wood/aluminium window with low-E double glazing.

U-window: 2,1

Energy-loss: ÷108 kWh/m²/year

Noise reduction R_w: 32 dB

1845/2008: Traditional box-window with, mounted with E-glass inside.

U-window: 1,6

Energy-loss: ÷59 kWh/m²/year

Noise reduction R_w: 45 dB