Cases studies: demonstration of energy efficiency measures in historic buildings

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Index

- Objectives
- Rules for the retrofitting of historic buildings
- Overview of the case studies
- Details of each case study and work achieved up to date
  - Istanbul case study
  - Glasgow case study
  - Benediktbeuern case study
  - Budapest case study
  - Santiago de Compostela case study
- Planning protocol for demonstration activities
### Main objective

Demonstration in seven real case studies the applicability of the EFFESUS new materials and validation of the Decision Support System (DSS) software tool.

### New materials

Development of new materials compatible with envelope retrofitting of historic buildings for increase their energy efficiency:
- Radiation selective coatings
- Aerogel insulation products
- Thermal insulating mortar
- Windows upgrade measures

### Specific objectives

To elaborate a monitoring plan to assess the performance of the developed technologies.

To prepare protocols, planning, modelling and implementation tools and to install the materials and systems developed in the case studies.

To demonstrate and validate the performance of the technological developments installed in the case studies.
General rules for the retrofitting of historic buildings

The main principle for the retrofitting of old buildings is to **preserve the original details** as much as possible.

1. Retain appearance of the building

2. Ensure reversibility

3. Without affecting the properties of the building/building envelope
Overview of the case studies- Rehabilitation/Intervention

**Budapest, Hungary**
- Window upgrade measures and integration of intelligent indoor systems.

**Istanbul, Turkey**
- Radiant selective coatings for exterior application.

**Glasgow, UK**
- Aerogel insulation products for use in cavities behind internal wall finishes.

**Benediktbeuern, Germany**
- New thermal insulating mortars.

**Santiago de Compostela, Spain**
- New control strategies to decrease the energy demand.
Overview of the case studies- Study and analysis

Visby, Sweden
Data collection and analysis to develop the structured categorisation of historic buildings and urban districts and validate the DSS software tool.

Genoa, Italy
Data collection and analysis to develop the structured categorisation of historic buildings and urban districts and validate the DSS software tool.
Overview of the case studies

Main selection criteria:

- Different European areas and different climate conditions.
- Different historic periods, constructed using different materials and architectural and urban patterns.
- Different levels of heritage protection.
- Strategically placed in Europe.
- The respective municipalities are committed to supporting the case studies in their cities.
Istanbul case study

Building in Beyoglu district

**Objective:** demonstrate the performance of a new IR reflective exterior coating compatible with historic buildings for reducing the heat transfer through the wall.

(planned to be performed by May 2015)

Street façade: traditional Turkey stone
Istanbul case study
Building in Beyoglu district

**Intervention plan:**

- 4th floor with the new coating

**Monitoring:**

- Indoor and outdoor surface temperature of the façade and windows.
- Surface temperature of the front and the back of a metal plate coated and fixed to the 4th floor façade.
- Heat flow
- Air temperature and relative humidity in both rooms
- Weather station
Glasgow case study
Flat in Yoker district

**Objective:** demonstrate the suitability of the aerogel insulation product(s) for use as insulation blown into cavities behind internal wall finishes.

(planned to be performed by Feb 2015)

- *Street façade: red sandstone*
- *External walls: traditional stone wall*
Glasgow case study

Flat in Yoker district

- Insulated walls with aerogel blown in
- Demonstration room
- Reference room
- Uninsulated wall

Monitoring:

- Heat flow
- Indoor and outdoor surface temperatures
- Air temperature and relative humidity in both rooms
Benediktbeuern case study

Abbey Benediktbeuern

**Objective:** demonstrate the performance of a new lime based mortar in order to reduce heat transfer through the building envelope.

