NEWSLETTER 02/2008

The EURACTIVE-ROOF project starts its last half a year of collective research

Project partners

Associations	
International Federation for the Roofers	**IFD**
Hungarian Federation of Roofing Contractors	ÉMSZ
Het Hellende Dak	HHD
Zentralverband des Deutschen Dachdeckerhandwerks	ZVDH
National Federation of Roofing Contractors	NFRC
National Energy Foundation	NEF
Construction Industry Federation (Roofing and Cladding Contractors Association)	CIF (RCCA)
Norwegian roofing research association	TPF
Schweizerischer Verband Dach und Wand	SVDW
Polskie Stowarzyszenie Dekarzy	PSD

Small/Medium Enterprises	
SolarVolta	SolarVolta
Biohaus	Biohaus
Bedachungstechnik Manfred Schröder GmbH	Schröder
Kuipers Consulting SL	Kuipers
Ecovent	ECOvent
H and E Costellos roofing	H&E
Tectum	Tectum
Alukol	Alukol
Puskas Muvek	Puskas
Schneiderbau	Schneider
Energy Equipment Testing Service Ltd	EETS
Solarwall Italia	Solarwall

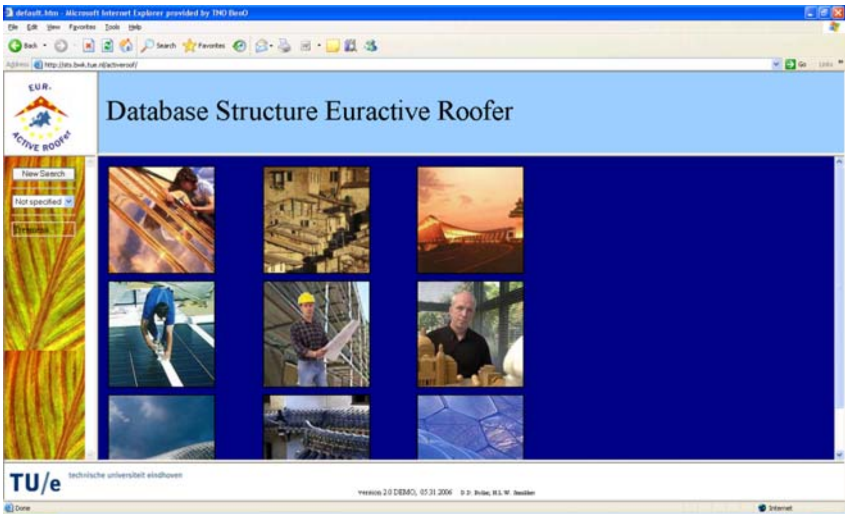
Research Institutes	
TNO	TNO
Building Research Establishment	BRE
Company for Quality Control and Innovation in Building	ÉMI
SINTEF Building and Infrastructure	SINTEF
Centre for Renewable Energy Sources	CRES
Cenergia	Cenergia
Bautechnisches Institut	BTI
Technische Universität Berlin	TU Berlin
TU Warsaw	WU T
Technische Universiteit Eindhoven	TU/e

EUR ACTIVE ROOFer Project

- **Collective Research project**
- **Subsidized by the European Commission**
- **New solutions for Active Roofers**
- **Upgrading of activities** from delivering roof coverings towards 'active-roof contractor'
- **Harmonised solutions -** Crossing European borders
- **Pan-European training -** Joint basis for roofers

The database:

- **a chance to get in front position and to design and built better roofs**
- **it offers the roofer**
  - **practical viewpoints for innovative roofs**
  - **best practice of subjects, solutions and projects**
  - **a tool to communicate knowledge**
- **the way to innovative roof engineering**
- **built on the shared knowledge of the federations**
- **basis for front position with decision-makers and designers**
- **high quality knowledge**
- **for high quality work**
- **for high quality buildings**



Effects of wind and earthquake

Work Package B of EUR Active Roofer deals with the effects of wind and earthquake to Active Roofs. Both studies into the loads as well on the resistance of Active Roofs are conducted. The work started early 2006, and is now nearly finished.

