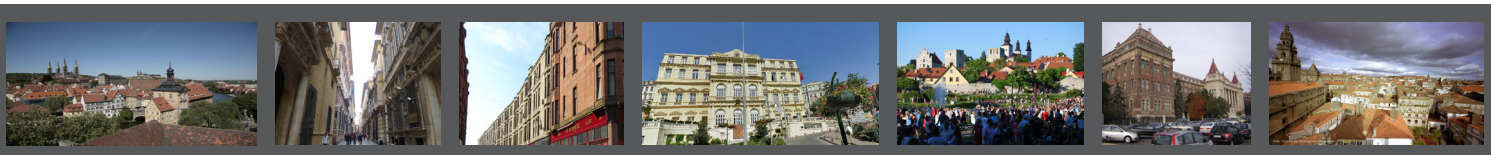

ENERGY EFFICIENCY FOR EU HISTORIC DISTRICTS SUSTAINABILITY

This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement No. 314678

NEWSLETTER NO. 3

EDITORIAL

Dear Friends,

Welcome to the 3rd edition of our newsletter. This publication is aimed at providing updated information of the EFFESUS project, which is getting more and more exciting and it is mainly focused on the first results of some of the new solutions, especially designed for heritage buildings and outlines the Visby (Sweden) case study. I wish to thank all of you for the support and trust received, so please keep on sending us your suggestions to enrich our publications!

Enjoy!

Isabel Rodriguez-Maribona,
EFFESUS coordinator

Development of new materials and experimental campaigns

EFFESUS is developing three solutions to significantly improve thermal insulation in historic buildings: radiant reflective coating, aerogel as blow in insulation and new lime mortars.

These solutions have the main objective of reducing heat transfer through the envelope and are especially designed to meet the needs of historic buildings. The importance of developing new solutions which are compatible with conservation criteria, considering their durability, reversibility and the preservation of the authenticity, is one of the outstanding values of EFFESUS. In order to test the behavior of the different materials, both from the energetic and conservative point of view, several substrates, representative of the European heritage, have been selected and characterized. Once the laboratory experimental campaigns will be finalized, the new materials will be tested in real outdoor conditions, thus checking most relevant and critical properties before their installation in the case study buildings.

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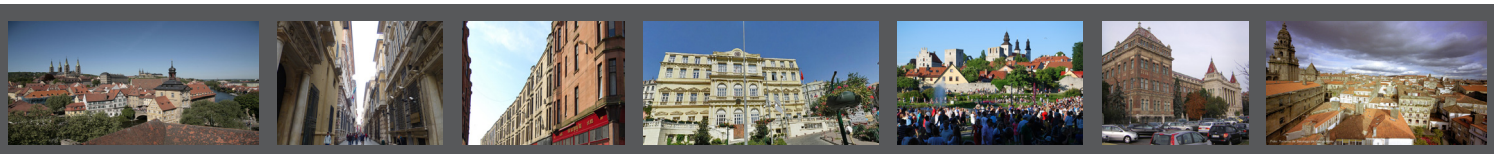

Role of Effesus Case Studies

The objective of the EFFESUS case studies is to demonstrate the applicability of the EFFESUS technological developments on real scale.

ISTANBUL: To test the performance of an exterior IR reflective coating, a suitable coating system is under development. The installation and monitoring of the coating is expected to be done by spring 2015.
GLASGOW: Currently three different aerogel options are being trialled: "candy floss" fibres, "fortified" beads and mix of both to test the performance of building fabric retrofitted with novel forms of aerogel insulation. Tests will be constructed in a traditional tenement building by October 2014.
BENEDIKTBEUERN: A new lime based mortar has been already installed in the Benediktbeuern (Germany) case study and the monitoring is ongoing.
BUDAPEST: In Hungary the improvement of original windows and integration of intelligent indoor climate solutions in one classroom of the historic building of University of Technology will be carried out by September/October 2014.
SANTIAGO DE COMPOSTELA: A dynamic geographical information system (GIS) and smart controls are planned to be implemented.

