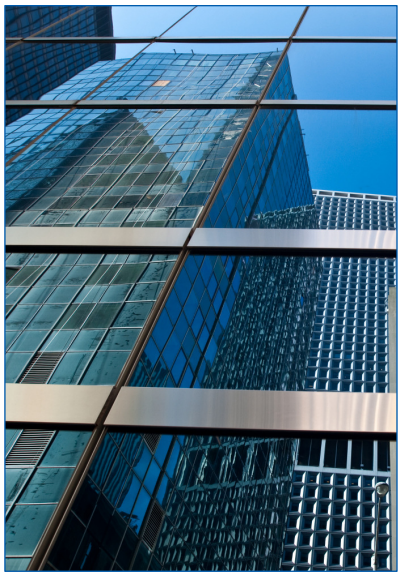
DYNASTEE
NEWSLETTER ISSUE 2012/1

Welcome to the new DYNASTEE



DYNASTEE is an informal grouping of organisations actively involved in the application of tools and methodologies relative to this field. The objective of DYNASTEE is to provide 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 25 years experience and would like to transfer its knowledge to industry, decision makers and research.

DYNASTEE is the international grouping that has all 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.

DYNASTEE functions under the auspices of the INIVE EEIG and constitutes a sustainable informal networking mechanism.

For more information visit the DYNASTEE web-site at www.dynastee.info

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DYNASTEE Newsletter editors

- Hans Bloem
- Luk Vandaele

What are dynamic methods?

Dynamic analysis methods are techniques to analyse dynamic processes and to identify typical parameters of physical processes like energy flows in buildings. Dynamic methods take into account the aspect of time whereas a static analysis method does not. Dynamic analysis, simulation and testing remains an area of high scientific interest.

The application of system identification techniques to the energy performance assessment of buildings and building components requires a high level of knowledge of statistics, physical and mathematical models. This factor, combined with the quality of the data, the description of the monitoring procedure and test environment, together with the experience of the user of the analysis software itself, can produce varying results from different users when applying different models and software packages.

The developed dynamical methods will enable new methods for providing guidelines for improving buildings with the purpose of obtaining energy savings and optimising efficient use of energy. Dynamic tools will indicate the most beneficial subject of improvement, as e.g. further insulation in the walls, tighten the building, change the windows, or insulate the roof and will be able to assess the thermal mass of the building.

It is expected that buildings in the future will play an active role in the integration of renewable energy in the energy system. Smart and intelligent meters are one of the big energy saving hopes by reducing the energy used in residential houses and public buildings, lowering the energy bill and carbon emissions. Dynamic methods are essential for NZEB and imply that smart meters can be used for automatic generation of reliable energy labels for buildings.

Regular trainings organised by DYNASTEE, take place in the form of workshops or Summer School and deals with the application of dynamic methods for outdoor testing, related analysis and modelling techniques. In general it is targeted to energy researchers, engineers, building designers and energy system managers.

Application of dynamic calculation techniques

By dynamic evaluation techniques (parameter identification) dynamic effects due to accumulation of heat in the equipment, test room envelope and test specimen are properly taken into account. Parameter identification is needed to be able to derive the steady state properties from a short test with dynamic (e.g. fluctuating outdoor) conditions.

The capability to extract these parameters from a test carried out under dynamic conditions and real climate, using a relatively short test period, is one of the main features of this approach.

Several tools have been developed or used in the framework of the PASLINK grouping such as CTSM, LORD or the SIT in the MATLAB to analyse building component testes using test cells. Although the step from test cell level to whole buildings level and other building systems is not trivial. New measurements devices and computer capabilities, together with background from previous work regarding experiment set up, quality of measurement, methods for dynamic analysis, etc, provide a very strong base to broaden the scope of application as mentioned.

