DYNASTEE
NEWSLETTER ISSUE 2016/7

# A Network of Excellence...

Building performance analysis, testing, modelling, is a hot issue, more than ever. DYNASTEE disseminates information and offers training on dynamic evaluation methods, bringing people together in their search for sharing experience and knowledge. In this newsletter you will find a short history of this exchange platform, as well as a report on the Summer School of last summer in Granada which was a successful event in this series.

As in the previous IEA Annex 58 project, DYNASTEE is again involved in the new project Annex 71 *"Building energy performance assessment based on in-situ measurements*". DYNASTEE offers its platform for the development of a network of excellence in this field. This newsletter will report regular updates on the progress of this challenging project.

And more and more research institutes are developing test facilities for the real scale performance assessment of building components. The new Loughborough (UK) facility described in this newsletter is focussing on the hygrothermal characteristics. In France there are new test cells being set up in La Rochelle and in Le Bourget for the energy performance assessment of façade and roof components. How to monitor and model the performances in a building in use, is explained in a further contribution.

More info is available on the website www.dynastee.info.

*Loughborough University twin-buildings for testing*

## CONTENTS



**DYNASTEE**

**Newsletter Editors**

- **Hans Bloem**
- **Luk Vandaele**

## IEA EBC Annex 71 – Building energy performance assessment based on in-situ measurements

*Staf Roels, operating agent of IEA EBC Annex 71*

Decreasing the energy use in buildings can only be achieved by an accurate characterization of the as-built energy performance of buildings. This is mainly for two reasons. First of all, despite the ever more stringent energy legislation for new and renovated buildings, monitoring the actual energy performances reveals in many cases a significant performance gap with the theoretically designed targets. Secondly, the ever increasing need for integration of renewables stresses the existing energy systems which can be remedied by using intelligent systems and energy grids that are aware of the actual status of the buildings.

Based on a workshop in Brussels a proposal has been developed to start a new IEA Annex-project on in-situ assessment of building energy performance. At the last ExCo-meeting in June 2016 the IEA EBC ExCo approved this proposal as the IEA EBC Annex 71-project. Annex 71 builds on the achievements of IEA EBC Annex 58 (http://www.iea-ebc.org/projects/ongoing-projects/ebc-annex-58/). In this project a first step has been taken to characterize the actual energy performance of buildings based on full scale dynamic measurements. Annex 58, however, was mainly restricted to the thermal performance of the building envelope, making use of rather intrusive tests and focusing on scale models or test buildings. The current project aims to make the step towards monitoring in-use buildings to develop replicable methodologies embedded in a statistical and building physical framework to characterize and assess the actual energy performance of buildings.

The project will focus on residential buildings, both on the level of individual dwellings as well as on the level of building communities. At both levels the development of characterisation methods as well as of quality assurance methods will be explored. Characterisation methods aim to translate the (dynamic) behaviour of a building into a simplified model that can be used in model predictive control, fault detection, optimisation of district energy systems… Quality assurance methods aim to pinpoint some of the most relevant actual building performances, such as the overall heat loss coefficient of a building, the energy efficiency of the heating (cooling) system, air tightness and solar absorption…

In October 2016 more than 50 researchers from industry, government and research institutes will gather in Leuven, Belgium for the first expert meeting of Annex 71. At this meeting the research project will be further developed and impetus will be given to the working plans of the different subtasks.

More info on the project can be found at the Dynastee website or at http://www.kuleuven.be/bwf/projects/annex71/index.htm.

## New facilities for the BERG at Loughborough University, UK

*David Allinson, Loughborough University*

The Building Energy Research Group (BERG) at Loughborough University has been investing in its test facilities over the summer. This included refurbishing the matched pair of test houses and installing a brand new hygrothermal test facility. These facilities complement the long standing measurement and simulation expertise within the group.

The matched pair of test houses (see picture on the front page) are a beautiful pair of semi-detached south facing 1930s houses. They have been refurbished with new: roofs and loft insulation; windows and doors; a multi-room tracer gas system; and systems for representing the presence of occupants. The synthetic occupancy system includes all new window actuators and automatic blinds as well as a new controller. The existing equipment for representing the internal gains from lights, appliances, people and hot water is maintained along with the data logging and thermal comfort measurement systems. The staged refurbishment is part of a long-term plan to generate high quality data sets for: direct side-by-side comparisons of energy saving technologies; overheating risk assessment; and accurate model calibration.