Earthquake loading of active roof products

Besides wind loading, earthquakes lead to horizontal loads on building structures. Comparative calculations have been made between wind loading and earthquake loads in various regions in Europe. For active roofs, these loads become important if they are leading to higher forces than found by applying the wind loads.
Within Europe, this may only be the case in some parts of southern Europe, e.g in Greece. Simple calculation models will be provided in the guidance and pre-standardisation documents of EUR Active Roofer.

Classification of wind loading on active roofs

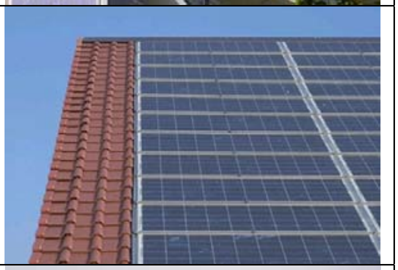
The wind loading on active roofs was covered partially by national guidelines, such as NVN and BRE digest. Within this project, the existing white spots in knowledge have been analysed, starting with a classification of active roofs with respect to wind loading. Three main classes have been defined for active roofs with respect to wind loading:

Class A: Products which are mounted to a building, but which are not a part of the roof covering. The aerodynamic coefficient of these products, in relation to the position on the building, is the key parameter to find the wind loads.
Class B: Products which are integrated on the roof, fulfilling also one or more of the traditional functions of the roof covering. In this case, the amount of pressure equalization that can be taken into account is relevant.
Class C: Products which are directly fixed (bonded) to the roof covering material. These materials simply must be fixed sufficiently to the base material.

An extended analysis was performed for these classes, and resulting calculation methods are given in TNO report 2006-D-R0203.

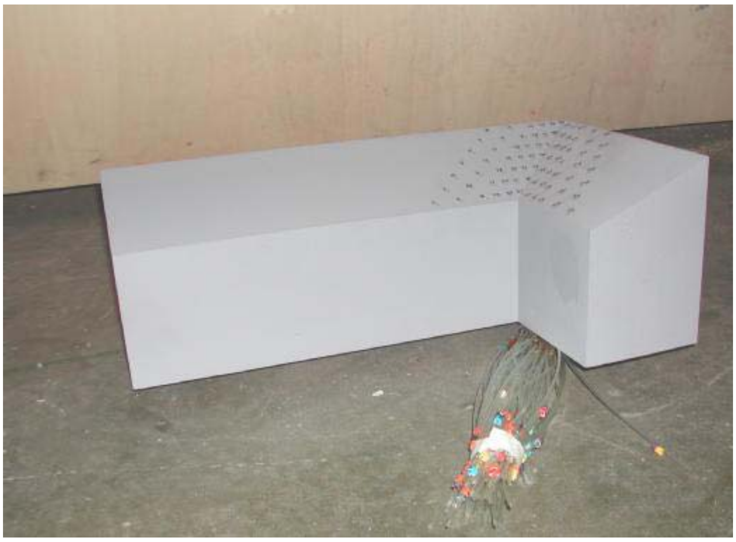
Wind loading on active roof products

The wind loading on active roof components is the result of a pressure difference over the roof product. This pressure difference depends on shape and dimensions of the building on which it is mounted, the location on the building on which the products are mounted; shape and dimensions of the product itself and of the roof structure. Typical examples are given in the overview below.

Products attached mechanically to buildings, as an add-on, for which the wind loading is determined strongly by the shape and dimensions of the product itself, together with the effect the building on which it is mounted, has on the wind. Examples are chimneys, lucarnes and vent outlets. Also, products as local wind turbines etcetera can be placed into this group.		
Products, integrated in the building envelope. These products may also fulfil other functions than e.g. energy resource, like rain screen. Examples are PV panels integrated between roofing tiles (or full roofs with PV panels).		
Products, which are placed on top of flat roofs, for which the resistance is delivered by the self-weight + additional ballast. These systems are widely spread, therefore an individual, custom made set of loading rules might lead to efficient structures.		
Products, attached to the roof, parallel to the roof surface, with a short distance to the roof surface. Examples are retrofit systems for photovoltaic systems on pitched roofs.		
Flexible solar energy systems (solar foils), which may serve as roof covering for flat and pitched roofs; often glued onto a substructure.		

Wind tunnel studies

An extended wind tunnel study was carried out by BRE to establish the wind loads in roof valleys. These experiments lead to coefficients for the local loads in roof valleys as a function of location and roof pitch.



