DYNASTEE
NEWSLETTER ISSUE 2013/3

Foreword

Dear reader,

With pleasure we present you the 3rd DYNASTEE Newsletter. Dynastee is a platform of information exchange on dynamic analysis, simulation and testing of the energy performance of buildings. Dynastee is closely linked with the activities of the IEA EBC Annex 58 project; it is responsible for the subtask on dissemination and the Network of excellence. This is done through activities such as training of researchers on dynamic methods (see the Summer School 2013), bringing its expertise from earlier projects (PASSYS-PASLINK) into the Annex 58 project, organising workshops (see the High Performance Buildings event in Brussels, June 2013), and this newsletter. This issue is dealing largely with the intermediate results and the progress made in the Annex 58 project. Bit by bit the expertise is growing and we are quite confident that the research community involved will find the right answers how to bridge the gap between the real performances of a building and the calculated or designed ones. The building industry is welcome to forward its questions to this growing Network of Excellence.

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DYNASTEE Newsletter Editors

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

Summary report of the workshop on

HIGH PERFORMANCE BUILDINGS
Design and Evaluation Methodologies

The EU Sustainable Energy Week (EUSEW) is an initiative of the European Commission coordinated by the Executive Agency for Competitiveness and Innovation, in close cooperation with the European Commission's Directorate-General for Energy. It showcases activities dedicated to energy performance, efficiency and renewable energy solutions. During that week, INIVE-DYNASTEE, EC-JRC-IET and ENEA organized a series of 4 half-day workshops on the theme "High Performance Buildings - Design and Evaluation Methodologies". The workshop was held in Brussels at the BBRI offices from 24 - 26 of June 2013. About 125 experts from all around the world registered for the workshop.

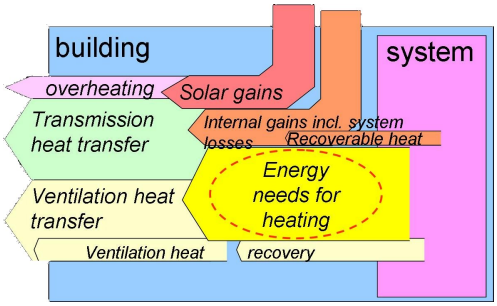
The aim of the event was to focus on the energy related part in the design process of new or renovated buildings. Four consecutive sessions dealt with dynamic aspects of performance assessment including cost analysis, monitoring, evaluation and modelling of high energy performance buildings, various aspects such as renewable energies and consumer behaviour, design case studies and EPBD related CEN energy standards. Experts from CEN TC371, working on the revision of the standards, were invited to participate as well as project leaders from IEA-EBC Annex 52 (nZEB), Annex 53 (Monitoring) and Annex 58 (Performance characterisation).

An overview of the IEA EBC-Annex 58 activities was given, focussing on characterization of thermal performance of building fabric based on full scale experiments to develop the necessary knowledge, tools and networks to characterise the actual energy performance and thermal response of building components and whole buildings based on full scale dynamic measurements.

This activity is highly relevant for achieving in-depth knowledge to the properties and features of different approaches to energy performance assessment.

Statistical methodologies were presented which are applicable for modelling building energy performance assessment based on measurements of heating in buildings, e.g. from smart metering. The range of methods spans from modelling based on simple daily readings of heat load, to detailed modelling based on high time-resolution data. Key performance indicators need to be coupled with knowledge of uncertainty provided by statistical techniques.

All papers and presentations from the workshop are available. Find the link on **www.dynastee.info**



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IEA EBC Annex 58-project

"Reliable building energy performance characterization based on full scale dynamic measurements"

Since 2011, international experts from all over the world are working together for four years within the research project IEA EBC Annex 58 on the topic of 'Reliable building energy performance characterization based on full scale dynamic measurements'. This project takes place in the framework of the 'Energy in Buildings and Communities Programme' of the International Energy Agency. The addendum of one of the previous Dynastee-newsletter gave an overall overview of the project and its main objectives (see www.dynastee.info Publications / Newsletter / Addendum to DYNASTEE Newsletter 2012/1.