In the past steady-state or averaging methods were widely applied. These methods usually require a very long period of testing. In some cases, this is because high thermal inertia leads to a long period of integration. In

other cases, in components with less thermal inertia, effects such as wind speed, long wave radiation, or solar irradiance in sunny weather, may become important and non-negligible. It makes it necessary to use multi-linear regressions in which the increase of the number of inputs leads to longer test periods in order for there to be enough degrees of freedom for regression. Dynamic methods are very useful for overcoming some of these problems. Traditionally, these methods have taken into consideration linear models with linear and time invariant parameters. Recent studies have shown the flexibility and usefulness of dynamic nonlinear models in several applications such as the modeling of ventilated photovoltaic modules, solar chimneys and also for dealing with problems related to warm sunny weather taking the boundary conditions in a test cell into account. Models including time-dependent parameters also present very interesting potential applicability in this field.

Summer school

A Summer School on "Dynamic calculation methods for building energy assessment" will be organized 18-22 June 2012 in Denmark at DTU in Lyngby (near Copenhagen).

1. Homework (participants are supposed to have some basic knowledge)

2. Building Physics and hints on experimental work.

3. Theory about models (ARMA methods, State-Space, etc.), modeling using time-series, validation and on some tools.

4. How to obtain results like physical characteristics, etc.

5. Modeling of a double skin PV ventilated facade as advanced example.

*See **www.dynastee.info** for further information on the summer school.*

The DYNASTEE Network's experience

On a glance, the DYNASTEE network has long term experience with:

Testing under outdoor conditions

- Use of PASLINK test cells (generation of high quality data series)
- PASSYS test cells and other test cells
- Test houses (energy systems performance assessment)
- Real building testing (occupancy behaviour)

Analysis applying dynamic methods for analysis and forecasting

- LORD (lumped model analysis tool)
- CTSM (Continuous Time Stochastic Modelling)
- Matlab – System Identification Toolbox
- Others (including regression techniques)

Modelling (based on technical specifications; design phase)

- TRNSYS
- ESP(-r)

Up to date Technology

Dynamic mathematical and statistical technologies are recognised as crucial in optimisation of energy efficiency.

Integration of renewable energy technologies in our society is rapidly taking place giving another perspective of the use of available energy resources. The recast of the Energy Performance for Buildings Directive, the Energy Service Directive and the Construction Product Regulation Directives require energy standards for calculation methods, certification, etc. New buildings will consume and produce energy for space heating while electricity consumption for systems and appliances is increasing.

Innovative applications in the energy sector for dynamic methods:

- Energy labeling for buildings (certification)
- In-situ measurements and analysis (new CEN – WG)
- Energy performance assessment of buildings (EPBD)
- Integration of solar and wind power in the grid (2020 targets)
- District heating (optimising CHP)
- Intelligent metering techniques

The developments of Nearly-Zero Energy Buildings are importantly based on dynamic characterization and method-ology. Beside dynamic evaluation and modelling, dynamic testing under real climate conditions is an essential part.

The Role of Simulation

The system identification techniques applied in the DYNASTEE network can extract the key performance characteristics of building components or energy system. But to investigate how the component may work in a design context for new or refurbished buildings requires the use of integrated simulation programs. So, in parallel with the system identification analysis techniques, model calibration, scaling and replication procedures have been developed that make use of the experimental data to formulate simulation models of the building components and then apply them to full-scale application.

In the hands of a skilled user, the major simulation programs that are in common use today can be used with some confidence in predicting the energy and environmental performance of buildings. However, new building components (e.g. advanced glazing, building-integrated renewables, phase change materials, new insulation products, ventilated constructions) are constantly being developed, most of which have significant interactive effects on building performance. It is necessary to check the ability of the simulation program to model such component performance when integrated into the building– this is where the use of measured building component data in a controlled but realistic outdoor environment has a role.

A procedure has been developed and applied within several major European projects. The calibration phase involves detailed analysis of measurements and predictions for the component of interest. This may require sensitivity analyses to suggest appropriate parameter values where there is uncertainty. Scaling involves the modelling of selected full-scale buildings for deployment of the building component under test. Simulations are undertaken of a base case of the building without the component, and then with the component included, to compare for a range of performance metrics. Lastly, replication involves repeating the simulations with different climate datasets and, perhaps, different local operational regimes.

