DYNASTEE

NEWSLETTER ISSUE 2013/2

Foreword

Dear reader,

With pleasure we announce the 2013 issue of the DYNASTEE Newsletter. A lot has happened during 2012 which has made us aware of the importance of the specific activities in the DYNASTEE network.

For the background information we refer kindly to our web-site www.dynastee.info, where also the first issue of the Newsletter can be downloaded.

To get some inspiration from Shakespeare, a trip to the famous Kronborg castle (known from the Hamlet) was organised. Lecturers and participants gathered in front of the chapel for a photo.

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DYNASTEE Newsletter Editors

- Hans Bloem
- Luk Vandaele

Successful Summer School 2012 in Copenhagen

A brief report of the Summer School on *Dynamic Calculation Methods for Building Energy Performance Assessment*.

The Summer School took place in Copenhagen 18-22 June and 30 registered participants filled the lecture rooms of the DTU for 5 days of lectures and exercises. The participants, of which were 21 PhD students, came from 10 EU countries and HongKong and had different backgrounds (architecture, electronics, statistics, building physics, etc.). The PhD students had the possibility to claim 2.5 credit points for attending the Summer School and 2.5 for the additional work on exercises.

The main objectives to organise the Summer School were to train a dynamic methodology to assess whole building energy performance and to assess thermal characteristics of building components, while supporting the European EPBD-recast Directive (2010) that requires nearly-zero energy buildings (nZEB) for which a significant part will be taken by renewable energy technologies.

At present energy renovation of existing buildings and realisation of new high performance buildings results in a growing interest in laboratory and on-site testing of full scale solutions for the building envelope.

Simulation and evaluation of energy performance data for buildings requires up to date methods based on dynamic calculation techniques. The approach will have to deal with building physics as well as applied mathematics and statistics.

A very good overview of the work on outdoor testing and analysis is presented in the recent doctoral thesis (August 2012) by Aitor Erkoreka on "Modelling and Testing of Green Roof using the Paslink Methodology for Characterization of its Energy Behaviour". Aitor defended his thesis successfully in October at the University of the Basque Country (picture below). The PASLINK test facility where the green roof was tested is situated in nearby Vitoria-Gasteiz. The article presents a literature review of the developments and current status of the test facility (PASLINK requirements for high quality testing) and the evaluation methodologies (linear regression and continuous time calculation techniques). The article can be downloaded from www.dynastee.info

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Summer School 2013 in Almeria, Spain

Dynamic Calculation Methods for Building Energy Performance Assessment

Announcement

The second edition of the DYNASTEE Summer School will take place in Spain organised again by DYNASTEE in close collaboration with CIEMAT, EC-JRC-IET, DTU-IMM (Denmark) and ESRU (Glasgow, UK). It will be organised in Almeria from 9 - 13 September, 2013. Estimated costs for the Summer School for the 5 days course is estimated at 500 Euro.

Accommodation: the organisers have reserved rooms at close distance from the auditorium; estimated costs are 58 euro/night/person.

More information (like travel possibilities) and details of the programme will follow.

During the last Summer School, the DTU CampusNet demonstrated to be of great importance for communication, sharing of information and reporting the results from the exercises. Participants to the 2013 Summer School will receive also access to the DTU CampusNet.

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Open software

During the Summer School the modelling for building energy performance assessment is carried out with the open source and free software R, see www.r-project.org. It is software developed for statistical modelling based on real data and it provides a huge number of functions for different types of modelling. During the Summer School 2013 also the participants will get hands-on experience in using R for regression analysis, time series modelling and grey-box modelling using provided examples and exercises. Especially, the focus is on how to build and validate a model for a given set of energy, temperature and climate measurements.

Training makes sense

Dynamic analysis techniques are not so easy to apply; one needs a skill and that is why since a long time, DYNASTEE organises training workshops, challenging system identification competitions and recently a successful Summer School.

Building Nearly Zero-Carbon Housing: **For Real!**

by **Malcolm Bell, Centre for the Built Environment, Leeds Sustainability Institute, Leeds Metropolitan University**

During the last 10 years evidence has begun to emerge of significant energy underperformance of new and renovated dwellings relative to that predicted at the design stage. This has resulted in the existence of what has become known as “The Performance Gap”. At the outset it is important to make clear that the performance gap discussed here does not refer to performance in-use, important though that is. Performance in-use is a complex function of a dwelling’s fabric & services, coupled with use and user behaviour and is not something over which a developer has direct control unless they also engage in housing management. Rather, it refers to the performance of the technology itself; for example, the gap between the theoretical and actual thermal transmittance of the thermal envelope or between the theoretical and actual efficiency of a heating system, all of which are under the direct control of the developer, designer and constructor.

Given that many dwellings are designed to just meet, rather than exceed, building regulatory standards, it is likely that, in a significant number of developments, dwellings will fail to achieve national regulations. The full extent of the performance gap across dwelling production, as a whole, is difficult to determine since the number of studies is small. However, the evidence indicates the existence of an underperformance risk that cannot be ignored. What is more, as Europe seeks to establish difficult and exacting near-zero carbon standards for its new housing and similar standards in the renovation of existing dwellings, the capacity for underperformance will be increased.