New insulated mortar
First Results

The last newsletter described ISOCAL, the new insulated mortar developed by Bofimex. The following results of the laboratory tests and the application process on real buildings will be covered in this case study.

Lab Tests:
The laboratory's tests are programmed in the University of Stuttgart (Germany) by Jürgen Frick and Manuela Reichert. The aim of this task is to evaluate the behaviour of the insulating mortar in response to extreme weather conditions such as frost, rain, snow, humidity, and heat. The lambda value claimed by Bofimex is also being tested and confirmed. GOUAS is in charge of the mortar's application is in charge of the mortar's application on the two sites.

Stone and Brick Wall

Wood Timber Wall

Gouas has to apply the mortar on two walls: one of wood timber frame filling bricks and the other wall filling part of stones and part of bricks. The two walls are 2.1 meters high and four meters long.

Some specific concerns:
1. Wood Timber Frame Wall
• The connection between the two pieces of wood in the middle of the wall
• The adhesion between stones (flat side) and mortar
2. Stone and brick wall
• We expect that there will be no problem with the brick wall since usually there's no problem with porous lime mortar in general).

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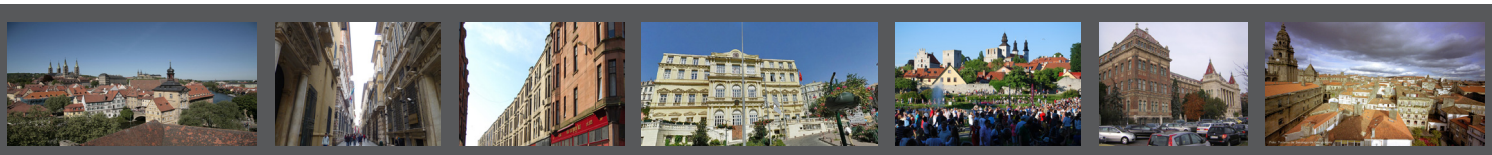

The surfaces were then prepared with 32 mm thick wooden beams to surround the mortar and ensure it is insulated properly. Then ISOCAL was applied in between the beams as specified in the fact sheet by the manufacturer.

Mortar Application on Wall

Problems encountered:
The adhesion of the mortar and the stone was not easy. For this kind of stone, users need to apply a contact layer of consolidation plaster. The connection between the two pieces of wood in the middle of the wood timber frame showed some cracks after seven days of drying even though mesh trips were put directly over the wooden beam.

Before performing a finishing layer of the Bofimex material, some parts of the ISOCAL were cut to simulate windows to check whether the material is reversible. We had no problem removing it without damage to the stones or bricks making a positive point for ISOCAL.

The only problem we had was with cleaning the tools. We had a lot of polystyrene bowls, and we had to collect them to not pollute the environment.

Application in a Real Building:
Another component of the trials was to apply the mortar in real weather conditions in a case study. We plastered an old wall with a window in the old cooperage of a Monastery in Benediktbeuern built in 1760.

It hosts the Fraunhofer-Center for Energy Efficiency of Historic Buildings and Conservation of Cultural Heritage Benediktbeuern, an innovative project of the Fraunhofer-Institute for Building Physics IBP which deals with all aspects of conserving Europe's architectural building heritage, as well as maintaining the fabric of historical buildings. Fraunhofer IBP agreed to use this wall on the condition that we do not put down the existing plaster and clean the wall after the EFFESUS project is finished.

We choose to apply the mortar by hand and not with a machine because the project requested that the material should be easy to use without need for special tools. To protect the wall we applied a distemper of lime (NHL2 and water). Then we put the wooden beam of 32 mm depth to ensure good insulation of the mortar.