At the latest expert meeting in Hong Kong October 2013, the project was halfway; time for an update on the status of the project. The aim and progress of subtasks 1 and 2 is described in more detail further on in this newsletter. In this article the general progress and ongoing research on dynamic data analysis and energy performance characterization is described.

Characterising the actual performance and dynamic behaviour of building components and buildings is an essential part to obtain – not only on paper, but in reality – high performance buildings. Furthermore, dynamic data analysis methods have shown to be a valuable tool to deduce simplified models of e.g. advanced components and systems to integrate them in a reliable way into Building Energy Simulation (BES) models or when optimizing smart grids for building communities. Investigating possibilities and limitations to characterise building (components) based on dynamic data is one of the key topics within Annex 58. This research is driven by case studies. As a first simplified case, an experiment on testing and data analysis is performed on a round robin test box. This test box can be seen as a scale model of a building, built by one of the participants, with unknown properties for the other participants. The test box 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. The obtained dynamic data are distributed to different institutes who have to try to characterize the test box based on the provided data. The first result show how different techniques can be used to characterize the thermal performance of the test box, going from a simple stationary analysis to advanced data analysis methods starting from the measured dynamic data.

As a second case study, an experiment has been set up in the twin houses at IBP Fraunhofer in Holzkirchen, Germany. The data of this experiment will both be used as validation data for BES-models, as well as case study to characterize the thermal performance of the houses based on so-called grey box modeling. As up till now, BES-models are typically validated by intermodel comparison, there is a lot of interest in participating in the current real validation case, both from inside Annex 58 as from external partners. The blind run for the validation case should be finished by January 2014, afterwards the data is made available within the project for the thermal characterization of the dwelling. Results are expected spring 2014.

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

Subtask 1: **State of the art on full scale testing and dynamic data analysis**

The IEA EBC Annex 58 is an international research collaboration on the topic 'Reliable building energy performance characterization based on full scale dynamic measurements'. The ultimate goal of the Annex is to develop the necessary knowledge, tools and networks 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.

It is since September 2011 that the Annex has been active, which means that the project is halfway at the moment of writing (fall 2013). At the working meeting in Hong Kong in October 2013, one of the first outcomes of the project was presented: the state of the art report on full scale testing and dynamic data analysis, which was the result of the work of participants of subtask 1.

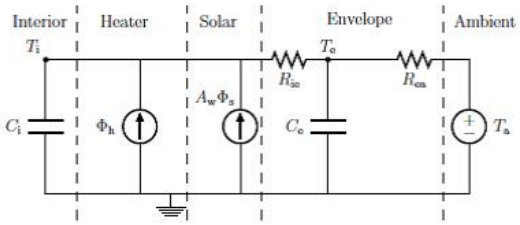
In subtask 1 an overview and evaluation was made of previous and ongoing in situ test activities based on a literature review and existing reports. An inventory was made of full scale test facilities available at different institutes all over the world. Common methods were described to analyze dynamic data, with their advantages and drawbacks. The overview of full scale testing and dynamic data analysis relates to energy performance characterization of either building components or whole buildings.

The data analysis methods discussed in the first section of the report range from averaging and regression methods to dynamic approaches. The methods are discussed in relation to their application in following in-situ measurements:

- measurement of thermal transmittance of building components based on heat flux meters;
- measurement of thermal and solar transmittance of building components tested in outdoor calorimetric test cells;
- measurement of heat loss coefficient and solar aperture of whole buildings based on co-heating tests;
- energy model characterization of whole buildings based on monitored dynamic energy and climatic data.

Left: Round Robin Test box at Almeria, Spain and right: one of the twin houses at IBP, Germany used as controlled test house for validation of BES-models.