The policy implications of a performance gap are considerable since European energy and carbon reduction policies place a very heavy emphasis on improving the efficiency of its building stock. In theory large reductions can be made in this sector but the policy will be seriously undermined if the performance gap is not closed, and just as important, kept closed. The key question is; how can this be achieved?

For some 20 years I have been trying to understand how the house building industry in the UK delivers energy efficient housing. During this work I have come to the conclusion that eliminating the performance gap in mainstream house building and renovation will require action in three fundamental areas: These I have called the three pillars of performance, which are illustrated in figure 1.

Further reading at www.dynastee.info.

Outdoor Test Facilities

CEA-INES test facility in Chambery (FR)

Four original PASSYS testcells can be found in good condition for testing at the test facility close to the Lac du Bourget in Chambery, France. These testcells are not upgraded to PASLINK caloric testcells but can be used for comparative thermal measurements or for specific experimental work. The figure 1 gives an impression of the good looking internal of the testroom. Figure 2 shows the south test-façade and the air treatment central. Figure 3 shows a general overview of the experimental INES platform, including the 4 PASSYS testcells, 11 solar benches and now 4 experimental houses.

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INIVE-DYNASTEE is organising with EC-JRC-IET and ENEA during the EU Sustainable Energy Week, 24-26 June 2013, Brussels an event on

High Performance Buildings

Design and Evaluation Methodologies

A **High Performance Building** is a building that consumes as little as possible energy during a whole year for heating, cooling, ventilation, light, hot water and copes with the presence of people and domestic appliances. Such a building is expected to have a climate optimised insulation of the envelope and profits from renewable energy resources while using thermal mass to balance thermal energy flows. The building energy systems are high efficient and innovative technologies that optimise the use of the available energy resources, delivered to the building or available in the environment of the building. Considered as high performance buildings are: low-energy, nearly-zero energy buildings, passive houses, etc.

The organisers would like to focus on the energy related part in the design process of new or renovation buildings that will cover calculation methods (in relation to EU standards and building simulation software), performance assessment methods (including evaluation of data from energy meter readings), integration of renewable energy technologies and variable aspects such as consumer behaviour in relation to smart metering. It is expected that dynamic calculation techniques will play an imminent role in the development of successful energy related techniques.

The event is organised in four consecutive sessions dealing with dynamic aspects of performance assessment including cost analysis, ICT monitoring, evaluation and modelling of high energy performance buildings, design case studies and EPBD related energy Standards.

Deadline for abstracts is 14 April 2013 and for accepted papers 30 May 2013.

Literature Review About **PASSYS-PASLINK**

During the last 25 years several documents and papers have been written on PASSYS/PASLINK test cells and methodology. The possibility to reproduce a testing procedure remains on the documentation that describes the testing environment and testing methodology. The PASLINK method is the most accurate method for testing building components under real weather conditions since, during many years; several research organisations have been working on it and have improved them.

The manuals and procedures developed during PASSYS and published in 1992, have been improved during the follow-up PASLINK period. High quality manuals and procedures were published in 1995. The use of these manuals and procedures have permitted the Laboratory for the Quality Control in Building of the Basque Government to set up two PASLINK type test cells at the outdoor test facility in Vitoria-Gasteiz. This fact proves that the available PASLINK documents are informative and accurate enough to reproduce such a complex outdoor test facility. Two main areas that are crucial to apply the PASLINK method correctly are as important, e.g. calibration and data analysis.

The calibration of the whole test cell is necessary to carry out the future experimental work with highest accuracy. This calibration test has been accurately described in the documentation of the IQ-TEST project. These documents give detailed information of two test components (an opaque wall and a window) needed for the calibration test and the method to carry out the calibration. There is also a detailed result document where the obtained results can be compared to the results obtained by other research institutions that carried out the same test. The opaque wall can be constructed using common materials while the window is a special one.

Finally data analysis skills are required for a proper analysis of the data series obtained during testing. The data series are containing dynamic information requiring dynamic analysis techniques. The data analysis techniques have been widely studied and many methods have been used by different researchers. Two main techniques have been proven to be the most suitable: stochastic state-space modelling by means of the maximum likelihood estimation method and the finite difference modelling by means of the output error method. Both techniques have associated software for treating the data series obtained by the PASLINK tests. The evolution of the data analysis techniques can be found in several books published by the JRC related to two System Identification Competitions and a workshop. There are also many articles related to these data analysis techniques.

Most of the above cited documents and articles have been collected by Aitor Erkoreka and are presented in the literature review chapter of his doctoral thesis "MODELLING AND TESTING OF GREEN ROOF USING THE PASLINK METHODOLOGY FOR CHARACTERIZATION OF ITS ENERGY BEHAVIOUR". The full documents in PDF are available to IEA Annex 58 members and a CD will be published with the most relevant documents required to be able to reproduce the PASLINK test environment and methodology.