Then we applied the ISOCAL Mortar with 3 cm thickness. Since the old walls are not flat, we had to apply the mortar in three layers but still encountered some problems with the adhesion of the mortar due to the uneven surface of the wall and the existing plaster.

Sometimes entire parts of mortar would fall off and we would need to apply them again with different layers and longer drying times for better adhesion.

This signifies that it is absolutely necessary to apply one contact layer in order to get smooth surfaced walls.
After seven days, we came back to finish the plaster. As agreed in the Visby meeting, we put a layer of "reabilitacal" finishing layer, provided by Bofimex, on the right side of the window. On the left side we placed a traditional French plaster based on Lime NHL5 provided by Bofimex and French river 'sand.'

Final result of Window Mortar

The visual result is good and we think that we can start to answer several questions about the project: ISOCAL seems to be compatible with historic buildings and is reversible and non-intrusive in the short-term (however, we need to confirm this is true after two years of life). It can be applied by every craftsman without any special tools and with simple training.

A problem to be resolved in the future is the proper cleaning of tools. Perhaps this can be supported by with instructions on the mortar packaging. Until then, we await the results of the laboratory experiments and the case study.

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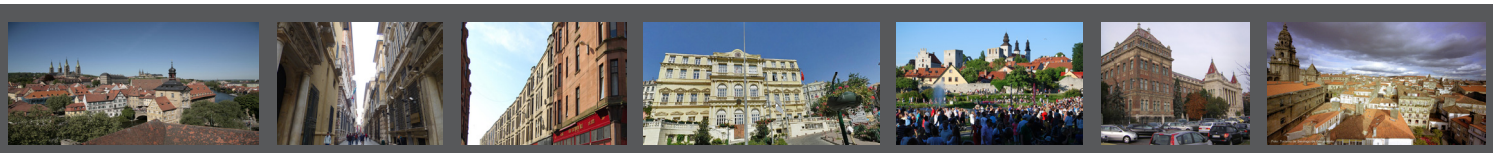

IR Reflective Coatings Development

Protective coatings applied for the conservation of Cultural Heritage have to meet a certain number of specific requirements. Specifically, the new IR reflective coating needs to fulfil the following requirements:

- Physically-chemically compatible
- Easily applicable
- Durable
- Aesthetically acceptable
- Reversible
- Non intrusive
- Reduces Heat Transfer

The chemical nature of the coating will mainly depend on the specific needs of the substrates on which it will be applied, and the desired durability to give to the coating. Thus, in order to design a suitable new coating from the point of view of its ideal properties a selection of five targeted substrates has been made.

Between the most abundant building materials of European Cultural Heritage sites there are sandstones, limestones, brick, travertines, granites, marbles and mortars (Davey, 1961; Mingarro Martín, 1996; Revuelta, 2000; Gisbert and Carrillo, 2001; Lazzarini and Laurenzi Tabasso, 1986).
These materials present some specific characteristics, namely:

- They are porous to a greater or less extent, so decay agents can enter into the substrate easily;
- When the buildings are located in urban, industrial or marine environments, they are subjected to the harmful action of contaminants, salts, etc;
- They are weathered due to their ancient condition i.e. may present different decay forms such as disaggregation, decolouration, etc.

The research will focus on different sandstone, limestone, solid bricks and lime mortars since these are commonly found in current European buildings. The selection of two stone substrates (including the limestone of the Istanbul case study and Villamayor sandstone) was performed according to the porosity and pore size of these materials. The aim was to make a selection of materials with a variety of porosity and pore size values.

Brick and lime mortar complete a representative selection of the porous materials that can be found at present in the Cultural Heritage buildings of Europe. On the other hand, an experimental set-up has been designed for the four substrates of interest. This experimental campaign includes mainly the following characterization tests:

- Physical properties: mineralogical analysis (DRX) and petrographic examination and density (just for the stony materials), porosimetry, colorimetry, adhesion
- Hydric properties: capillary water absorption, absorption at atmospheric pressure, water vapour permeability
- Water contact angle
- Penetration into substrate, coating appearance, reversibility
- Optical properties: Reflectance
- Durability: salt crystallization, frost/thaw cycles and UV light and condensation

Different Mortars researched in the study

In order to ensure that the reversibility of the IR reflective system is achieved, the use of a reversible primer prior the addition of the final IR reflective coating has been agreed upon. After testing different candidate primers widely used in Historic Buildings, a final primer has been selected.