Outdoor Test Facilities

The strength of the DYNASTEE network lays it is multi-disciplinary nature of academic and research groupings in Europe. In addition the presence of outdoor test facilities at several partner organisations offers the direct interaction between realistic experimental testing and dynamic evaluation and simulation.

In this issue three sites will be presented briefly. For details and contact information please visit the DYNASTEE web-site.

1- CIEMAT – PSA, Spain

CIEMAT has been involved in activities in this field of research since 1986 till now, mainly focusing in aspects related to outdoors tests of buildings, building components and passive building systems, in sunny weather conditions.

The Group's activities are largely experimental, focusing in energy performance assessment of buildings, and building components. These activities are carried out in the LECE's Outdoor Laboratory at the Plataforma Solar de Almería (PSA) and the PSE ARFRISOL Research Energy Demonstrator Office Building Prototypes (C-DdI), one of which is also at the PSA.

The LECE has several systems for studying actual-size construction systems experimentally under real weather conditions, using data analysis, system-identification and time-series-analysis techniques.

Reference monozone building

PASLINKoriginal test-cell

2- LCCE – Vitoria, Spain

Basque Government (owner) and the University (operator of the test site) of the Basque Country.

Two renovated PASLINK test cells are available for outdoor testing at the LCCE premises in Vitoria. Thermal bridges have been removed, air infiltration rates have become negligible and the inner surface for HFS Tiles installation was improved.

In one of the test cells, roof components can also be tested. A dedicated insulation frame for roof components have been designed and constructed. This new development was carried out entirely by the LCCE staff. It minimizes border effects and makes it easier to manipulate roof samples although they are heavy roofs.

(1) Interior of PASLINK renovated test-cell with HeatFlow sensor tiles

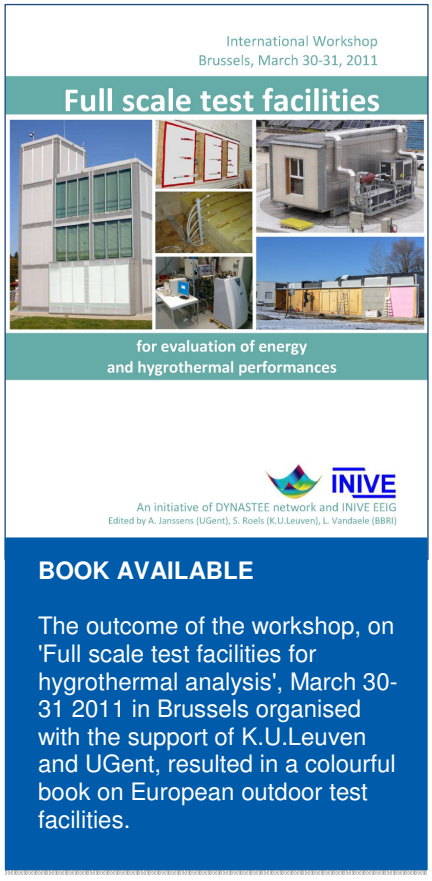
(2) Roof component testing

3- University of Florence, Italy

A new test cell will become available in 2012 at the Florence University, Italy, with the aim to become an outdoor experimental site able to test innovative energy efficiency facades and building components.

The test-cell has a wooden structure with strongly reduced thermal bridges, an insulated frame, rotatable platform and sensitive flux sensors. It will measure and compare thermal differences of innovative opaque and transparent components, massive and light, high vs low density insulation material, all testing under dynamic and real external conditions; moreover effect of solar shading on transparent components and daylight effect on different orientation can be investigated. It is part of a large project Abitare Mediterraneo financed by the Tuscany Region to support technological development of new building components suitable for Mediterranean climate.