TNO had performed a range of wind tunnel tests on solar energy systems placed on flat roofs. Values have been used already for NVN 7250 and BRE Digest 489, and will be the basis for the pre-standardisation document of EUR Active Roofer. The Figure below gives some images of these experiments.

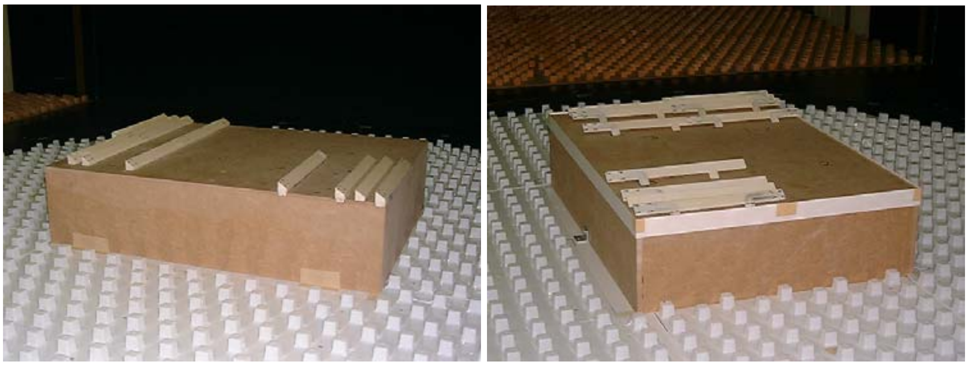


Figure: View of the wind tunnel model Left: with closed structure, and no parapets. To the right: solar energy systems with open structure, roof with parapet.

Computational Fluid Dynamics (CFD) Studies
The use of CFD is also investigated in this project. Application of programs to calculate the effect of flows around buildings may be an interesting way to predict pressures on active roof products. This is of interest of both wind loading and driving rain studies. The University of Berlin performs a series of calculations. First, validation and verification of CFD programs is performed to select the most appropriate program. The wind tunnel test carried out by TNO on products on flat roofs serve as reference for this exercise. After selecting one of the programs, a parametric study to different solutions can be performed.

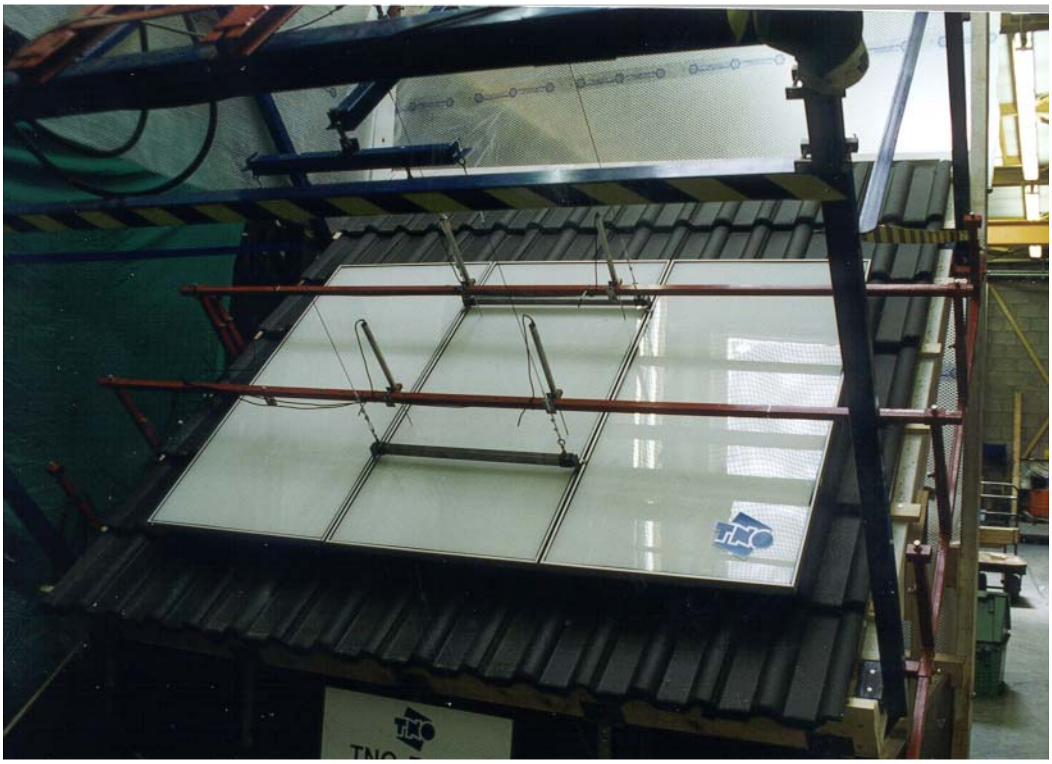
Full scale testing
To obtain design data for such situations, full scale and wind tunnel experiments are being performed in the EUR-ACTIVE Roofer project. A full scale measurement in the Netherlands will be accompanied by model tests on the same house in the wind tunnel of BRE. Besides comparing the results of these tests, parametric studies will be performed in the wind tunnel. These experiments may serve as a bench mark study in the future, for e.g. further model studies, or for CFD calculations.