Calorimetric facility at IBP-Holzkirchen



Example of RC-network representing a two-state grey box model for energy characterization of a building

The 25 test facilities described in the second section of the report are subdivided in three main groups, depending on the scope and scale of the testing:

- Test facilities for evaluation of (hygro)thermal building envelope performances
- Facilities for evaluation of building component energy performances
- Building integrated energy performance testing of components and systems

Within each group, facilities with a long tradition as well as recently developed or planned platforms are described. Compared to the previously published book on 'Full scale test facilities' (see Dynastee newsletter 2012/1), the subtask 1 report contains 10 new test facility descriptions.

More information:
www.ecbcs.org/annexes/annex58.htm

Subtask 2: **Decision tree**

The overall intention of Subtask 2 is to conceptualise the optimisation of full scale dynamic testing, based on the State of the art information gained from Subtask 1 and expert input obtained from annex members. When addressing the subject of building performance testing there are two key elements which must be appreciated in order to ensure reliable, accurate results are obtained:

1. Ensuring the test environment and experimental set up are correct and fit for purpose. This includes correct monitoring equipment, accurate sensor placement and robust control procedures.

2. Correct methods of data handling and analysis.

In order to present these concepts in a manageable, user-friendly way, Subtask 2 involves the production of a decision tree to aid researchers in their decision making when considering a full scale dynamic test. The decision tree acts as a guide to ensure the user has considered all possible aspects of their chosen environment, and by following the line of questioning within the decision tree they will ultimately arrive at documents which offer more information. These include published academic papers, ISO documents and test protocols. The researcher is questioned about a range of parameters, from broad considerations such as such as the test environment and conditions to the level of accuracy required from the results, allowing the most appropriate documents to be presented at the end.

During development, the decision tree is using the Xmind programme, a simple to use tool which allows wide ranging decision trees to be constructed and presented in a manageable way. Moving forward, the intention is to take the decision tree to an online platform, or possibly a living Wiki, with easy access for users.

The layout of the decision tree follows a question/response format, with a common route of questioning. For most topics this is:

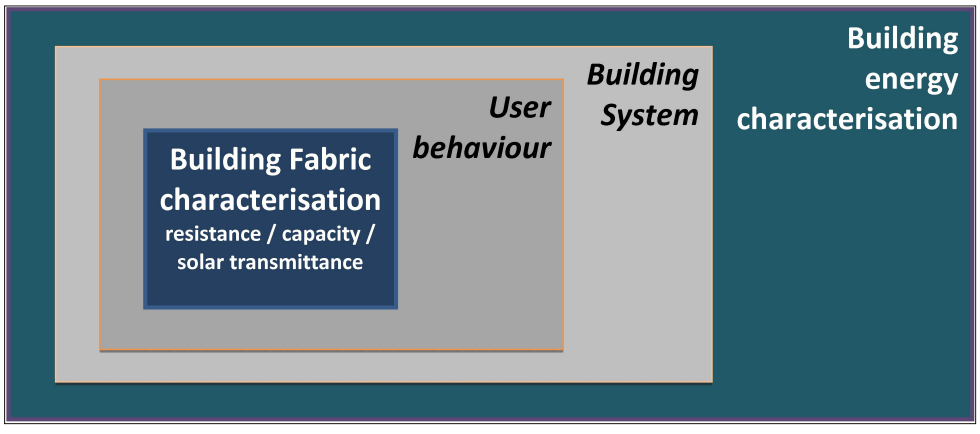
1. What do we want to characterise?
2. The specific aspect.
3. Test Environment.
4. Test Conditions.
5. Degree of accuracy required.

Each question offers multiple responses for the user. Each path follows the same questioning logic. The number of **specific aspect** stages depends on the topic, for example within whole building envelope there are fewer sub topics than for specific building components. This is a weakness to the decision tree as it is a non-standard question with limitless answers. Components are often more defined and accompanied with test procedures. Going forward, the test environments with less content are those which Annex 58 will focus, capturing information that are necessary to realise a good reliable test environment.