Currently, all the specimens coated with the coating system (primer + IR reflective coating) are being prepared for characterisation. The experimental campaign will be finished by the beginning of October.

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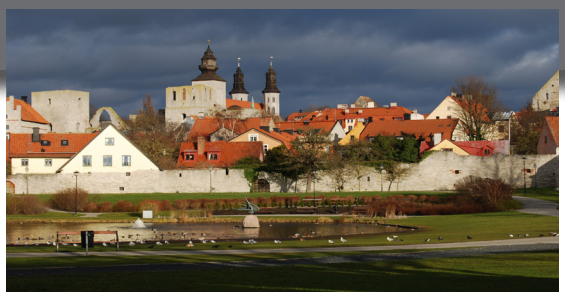
Case Study in Focus: *Visby*



Fact Sheet: Case Study Visby

Country	Sweden
Climate	Continental
Selected District	Medieval city centre
Case Study Level	Analysis
Local coordinator	Uppsala University
Scientific advisory	Uppsala University

Interview

Prof. Tor Broström, professor in building conservation and researcher Fredrik Berg at Uppsala University (Campus Gotland), tells about the role of Visby in EFFESUS. Visby is located on the island of Gotland in the Baltic Sea and is typical for many European historic city centres as its conservation aspects set a limit to energy performance. The municipality has set high standards for energy efficiency and launched a plan for the historic centre in which energy aspects are integrated with a general plan for building conservation. The historic town also has a wide spread network for district heating.

EFFESUS: Why was Visby chosen to provide information and data for the decision support system model to be developed in EFFESUS?

Since the University is literally in the heart of a World Heritage Site, we have a tradition of applied research of both practical and theoretical nature regarding the sustainable management of historic districts in Visby. In addition to its proximity, Visby is also a good example of a vital town with a historic core on one side of the town wall and a modern urban area on the other. It is therefore in everybody's interest to find a viable balance between energy saving potential and conservation policies, despite all the tension and trade-offs that it entails.

EFFESUS: What is the main purpose of the Visby case study?

Visby has been used to validate a new interdisciplinary building categorisation method that facilitates assessments of aspects associated to both cultural heritage significance and energy consumption. Considering that the investigation of a building stock as a whole normally cannot be made on a house by house basis, the main purpose has been to investigate and develop methods for reducing a historic building stock into representative building categories. The decision support system will then allow for a detailed analysis of a few selected buildings and the extrapolation of these results to a district level. On top of that we have also been working on identifying different historic district typologies.

EFFESUS: How did you collect the information that will be used in the categorisation methods and decision support system?

Since our ambition was not to reinvent the wheel when developing these methods, we tried to collate as much existing material and relevant information about the building stock as possible. This meant conducting and structuring a large but low-cost desktop survey using sources such as building inventories, digital cadastre maps and the *EPC database.*

EFFESUS: What are the most innovative and advantageous aspects of the EFFESUS related research done in Visby?

One of the most interesting spin-offs we have seen is how the different building categories can be correlated to the local conservation plan. Eventually this gives us a unique possibility to study the relation between historic character, heating demand, and refurbishment strategies which hopefully can contribute to better cooperation between stakeholders. And although the obtained results so far are local, we look forward to seeing more historic districts contributing to further validation of the method as the project advances.

EFFESUS: Can you describe Visby's district heating system and the main challenges regarding the use of district heating in Visby?