Test house for full scale experiments (left), and corresponding wind tunnel model.

Results from these experiments are expected early 2008, just in time to have the knowledge from these experiments included in dissemination and training.

Uplift resistance of active roof products

The uplift resistance of roof products may be delivered by the self weight of the structure and products, or by applying appropriate mechanical fixings. The design values for this uplift resistance are determined by experiments, usually following a codified procedure.
Active roof products may be fixed in various ways, which usually are covered by current procedures. The strength of screws and nails in different material should normally be available from the manufacturer. For roofing tiles and slates, recently EN 14437 was developed. The procedures in this standard form the basis for a method to establish the uplift resistance to solar energy systems. Some indicative tests have been performed to check the suitability of this test method. Results will be used in guidance documents, and the procedures will be included in the training programs.



Test performed on solar energy mock up in the laboratory.

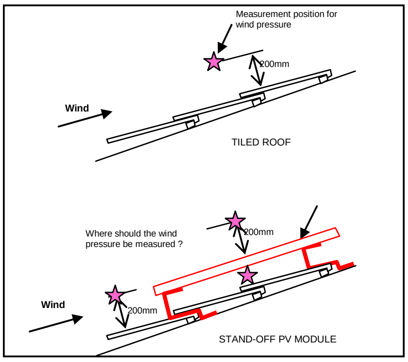
Rain and wind driven rain

The principal objectives of this work package are:

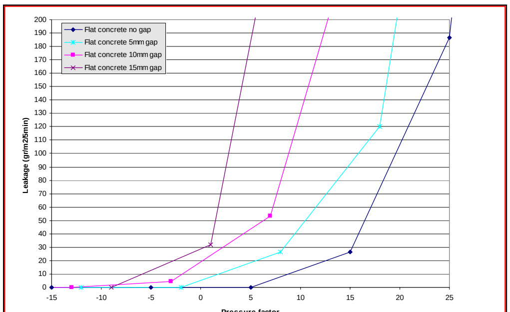
- To undertake prenormative research into the performance of Active Roofs under rain and driving rain action.
- To develop technical solutions for minimising leakage of Active Roofs.
- To prepare technical guidance and assessment methods for evaluating the performance of roof accessories and fittings of Active Roofs to driving rain.

During the last six months there has been one Working Group meeting which was held in Dublin in July and kindly hosted by Eamonn Costello and sponsored jointly by H & E Costellos Roofing Ltd, Kingspan Building, Sika Ireland Ltd and Moy Materials. Test has been carried out by BRE to determine the correct location for measuring the reference pressure for driving rain tests on stand-off PV systems, as shown in the figures below:

Dummy stand-off PV module used for testing



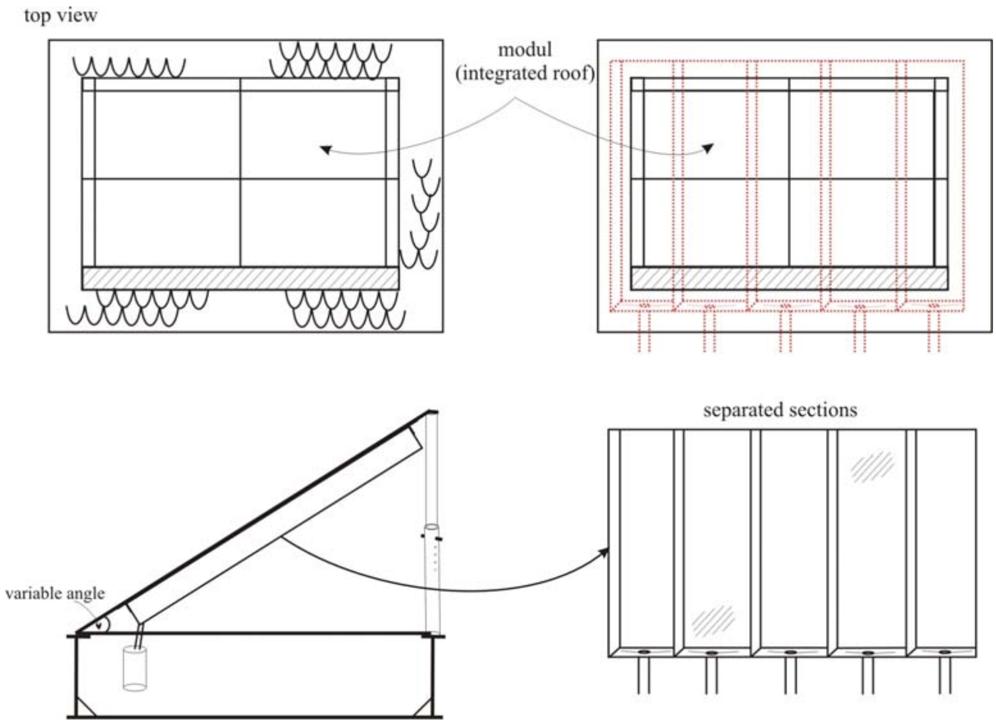
Other testing, carried out to determine the effect on driving rain performance of gaps between tiles caused by the hooks of stand-off PV modules has shown that these gaps should not be more than about 5mm otherwise they can cause a significant increase in rain leakage as shown in the test results in the figure below:



Effect of gap size on performance of flat concrete tiles

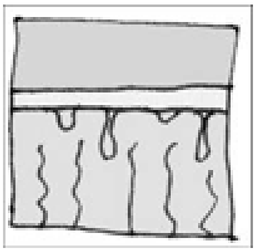
Other work in this WPC has been carried out by Biohaus who have installed a full-scale test bench to measure wind pressures and rainfall rate on a roof with a PV module, and the Technical University of Berlin have started to carry out CFD studies to simulate driving rain effects on tiled roofs. Preliminary measurements from the Biohaus experiments have been presented at the 5th Annual Congress in Siofok.

Biohaus test bench



Main outputs from WPC

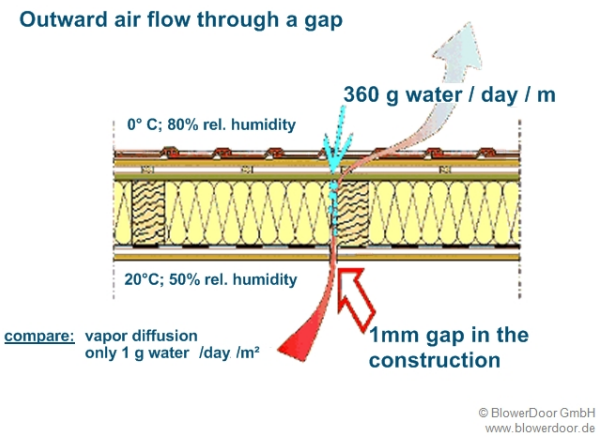
- A classification system for PV systems
- A test method for assessing the driving rain performance of PV systems
- Guidance on acceptable gaps between tiles to minimise rain leakage
- Full scale measurements of the driving rain performance of an active roof system
- A computational tool (CFD) for modelling driving rain penetration through roof tile arrays
- An assessment of driving rain rates from full scale wind and rain measurements



Condensation

In the near future buildings will be more insulated and air tightness will be a crucial fact for the efficiency of a building. And therefore follows the need to avoid condensation inside constructions in order to:

- minimize the thermal losses
- optimize the living comfort
- stop condensation damages in constructions



Laboratory Tests:

The additional tests with the full scale thermal panel are finished.

The values for humidity and temperature were taken at particular points of the whole roof construction during heating and cooling cycles in the thermal/rain apparatus of BTI.