It is the intention that all pathways terminate in a document offering further guidance. Guidance will be taken from the work of Subtask 1 (State of the Art) which covers current aspects of dynamic building testing. It is appreciated that not all pathways will be covered (particularly with regards to novel technologies) input from Annex members will be used to populate the decision tree as reliable guidance is developed.

The degree of accuracy, element of the decision tree is an area which is under constant investigation and develops with technology and better understanding of test procedure and data. Some forms of testing are not fully developed and confidence cannot be guaranteed. It is the case that later versions of the decision tree and guidance contained in the road map will offer information on accuracy when it is known.

Further information can be obtained from **Martin Fletcher, Sub Task 2 leaders: Professor Chris Gorse and Dr Aitor Erkoreka**



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Group picture taken at mini-Hollywood (cowboy-city) near PSA-Tabernas.

Outcome of **Summer School 2013** that took place 9-13 September in Almeria, Spain

The second edition of the DYNASTEE Summer School on **Dynamic Calculation Methods for Building Energy Assessment** has been another very successful event with more than expected participants (36 students from 10 EU and 3 non-EU countries, China, India and Canada). The week-long Summer School was devoted to daily lectures by 5 lecturers on building physics and theory of time series analysis as well as plenty of time to guided exercises for improvement of skill of the students.

The ambience of Mediterranean climate, the high quality of the organisation and the sympathy of the student group made the outcome of the whole week, very positive and made the organisers conclude to organise a third Summer School in 2014 (follow us on www.dynastee.info). The requirement of a dedicated book on the lectured topics available at the next edition (probably before Summer 2014) was emphasised as well as the importance of the Open Source software tool environment **R** for future work on the application of dynamic mathematical techniques for energy performance assessment. One of the applied tools, **CTSM-R**, is partly an outcome of DYNASTEE and PASSYS initiatives.

The students were lectured on building physics as well as the applied mathematical and statistical techniques to basic building energy transfer problems. The problem, how to translate a physical energy system into mathematical equations and to assess the corresponding parameters was addressed and the dynamic methodologies were discussed. An in-situ wall exercise was provided and a simple building energy study also for a common approach while applying R-scripts for solving the mathematical equations to assess the thermal characteristics of the parameters in subject.

OPEN COMPETITION
Energy Design of High Performance Buildings

Organised by EC-JRC and ESRU for DYNASTEE

SUMMARY: The objective is to assess for a simplified high performance building (a cube), in a freely chosen climate and associated building energy regulations, the minimum primary energy consumption and GHG emissions for local boundary conditions by optimising thermal characteristics of the building envelop and the choice of building energy systems. The design freedom is in the building construction composition, the specific thermal parameters, the available energy resources and building system technologies. The energy design approach should follow three steps that deal with

1. building energy needs (envelope and its volume),

2. building system operational energy and

3. optimisation for available energy resources (feedback to step 1 and 2)

A High Performance Building (HPB) 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, profits from environmental energy resources and uses 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.

Each Member State has its national and sometimes regional building codes and regulation. They differ for particular parameters based on specific conditions such as climate, energy-mix and calculation methodology. As an example, Member States differ for the dimensions used for floor area, e.g internal, external or heart to heart dimensions. This will affect the reporting of energy performance expressed in kWh/m2. In the scope of this competition it has been decided to apply the external dimension which is limited to 10 by 10 meters. The minimum requirements set by the Member States in the building codes influence a lot the calculation methodology and results for reporting. The level of comfort that includes indoor temperature settings, temperature control regime, the air change rate etc. might differ even from one part of the country to another.

Beside the applied climate and building parameter settings, the results of primary energy consumption and GHG emission figures have to be reported.

The full description can be downloaded. For more detailed information please contact: **info@dynastee.info**

Target group: under-graduate, postdoc, PhD students and researchers level

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**