New design of PASLINK testcell in Florence



DYNASTEE

ABOUT DYNASTEE

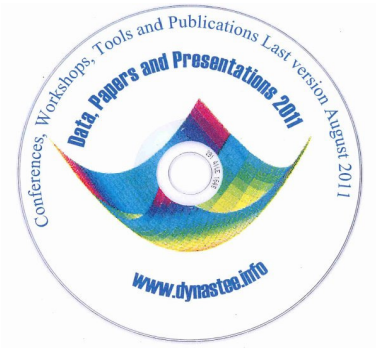
The DYNASTEE Network

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 an informal grouping of organizations actively involved in the application of tools and methodologies relative to this field. DYNASTEE functions under the auspices of the INIVE EEIG and constitutes a sustainable informal networking mechanism, which is intended for those who are involved in research and applications for the assessment of energy performance of buildings in relation to the Energy Performance for Buildings Directive (EPBD).

The Network of Excellence

The DYNASTEE network will be involved importantly in the Network of Excellence of the Annex 58. It will play a co-ordinating role between partners in the Annex 58 grouping, the DYNASTEE network and other European networks, such as INIVE. In addition it will facilitate the transfer of knowledge and expertise by organising conferences, workshops and training events.



Publications

During the last ten years a number of workshops, conferences and training events have been organised by the DYNASTEE network. The outcome of these events in the form of papers and presentations has been collected on a CD together with data and tools for self-training. The CD can be mailed upon request. Visit the DYNASTEE web-site www.dynastee.info for further details.

IEA ECBCS Annex 58

International Energy Agency
Energy Conservation in Buildings and Community Systems Programme

During 2011 the DYNASTEE network organised two workshops that resulted in the successful submission of the IEA ECBCS Annex 58 proposal on the topic of "Reliable Building Energy Performance Characterisation Based on Full Scale Dynamic Measurements".

Major aim of the Annex 58 project is a collaboration in the ECBCS-context to:

- Develop the necessary knowledge and tools to achieve reliable in-situ dynamic testing and data analysis methods that can be used to characterize and label the effective energy performance of building components and whole buildings.
- Develop procedures with the focus both on the test environment and experimental setup as well as on the data analysis and performance prediction.

Organisations or people interested in receiving more information about this Annex 58 can be found at the Annex 58 website at http://www.kuleuven.be/bwf/projects/annex58/index.htm

INIVE

The INIVE Network

INIVE EEIG (International Network for Information on Ventilation and Energy Performance) was created in 2001 as a so-called European Economic Interest Grouping. The main reason for founding INIVE was to set up a worldwide acting network of excellence in knowledge gathering and dissemination. At present, INIVE has 11 member organisations (BBRI, CETIAT, CIMNE, CSTB, ERG, ENTPE, IBP, SINTEF, NKUA, TMT US and TNO), and there is interest in joining among other organisations. (www.inive.org)

The original reason for creating INIVE was the availability of a strong entity able to act as the Operating Agent for the IEA' Air Infiltration and Ventilation Centre (AIVC). AIVC is the IEA Information Centre that deals with the topic of energy efficient ventilation and air tightness of buildings. Since 2001, INIVE has been the Operating Agent for the AIVC (www.aivc.org).

As a service provider to the European Commission and the European Agency for Competitiveness and Innovation, INIVE EEIG has been coordinating the European Buildings Platform since 2006 and, since 2009, BUILD UP, which is THE European portal on Energy Efficiency (www.buildup.eu).

INIVE aims to stimulate and contribute to the creation of new knowledge in key areas of ventilation and energy efficiency. In the ASIEPI project (www.asiepi.eu), which finished in March 2010 and was coordinated by INIVE, several critical areas related to energy-efficiency policies were analysed, with a whole range of new findings as a result.

INIVE facilitates also structured collaborations, which go beyond the duration of single projects. The best example of such collaboration is the DYNASTEE network (www.dynastee.info), which is the leading network of use and development of system identification techniques and related applications. The DYNASTEE-PASLINK network is a part of the INIVE Activities.