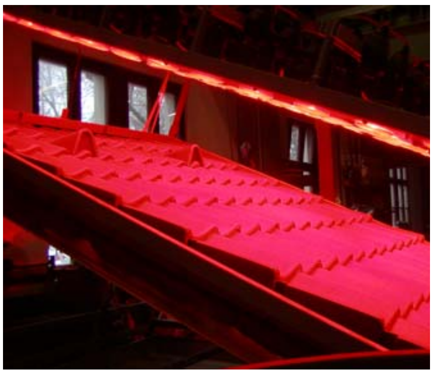
But also under real conditions the values were taken. Therefore the construction was erected outdoors. For the first time with a south-orientation and the second time south-west orientated.

The results and data now will be compared among each other and with the data from the tests in the climatic chamber.

An additional test with an erected roof construction is running in order to measure different flow speeds in the ventilation gap for different construction variations.
And the consequence of condensation in the construction on the materials will be checked.

Full scale tests, carried out by Kuipers, Solarwall, Cenergia and EMI are still running and should be finalized in spring 2008.

The further calculations with the full scale test model are not available yet but are under way.

Snow and Ice Load

Fresh Air Ventilation Intake and Snow Inlet Problems

One active element found on many building roofs is a fresh air ventilation intake, which purpose is to provide satisfactorily amounts of fresh air to the interior of the building. These air intakes need to be sufficiently shielded from water ingress in the form of rain, wind-driven rain, snow and wind-driven snow.

In several buildings experiencing moisture damage problems, the original cause or source for these problems may be led back to water ingress through the fresh air ventilation intakes. In many cases it is suspected that the roof itself has some unknown and hidden leakage spots, whereas the culprit is in fact often the air intakes. Regretfully, it is often observed that the air intakes have insufficient or no shielding at all.

Often it is relatively simple to shield both new and existing air intakes from undesirable snow and rain ingress. It is of course best to take this shielding into account already at the planning stage and as early as possible in order to be able to make a proper shielding in the most effective way. There have been cases where physical dimensions of the building have made it difficult to avoid snow and rain ingress through the air intakes since this was not part of the planning phase in the building process. Besides, if moisture is led into the buildings through the air intakes, this might be undetected for longer time periods. Hence, it may cause large building damages and even lead to health problems among human beings due to fungus growth.

GENERAL SOLUTION PRINCIPLES

Generally, the following two principles should be followed by making a fresh air ventilation intake:

- **Shielding** - block off as much as possible of the snow and rain from penetrating the air intake, e.g. by making a shield where air enters only upwards from below and into a larger space and thereby with reduced air velocity, see fig.1.
- **Drainage** - make a watertight system which drains away any water coming into the ventilation system.

The general principles above are also valid for most building components and structures.

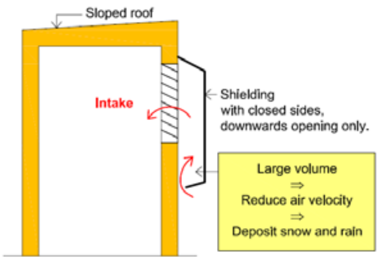


Fig.1. Principal drawing for shielding a fresh air ventilation intake. Note that the sides are also to be shielded, i.e. only air intake from under the shielding and upwards.

REAL PROBLEM EXAMPLE

A building located at an university campus experienced extensive moisture problems with large fungus damages. Several people got sick and finally the building had to be evacuated.

The building has two large fresh air ventilation intakes and outlets situated on the roof, see fig.2. The intakes are placed vertically on the base of the ventilation houses, while the outlets are placed horizontally on the top of the ventilation houses. Originally there was no shielding except the normal intake grid covers.

Firstly, it was thought that the moisture coming into the building originated from leakages in the roof or earlier built-in moisture in the roof. This first assumption was found not to be correct. In fact, the culprit was the fresh air ventilation intakes. The air intakes had no shielding and through them snow and rain penetrated into the building. The air intakes were then shielded as depicted in fig.2. The shielding has been working satisfactorily with respect to no more observations of moisture or fungus growth problems.

Note that it is also recommended to shield the open sides shown here, i.e. only air intake from under the shielding and upwards. With the current design, snow and rain may still pass through the air intakes if the wind direction is unfavourable with respect to the shielding as of today.