IEA ECBCS Annex 58-project **'Reliable building energy performance characterization based on full scale dynamic measurements'**

The DYNASTEE-network is strongly involved in Annex 58. This research project was approved in 2011 in the framework of the 'Energy Conservation in Buildings and Community Systems' -programme of the International Energy Agency. Launched at the kick-off meeting in Leuven, Belgium, September 2011, Annex 58 will work four years with international experts from all over the world on the topic of 'Reliable building energy performance characterization based on full scale dynamic measurements'. Major aim of the project is to develop the necessary knowledge, tools and networks – this is where DYNASTEE comes in – to achieve reliable in situ dynamic testing and data analysis methods that can be used to characterize the actual energy performance of building components and whole buildings. After the kick-off meeting in Leuven and the second expert meeting in Bilbao, the third expert-meeting of Annex 58 was hosted September 2012 by Leeds Metropolitan University in the UK.

The addendum of the previous DYNASTEE -newsletter gave an overall overview of the project and its main objectives (see http://www.dynastee.info/download/DYNASTEE-NL-2012-A-Addendum.pdf). In this article the progress and ongoing research within the different subtasks is presented. As successful full scale dynamic testing requires quality over the whole process chain of full scale testing and dynamic data analysis, the project is organised around this process chain and the following subtasks have been defined:

Subtask 1 – State of the art on full scale testing and dynamic data analysis serves as a common background. It draws an inventory of full scale test facilities all over the world and the common methods with their advantages and drawbacks to analyse the obtained dynamic data are being described. This allows to give an overview of the current state of the art on full scale testing and dynamic data analysis and to highlight the necessary skills.

Goal of **Subtask 2 – optimizing full scale dynamic testing** is to develop a roadmap on how to realise a good test environment and test set-up to measure the actual thermal performance of building components and whole buildings in situ. A specific point of attention is the use of numerical models for the design of full scale tests. Based on the discussion during the first meetings the roadmap was transformed in a decision tree: what kind of data set needs to be collected in order to obtain a certain characterisation at component level (new or existing) or whole building level. A start for the decision tree has been presented during the Leeds-meeting, based on the results of a questionnaire distributed among the participants.

Subtask 3 – dynamic data analysis and performance characterisation focuses on quality procedures for full scale dynamic data analysis and on how to characterise building components and whole buildings starting from full scale dynamic data sets. The outcome will be a methodology for dynamic data analysis, taking into account the purpose of the in situ testing, the existence of prior physical knowledge, the available data and statistical tools,… The methodologies will be tested and validated on data collected in ST2 in a way that quality procedures and guidelines can be developed.

Subtask 4 – application of the developed framework applies the developed concepts and shows the applicability and importance of full scale dynamic testing for different issues with respect to energy conservation in buildings and community systems, such as the verification of common BES-models, the characterisation of buildings based on in situ testing and smart meter readings and the application of dynamic building characterisation for optimising smart grids.

Finally, **Subtask 5** develops a network of excellence on 'in situ testing and dynamic data analysis' for dissemination, knowledge exchange and guidelines on testing. A close collaboration with DYNASTEE is foreseen. Via the DYNASTEE-network international workshops, annual trainings, .. related to Annex 58 are organised.

To link the different subtask common case studies are defined. As a first 'virtual' case study a round robin experiment was proposed. The global objective of the round robin experiment is to design and perform a well-controlled comparative experiment on testing and data analysis. The main idea is that a test box (a scale model of a building with unknown properties) is shipped to different partners (different climatic conditions) with the aim to perform a full scale measurement of the test box under real climatic conditions. In a second step, the obtained dynamic data is distributed to different institutes who have to try to characterize the test box based on the provided data.

The test box has been constructed and is sent around to the different institutes. Each institute is allowed to design an experiment based on their own knowledge and experience in order to characterize the box. Additionally, some basic measurements are carried out allowing a comparison between different institutes and climates. Currently, the first set of experiments is running at BBRI, Belgium. The results of the measurements will be used as input for Subtask 3 where participants are challenged to characterize the test box (overall heat loss coefficient, g-value of the window, dynamic characteristics,..) based on the measured data.

Further information about IEA ECBCS Annex 58 can be found at www.ecbcs.org/annexes/annex58.htm

Round robin experiment running on blind test box at BBRI, Limelette, Belgium.

ABOUT DYNASTEE

DYNASTEE is an informal grouping of organisations involved in research and application of tools and methodologies for DYNAmic Simulation, Testing and Analysis of Energy and Environmental performances of buildings. DYNASTEE provides a multidisciplinary environment for a cohesive approach to the research work related to the energy performance assessment of buildings in relation to the Energy Performance for Buildings Directive (EPBD).

DYNASTEE, being a network of competence in the field of outdoor testing, dynamic analysis and simulation, has over 25 years of experience through a series of EU research projects. DYNASTEE is an open platform for sharing knowledge with industry, decision makers and researchers.

DYNASTEE has the expertise needed to support the developments and design of Nearly-Zero Energy Buildings as required by the EPBD. Specific outdoor experimental work needs knowledge of the analysis process in order to optimise the dynamic information in the measurement data. Simulation requires results from analysis in order to be able to scale and replicate the results from analysis and testing to real buildings in different climates.

DYNASTEE functions under the auspices of the INIVE EEIG. For more information visit the DYNASTEE web-site at www.dynastee.info