As of today circa 25 % of the buildings in the historic town are connected to the district heating network. In that sense, the area has great potential. The fuel distribution for the system is at the moment a mix of waste heat, biogas, petroleum and roughly 75 % wood. But because of high installation costs and the fact that the entire area is subject to mandatory excavations whenever the grid is extended, many owners of smaller buildings find the costs too high.

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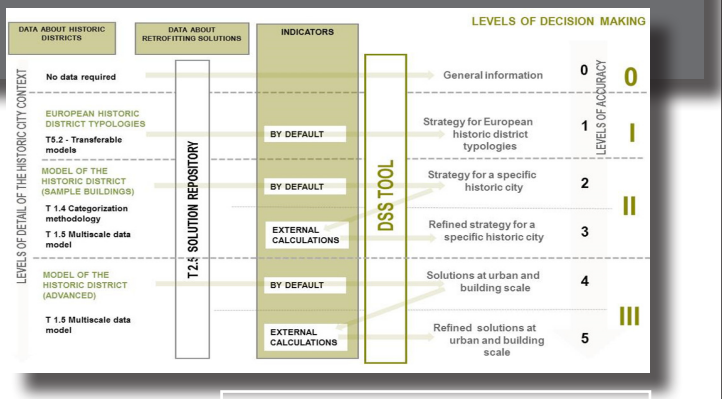
Conceptualisation, Results Integration and Strategies for Decision Making



Levels of Decision Making

At this point of the project, conceptualisation and result integration has been necessary in order to start defining the strategies for an overall methodology to assess energy interventions in cultural heritage both at building and district level. In addition the transferable models that will ensure the replicability of the results have been defined.

Results integration strategy

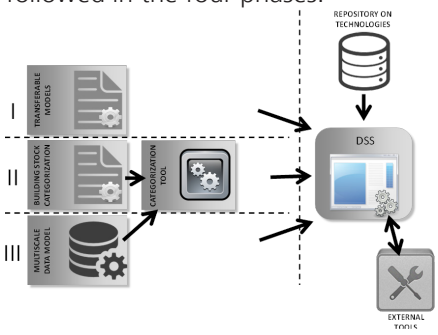
In this task, the conceptual preparations of the project results and the strategy for their integration in the final methodology and DSS have been defined. The different outcomes of the project so far (listed below) have been analysed and conceptualized in order to identify their role in the overall methodology.

- Impact Indicators
- European building stock categorization
- EFFESUS multiscale data model
- Repository on existing and replicable technologies
- Historic district geographical information system
- Transferable models

As a context for the strategy an overview of the state of the art decision making process for Historic Districts has been reviewed. In order to achieve a widespread use of the DSS, it has been tailored with four levels of decision making that links different levels of information availability with the different levels of results accuracy that could be provided by the tool. The different levels are the following:

- Level 0-General information
- Level I-Strategy for European historic district typologies
- Level II-Strategy for a specific historic city
- Level III-Solutions at urban and building scale

In this task, a first approach of information and methodological flow in the overall methodology regarding the II and III decision levels has been identified. The methodology addresses the multiscale nature of sustainability of the historic district, as strategies are defined at district level but they have to be implemented at building level. The methodology in the defined decision levels will take into account 4 different phases (Modelling, Decision Making, Management and Feedback) and the multiscale approach will be followed in the four phases.



Integration of DSS modules

In order to define the results integration strategy the information about the historic district, technologies and indicators has been analyzed and their connections drafted, as well as the integration between the different modules that will compose the DSS. The figure above shows the integration of the different modules in the DSS.

Transferable models

The objective of the "Transferable models" is to develop a characterisation method for historic districts and their buildings with limited information. A summary of the literature shows that district characterisation methods vary to a great extent since district analysis normally requires a manifold of complex indicators. Despite the level of detail, most studies emphasize that if a district is to be characterised, the required information must span from building to urban level.