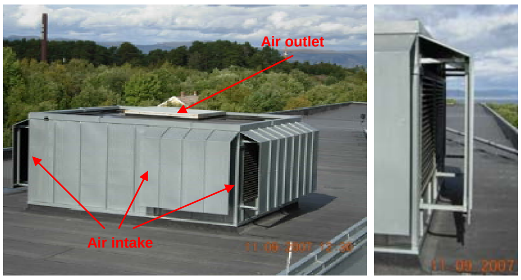


Fig.2. Shielded fresh air intakes on the roof where it earlier was extensive moisture problems with large fungus damages and so huge health problems among people that the building had to be evacuated. Vertical intakes on the sides and horizontal outlet on the top. Note that it is also recommended to shield the open sides shown here, i.e. only air intake from under the shielding and upwards. (Photo: SINTEF Building and Infrastructure)

Safety, Installation, Maintenance and Repair

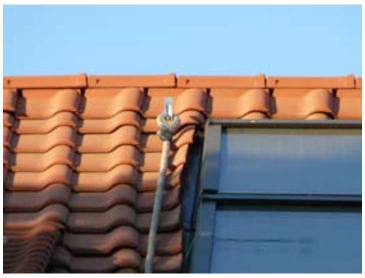
The majority of the Installation, Maintenance and Repair (IM&R) works take part on existing roofs in different, often severe climatic conditions. In case of Active Roofs this kind of work will be increased because of the wide variety of products integrated in the roof, which leads to more risky joints and possibilities of failure than a traditional roof. Many failures have their origin in the early design stage, where the roofer is usually not involved. Poor design will increase the chance of problems during IM&R works and during the use of the roofs, such as leakage and lacking safety devices.
Therefore the objectives of the work package are:

1. Improve the IM&R by providing input for the roofer in the design stage of the roof by developing knowledge and tools, which lead to effective installation, safer IM&R and more failure proof Active Roofs.

2. Improve the diagnostic methods of the existing situation for more proper, “intelligent” procedures and development of non-destructive detecting of the present moisture situation and possible failure spots inside the roof.

3. Innovative safety devices, best practice catalogues and basis for legislation of (mandatory) safety devices.





The full scale test aims

- identify and compare the temperature and humidity condition of integrated and non integrated solar collector system
- increase artificially the vapour and test the possible condensation in winter periode
- test the efficiency changing of integrated PV systems in summer periode

Best Practice Catalogue

For the Best Practice Catalogue relating the Installation, Maintenance & Repair good examples were gathered with the activity of the partners from different countries based upon basic guidelines and companies system information. The main feature of the Best Practice Catalogue was primarily discussed and presented with discussion.
The principles of mobile safety devices were presented and discussed in Krakow. The devices were manufactured in Hungary with involving SMEs, the experiences of realization of the devices and further challenges were discussed in Trondheim. The testing of the devices has been started in laboratory model; the preparation of the test devices in real circumstances has been started. Experiences on innovative mobile or fixed + mobile systems were discussed in the Dutch Roofing School in and by the representative of Dutch Pitch Roof Federation in Holland.
The legislation proposals concerning Installation, Maintenance & Repair were presented, focusing the safe access to the roof, the mobile of safety devices and the increase of the reserve in safety via double independent safety system.

The failure detection system has been tested in laboratory scale applied to the formal four model roofing system and two inverted roof systems, and a new geotextile material is started to test for a better localization. A pilot roofing project has been installed and monitored in Hungary.

Gaining relevant experiences from the laboratory experiences and the pilot project of the failure detection system in Hungary, further laboratory test will be carried out in Norway and a pilot project application in Ireland. The test will be focused of the application of the geotextile with wires as better possibility of the localization
.
Pitch roof mobile safety devices will be tested in real installation circumstances in the full scale PV application project in Csobánka, Hungary. Also a test of the innovative mobile safety systems in roofing schools is foreseen.
The labelling system of the Installation, Maintenance and Repair works is facing further discussions.

Guidance and dissemination

The main objectives of work package Guidance and dissemination are laid down in the following four points:

1. Evaluation of the performance criteria of work packages on wind loading, rain and driving rain, snow and snowdrift, condensation effects and Safety in Installation, Maintenance and Repair
2. An increase of competitiveness of roofers through development of simple rules for design and guidelines on Active Roofs.
3. Gathering of best practice examples.
4. Providing guidance documents for the European SMEs on Active Roofs.