The new hygrothermal test facility was funded by the UK government and will enable the BERG to carry out high quality research into heat transfer and moisture movement through building walls. It comprises a pair of climate chambers that 'sandwich' a wall specimen. The chambers reproduce the climate inside and outside of a building. Air temperature, relative humidity and air velocity can all be controlled and rainfall and sunshine can be simulated. Wall samples of up to 2.4m x 2.4m can be tested under dynamic or steady state conditions. An optional metering box will allow the facility to operate as a guarded hot box.

For further information please contact: David Allinson d.allinson@lboro.ac.uk http://www.lboro.ac.uk/departments/civil-building/staff/allinsondavid/

## Test facilities for façade and roof testing in La Rochelle, France

*Maxime Doya, Tipee*

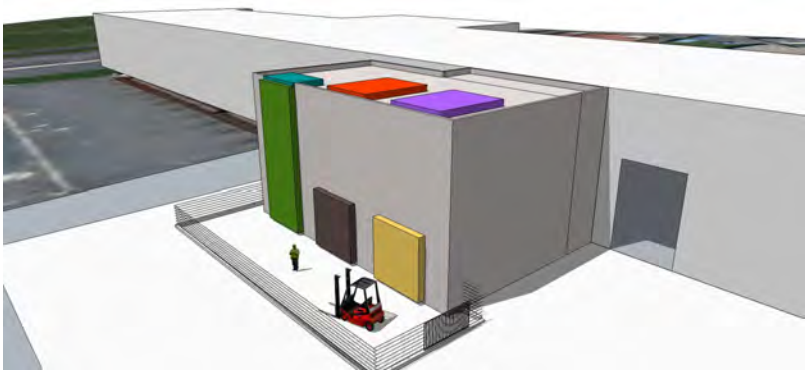
*Jérôme Le Dréau, La Rochelle University*

Tipee in cooperation with La Rochelle University (LaSIE UMR CNRS 7356) is building a new test facility in La Rochelle, on the west coast of France. In these test-cells, facade elements will be exposed to the meteorological variations of outdoor environment, while maintaining a high level of accuracy in measurements. This full-scale equipment will allow to test the energy performances of flat-roof elements (3 m × 4 m) or façade elements (from 3 up to 9 m high) in real conditions. The double height cell can be used as a whole to study energy efficient envelopes on high-raised ceiling premises or be split in two volumes to study the performance of solutions treating thermal bridges between intermediate floors.

HVAC strategies can be multiple as the ventilation, heating and cooling systems will be able to be switched off independently. The test-cells can be set in over- or under-pressure through an intake fan located on the façade or through an exhaust fan located on the roof. The heating is provided by an electrical coil, meanwhile the cooling system is an air-conditioning unit operated with a primary loop water temperature between 7 and 19°C. This temperature range gives option to avoid condensation in the test-cells and refine the measured energy balances.

The weight load of the tested element is handled by a composite beam structure (low thermal conductivity) internal to the test-cells. The beams can support a frame made of concrete or metal that mimics the primary structure of a building to which envelope solutions can be bonded. It is believed that designed that way, the energy budgets monitored within test cells might cover the thermal exchanges due to the envelope and anchoring systems together (i.e. thermal bridges impact).

The modularity of the equipment will allow to perform different types of tests to characterise the thermal performance and the durability of components and assess the thermal comfort conditions. Innovative components such as passive and dynamic facades will be tested and characterisation methodologies will be further developed. This equipment will permit to follow experimental methodologies as described in PASLink methodologies, or will operate as in a real-building with normal to free-cooling strategies air change rates. The test facility will be ready by the end of this year, instrumentation and calibration will take place in 2017 and the first results should be available at the end of 2017. For further information: http://www.plateforme-tipee.com/nos-prestations/laboratoire-essai-batiment.



*Test facility for façade and roof testing in La Rochelle, France*

## Design of a new full-scale facility for building envelope test: FACT (FACade Tool)

*Lorenza Bianco, CEA – LITEN*

In the last years, several innovations have been introduced in the field of building envelope research and development, both for new buildings, like adaptive envelope, and for existing ones as retrofit solutions. To bridge the gap between research and commercially available products, one of the key step is to evaluate these technologies in 1:1 scale and under real boundary conditions. For this purpose, test in outdoor full-scale facilities in complement with dynamic numerical simulation, allow to assess the performances of these complex envelope components, systems or whole building. In this framework a new versatile facility, named FACT (FACade Tool), is under

construction in the south-eastern France (CEA- INES platform – Le Bourget du Lac) for building envelope components test. This new full-scale tool will be dedicated to infield evaluation of: opaque and transparent elements, light-weight and massive façades, different thickness and heights and different geometry of the indoor environment. The aim of this paper is to present the design phase, the concept and the working principle of the facility. The layout definition was supported by preliminary simulations and the results of this modelling activity are discussed in order to guide the construction of the facility and to outline the experimental protocol for the next campaigns in FACT.