**Description of the building:**
- One of Upper Bavaria’s oldest monastery complexes.
- Constructed in 1760.
- Application wall made out of mixed materials (field stones and bricks/no cement) and an area of about 8m².
Benediktbeuern case study

Abbey Benediktbeuern

Description of the intervention and monitoring plan:

Application of thermal insulating mortar, Isocal (June 2014)

1. Application of NHL2 lime paint
2. Application of the new thermal insulating lime based mortar, Isocal (3cm)
3. Implementation of the finishing layer 7 days after
**Benediktbeuern case study**

**Abbey Benediktbeuern**

**Description of the intervention and monitoring plan:**

**Monitoring:**

- Energy consumption
- Environmental parameters
  - air temperature
  - surface temperature
  - relative humidity
  - heat flux

Horizontal slice of the wall and sensor positions in the different layers
**Budapest case study**

**University of Technology and Economics**

**Objective:** demonstrate the improvement of original windows and intelligent indoor climate solutions.

- Replacement of the old windows by new windows with improved insulation, moisture and ventilation (partially finished)

- Integration of a intelligent indoor climate solutions: management of the existing lighting and heating system, control of the ventilation valves and blinds by Building Management System (BMS) (partially finished)
Budapest case study

University of Technology and Economics

Description of the intervention and monitoring plan

Existing windows: wooden box-windows with two layers of sashes separated by a 12 cm thick air gap, subdivided into 6 panes.

Prototype windows: wooden box-windows with two layers of glass sashes, thermal shades in between and ventilation valves.
Budapest case study

University of Technology and Economics

Replacement of original windows (Sept 2014)

1- Remove the original windows

Interior of the existing frame: mixture of bricks and mortar
Budapest case study

University of Technology and Economics

Replacement of original windows

2- Installing the new windows

Seal stripping

Screwing

Windows installed
Budapest case study

University of Technology and Economics

Description of the intervention and monitoring plan

• Monitoring in parallel in two rooms (planned to start in Feb 2015)
• Environmental monitoring and energy consumption:
  ✓ Surface temperature (surface contact sensors in both glazing layers)
  ✓ Air temperature and relative humidity of the windows (T/RH sensors in the cavity)
  ✓ Air temperature and relative humidity of the rooms.
  ✓ Thermal and electrical consumption metering
  ✓ Weather station
**Objective:** implementation of new control strategies to decrease the energy demand in historic buildings.

**Intervention plan:**
- Increase the number of sensors: electrical counters for the illumination circuit and heat consumption
- Integration with the existing controlling logic and communication bus.
The Planning Protocol for Demonstration Activities

Importance of Project Management planning:

Only one partner is local to the demonstration site and communication with other partners involved can be delayed.

Objective:

To guide the partners involved in each case study towards achieving a successful implementation of the innovations developed in the project.
The Planning Protocol for Demonstration Activities

Criteria to measure the success:

1. “Reversible” capability of the installation

2. Satisfaction of the building owner with the quality of the work and the condition of the building at the end of the demonstration.

3. The objectives of the project will be achieved within the allocated budgets.
The Planning Protocol for Demonstration Activities

Key steps:

“Before”: Planning and Coordination

“During”: The Installation

“After”: Handover and Commissioning

Outcome of this activity:

Written record of what work is to be done by whom, by when and how to preserve the heritage value of the building.
### Istanbul case study

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<th>Local partner</th>
<th>Material development</th>
<th>Material installation</th>
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<td>sampas nanotechnology</td>
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### Glasgow case study

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<td>HISTORIC SCOTLAND ALBA AOSMHOR</td>
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<td>HOR BER</td>
<td>snekkeriet</td>
<td>NTNU</td>
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International Symposium BAU 2015, Munich, 24 January 2015
Benedikt beuern case study

Local partner
Fraunhofer IBP

Material development
BOFIMEX

Material installation
Franz Gouas

Santiago de Compostela case study

Monitoring
Consiglio Nazionale delle Ricerche

Planning protocols
Dennis Rodwell
Architect and Planner

Red

Delap and Waller EcoCo
Integrated Sustainable Design Consultants
Thank you for your attention
Vielen Dank für Ihre Aufmerksamkeit

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