Presentations on national roofer meetings have been done. For further presentations interested organisations can register at IFD office.
Further information is planned on national level.

Publication of the (intermediate) results in national and international journals for the roofing trade has been done, e.g. in Germany. Further publications are foreseen.
A further developed draft document for guidance has been set up, of which the performance requirements and assessment procedures, the product characteristics and the application rules are an integral part. This draft documents is European, under the IFD-mark and passing relevant courses may lead to a marking for Active Roofs as EAR in the future.
The **EAR-marking (E**ur**A**ctive **R**oof**)** system can/may include a proposal for product and system label (Active Roofs), as well as label of the process (Active Roofers).

EAR-marking (Eur**A**ctive **R**oof) given by the roofing company

	Covering or waterproofing with **EAR-marking** include		
	Systems with products Fulfil requirements on national side		Roofer Trained and registered company with trained staff
Examples for tasks of national federations and/or IFD:	List of systems (including products, installation instructions and performance)		List of companies Training courses

Pre-Standardization of Active Roof Components – Solar Energy Systems

The 'state of the art' of standardization in the field of active roofs is at the moment on a very low level or even for some aspects non-existing. The EURACTIVE ROOFer project therefore sets up several work packages to study the main aspects of roof products like protection against climate exposures like wind, rain, condensation, snow, ice etc. The aim of this work is to generate test methods on all the relevant aspects in order to take this up in European pre-standards for active roofs.

Therefore there is a strong need for European-wide guidelines and performance requirements on active roofs. Besides, without these standards and regulations there is an actual danger that non-regulated roof-products will be introduced into the well regulated building environment. And finally, without such standards CE marking will not be possible.

The European Pre-Standardisation document specifies proposals for test methods and requirements for the most important aspects of the quality of active roofs, and as an example it is focused on the building integration of solar energy systems (photovoltaic and thermal) as stand-alone or integrated part of building components or units. It concerns roofs as well as facades of houses, residential buildings and commercial and industrial buildings. Where relevant, the provisions described in this proposal are to be applied to complete solar systems that are installed (in accordance with the guidelines of the supplier) in its intended architectural context with all construction details included.

The content of the document is based on the results of the work packages B, C, D, E and F of the European funded project EURACTIVE ROOFer. The IFD guideline will be presented as a pre-standardization proposal to the relevant CEN and EOTA committees as input for a final European standard in this working field

Outline of the Pre-Standard

CONTENTS:

SCOPE

The Pre-Standard is set-up as an 'umbrella' standard for different active components on the roof (like solar systems, windmills, etc)
The European Pre-Standardisation document specifies the application of solar energy solar energy systems (photovoltaic and thermal) as stand-alone or integrated part of building components or units. It concerns roofs as well as facades of houses, residential buildings and commercial and industrial buildings. Where relevant, the provisions described in this proposal are to be applied to complete solar systems that are installed (in accordance with the guidelines of the supplier) in its intended architectural context with all construction details included.

After mounting of the solar energy system the regular functions and properties of the building envelope should remain unaltered, respectively adequate. One may think of construction safety (increased load due to the solar energy system), water drainage, presence of thermal bridges, pressure resistance and negotiability of the underlying insulation material.

Glazed Solar energy elements that are finished as normal glass elements fall outside the scope of this pre-standard (except the cables). As far as the mounting of such elements in wooden, plastic and metal frames is concerned the requirements for normal glass elements are applicable.

Training Activities

Finally, the draft documents will be the basis for training courses.

Training conception

Target groups

- Contractor, manager and master craftsmen
- Employees (manager and staffer)
    - Manager in engineering, master craftsmen
    - Craftsmen

Character of the training

- Basic course
- Consolidation course
- Practise course

Organisation of the training

- Timeframe
- Central training
- Inhouse-training
- Training by e-learning

Themes of the training

- Safety/protection against accidents
- Basics of the roof structure
    - Pitched roof
    - Flat roof (< 5°)
- Basics of structural physics
- Active elements
- Maintenance and maintenance measure

The input from workshops, seminars and information meetings will give input to finalize the necessary training documents for the project. But these documents have to be updated regularly after the end of the project.

This is a continuing task of IFD.