## In-use office building energy characterization through basic monitoring and modelling

*A.Erkoreka, E. Garcia, K. Martin, J. Teres-Zubiaga, L. Del Portillon,ENEDI, Department of Thermal Engineering, UPV/EHU*

*(Article in Energy and Buildings 119 (2016) 256–266)*

**Abstract**

Due to the European Union energy reduction strategy, many in-use buildings will be energetically monitored in the coming years to obtain their main thermal characteristics to improve or prove their energy efficiency. This is difficult to do with a reduced set of sensors and a robust data analysis methodology. This paper is focused on proposing some modifications on the existing ISO 9869 method and co-heating method to make them usable with basic energy monitoring data of in-use buildings and obtain their main thermal characteristics: the Heat Loss Coefficient (HLC considers heat losses through envelope plus infiltration) and the solar aperture (Sa or gA-value) of the whole building. Under the FP7 project A2PBEER an occupied big office building has been energetically monitored. This monitoring system has been designed and installed while the building was in operation. Using this monitored data a modified ISO 9869 method has been applied to some specifically selected cloudy and cold winter periods to obtain the HLC of the building.


*FACT (FACade Tool), CEA - LITEN at Lac du Bourget (FR)*

Taking this HLC as a reference, a modified co-heating method has been used to estimate both the HLC again and the Sa of the whole building. Although monitoring was carried out under very difficult conditions since the building was occupied, the proposed modifications on those two existing methods have delivered very reliable results with these two Key Performance Indicators (HLC and Sa) of the building under real operation conditions.

## Call for Papers- Special issue on "Metrology for building energy performance assessment"

**Background**

Building energy performance can be assessed in several ways: calculations, measurements or both. If the scientific works have been made for a long time on calculation and modeling building energy behavior, the need of mastering the building energy consumption leads to the necessity of adding measurements. But it is observed a strong performance gap between predicted and actual energy performance. Then the building energy community faces now to new challenge for uncertainty assessment.

**Aim and Scope of the Special Issue**

The objective of this special issue is to provide an opportunity for researchers to publish their latest and original work on energy performance assessment through monitoring at the building scale. Papers should present methods and approaches for building energy performance assessment through meas-ure and verification protocols. For example topics like measurement and verification protocols, uncertainty analysis, data mining, testing and validation methods.

This special issue is open to everyone, so all authors that feel they meet the aims and scope of the call for papers are invited to submit their manuscripts.

Guest Editor **e-mail address**: antoine.caucheteux@cerema.fr

**Online submission**: http://www.editorialmanager.com/ijmqe/default.aspx

Submission deadline: December 15, 2016

Reviewers' feedback: February 28, 2017

# Outcome of the Summer School 2016 in Granada, Spain

Another successful Summer School on Dynamic Calculation Methods for Building Energy Assessment has taken place from 19-24 June, 2016 in lovely and inviting Granada, Spain.

A record number of 34 participants from all over the world gathered at the Civil Engineering School, University of Granada, nearby the famous Alhambra, to get trained in methodologies for assessment of building energy performance. Participants came from Japan, China, South-Korea, Mexico, Canada, Lebanon and from 14 European countries. Most of them were PhD or post-doc students and many are involved in IEA-EBC projects.

The event was opened by Professor Montserrat Zamorano Toro, director of the Civil Engineering School of the University of Granada. Many thanks go to her Department as well as to Professor Diego Pablo Ruiz Padillo of the Applied Physics School. The introductory presentation was made by Paul Baker, invited speaker and expert on in-situ measurements and analysis. He showed the importance and practical side of carrying out experimental work on site to collect proper data for analysis.

Twelve dedicated lectures were given by six experts from different organizations; University of Strathclyde, Danish Technical University, EC-JRC and CIEMAT (special thanks go to Maria-Jose Jimenez also). Each day the lectures were followed by time for exercises using the provided data and software tools. The applied methods are based on linear regression techniques and dynamic models in the open software environment R. Plenty of time was made available for practical work, working in groups or individually.