The method proposed is based on a hierarchial approach in which national, district and building characterisation is done in 14 steps. In order to keep the required input information at a manageable level, the characterisation is conducted using questions, options and estimations which the user will provide. Finally, as each step has its own embedded parameters, the result is a combination of values and attributes ascribed to a set of district and building typologies which can be used as input for the DSS.

The method has been subjected to initial testing and applied on the historic building stocks of Visby and the street Corso Garibaldi in Genoa. The tests have been conducted on a hypothetical level with the help of a story-board. The results show that the method is practicable and that two diverse historic districts can be characterised on a hypothetical level by estimation with regards to cultural heritage legislation, climate and building typologies.

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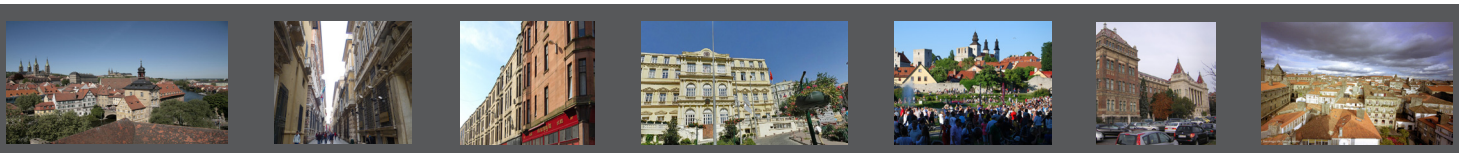

Partners in Focus:

SNANO

SAMPAŞ Nanotechnology (SNANO) is one of the few companies that focuses on commercialization of custom designed nano and green technology solutions in Turkey. Due to its technical background in material science and engineering disciplines SNANO will take part in challenging technical tasks related to material science research, in particular in the development of new materials for envelope retrofitting. SNANO will be involved in the application of innovative reflective coatings at a demonstration site in Beyoglu Township located in Istanbul and in dissemination activities.

D´APPOLONIA S.p.A

D'Appolonia S.p.A., as part of the RINA group, is a major Italian company which provides integrated engineering services to clients belonging both to the public and the private sector in the energy, environment, construction, oil and gas, transport, electronics and telecommunications domains. In EFFESUS, D'Appolonia leads the development of the repository on existing and replicable technologies for energy efficient improvements in historic buildings and districts. Moreover it contributes to the conceptualisation, results integration, and strategies for decision making.

SANTIAGO

The Consortium of the city of Santiago de Compostela is a public body shared by the Government of Spain, the regional Government of Galicia and the municipal Government of Santiago de Compostela. The main function is to encourage and coordinate the loyal and active cooperation between all entities and agents. In EFFESUS the Consortium acts as an end user and policy maker while serving as local coordinator of the Santiago case study. Moreover it participates in the definition of good practices and conservation criteria for the implementation of energy efficient rehabilitations.

Upcoming Events

Historical Scotland to host Energy Efficieny Conference 2014 – 30th September 2014 (Glasgow, Scotland)
A two day conference on the energy efficiency technologies and fabrics that have led to Performance improvements of historical buildings in Glasgow. More information available here: www.effesus.eu/events

Project Partners:

TECNALIA Research & Innovation / Fraunhofer-Gesellschaft / R.E.D. SRL / Integrated Information Systems / SNEKKERIET VERDAL AS / SAMPAŞ Nanotechnology / D'APPOLONIA SPA / Consortium of the City of Santiago de Compostela / ACCIONA Infrastructures S.A./ Uppsala University / EURAC RESEARCH / Delap & Waller EcoCo Ltd. / Dennis Rodwell / National Research Council – Institute of Atmospheric Sciences and Climate / University of Stuttgart – Institute of Materials Testing / Norwegian University of Science and Technology / BOFIMEX BOUWSTOFFEN BV / Historic Scotland / A. Proctor Group Ltd. / HOR-BER Ltd. / SAS GOUAS / Advanced Management Solutions Ltd. / Active Aerogels Lda

EFFESUS Key Facts

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