As a break during the week-long Summer School, a visit to the impressive Alhambra was organized followed by a lovely social dinner in the Albayzin area.

A special presentation was given by Jessica Ferrer from Rockwool, one of the sponsors. Upon the very positive feedback from these participants and organizers and after 5 successful Summer Schools it has been decided to organize in 2017 another one on the topic of building energy performance assessment.

# A bit of DYNASTEE history

DYNASTEE stands for: "**DYN**amic **A**nalysis, **S**imulation and **T**esting applied to the **E**nergy and **E**nvironmental performance of buildings". DYNASTEE is a platform for exchange of knowledge and information on the application of tools and methodologies for the assessment of the energy performance of buildings. DYNASTEE functions under the auspices of the INIVE EEIG and it is open to all researchers, industrial developers and designers, involved in these items.

The EU energy research projects PASSYS (1985-1992) COMPASS and PASLINK created the initial European network of outdoor test facilities, developed test methods, analysis methodologies and simulation techniques. It resulted eventually into the PASLINK EEIG network (1994). The grouping profiled itself as a scientific community of experts on Testing, Analysis and Modelling. In 1998, PASLINK EEIG started a new project PV-HYBRI-PAS on the overall performance assessment of photovoltaic technologies integrated in the building envelope. . The use of the outdoor test facilities in several Member States situated in different climates, together with the available expertise on analysis and simulation techniques, offered the ingredients for more successful projects: IQ-TEST (2001), focussing on quality assurance in testing and analysis under outdoor test conditions as well as evaluation techniques of collected in-situ data. The expertise of the grouping was also offered to other European projects, such as DAME-BC, ROOFSOL, PRESCRIPT, IMPACT and PV-ROOF. In 2005 the EEIG was converted into an informal network that today is known as DYNASTEE. It is offering a network of excellence and should be considered as an open platform for sharing knowledge with industry, decision makers and researchers. It has been very active in supporting projects such as the IEA-EBC Annex 58 and recently the new project IEA-EBC Annex 71 'Building energy performance assessment based on in-situ measurements'.

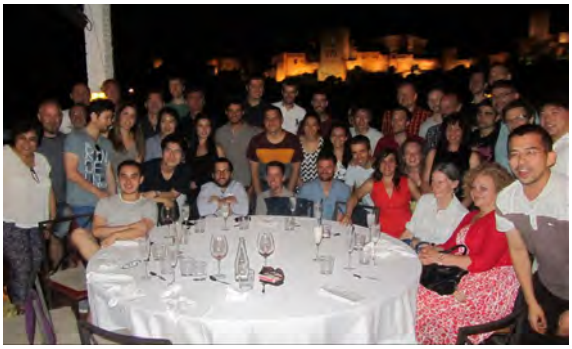
DYNASTEE, being a network of competence in the field of outdoor testing, dynamic analysis and simulation, has over 30 years of experience through a series of EU research projects. Dynamic analysis methods are techniques to analyse dynamic processes and to identify typical parameters of physical processes like energy flows in buildings. Dynamic analysis, simulation and testing remains an area of high scientific interest. Dynamic mathematical and statistical technologies are recognised being crucial in optimisation of energy efficiency. Integration of renewable energy technologies in our built environment is rapidly evolving, giving another perspective to the use of available energy resources.

It is expected that buildings will play an active role in the integration of renewable energies in the energy system. Energy flexible buildings will allow to charge, store and discharge fluctuating energy flows and to manage the energy demand. Smart and intelligent meters and data management systems will play an important role in this transition. Dynamic methods are essential for Nearly Zero Energy Buildings (as requested by the EPBD) and imply that smart meters can be used for automated generation of reliable energy labels for buildings.

Regular trainings organised by DYNASTEE, take place in the form of workshops or Summer Schools and deal with the application of dynamic methods for outdoor testing, related analysis and modelling techniques. Five yearly editions of the Summer Schools have trained over 150 people with academic or building technical background. In general it is targeted to energy researchers, engineers, building designers and energy system managers.

The strength of the DYNASTEE network lays in its multi-disciplinary nature of academic and research teams. In addition the availability of high quality outdoor test facilities at several member organisations offers a direct interaction between realistic experimental testing and dynamic evaluation and simulation.

For more information please visit the DYNASTEE website www.dynastee.info where regular published newsletters can be found as well.



*Participants and lecturers gathered after a nice dinner in front of the Alhambra*