DYNASTEE

NEWSLETTER ISSUE 2023/21

Foreword

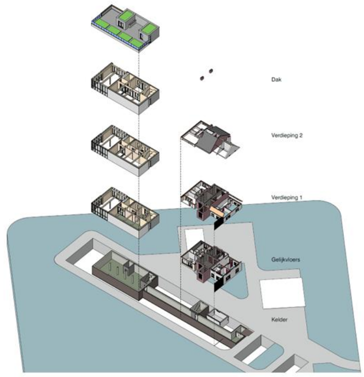
As we approach the end of 2023, we look back upon an eventful year. In April, the DYNASTEE Spring School on Building Performance Measurement took place at the University of Salford (UK). We were happy to organise a physical training event again after two years of webinars due to the pandemic. A new training event, the Summer School 2024, has already been planned to take place in Almería (ES) in September. You'll find more information on the summer school in this Newsletter.

At the end of the spring school, the DYNASTEE European Building Performance Symposium was held. We spoke about the outcomes and follow-up of the IEA-EBC Annex 71 project, legislation, measurements and analyses techniques for the as-built energetic performance of buildings, and the plans for the new ConstrucThor test facilities in Belgium were presented.

In the past months, professors David Allinson, Cliff Elwell and Richard Fitton developed an idea for a new IEA-EBC Annex project, following up on the work of Annex 58 and Annex 71. The construction work for ConstrucThor has started this autumn. In this newsletter, you'll also find articles on the updates in building regulations as well as the Heat3D application for rapid U-value assessment.

We wish you happy holidays and all the best for 2024. There are plenty of new developments, projects and events to look forward to!

Twan Rovers



Exploded view of ConstrucThor test facilities (by MVC Architecten + U/Define)

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Hans Bloem, INIVE

Twan Rovers, Saxion University of Applied Sciences

Summer School 2024 in Almeria, Spain, 11-18 September 2024

Whole building energy performance assessment. From in-situ measurements to smart metering data.

After nine Summer/Spring Schools and two training Webinars, DYNASTEE is proud to announce that for the tenth time it will organise a physical Summer School in 2024. This time it will take place in the south of Spain from 11-18 September 2024. More than 190 PhD students and researchers have participated in the nine preceding physical Summer/Spring Schools and their enthusiastic response has made us decide to continue organising this dedicated course.

Course Schedule: The course will be 6 days with 3 days - weekend - 3 days. The aim of the Summer School is to train the participants on the application of analysis techniques towards whole building analysis from in-situ measurements and metering data. The main goal is the assessment of the HTC (Heat Transfer Coefficient) using real data from experiments. New is the introduction course on metering data and a dedicated exercise by applying statistical analysis methods to metering data. Three days will be devoted to linear regression and discrete time methods by applying the user-friendly software tool LORD. After the weekend, 3 days will be devoted to continuous time methods also, like CTSM-R and applied to high quality real data. The course concept will remain the same as in previous years, which means about half of the time is devoted to lectures and the other half to performing exercises using benchmark data. This schedule leaves a weekend between the first and second parts of the course that the participants can use to dig into the training material or just to have a rest. A social event will be organised during the break.

Dates: 11 - 18 September 2024. Note that the Summer School will end on Wednesday 18 September at 17:00.

Venue: CIESOL at the University of Almería, Spain. Almería can be reached in different ways. The most common travelling option is to fly to Madrid or Barcelona and then to change for Almería. It is also possible to fly to Malaga or Granada and then take a bus to Almeria.

Fee: The fee covers presentations and data of the lectures and relevant papers, lunches and coffee breaks during the lectures, a joint dinner and participation to the social event during the weekend. Details of the announcement including the participation fee will be soon available on the DYNASTEE website.

For pre-registration please contact Marta Ruiz e-mail: mruiz.serviciosexternos@psa.es

Feel free to contact mjose.jimenez@psa.es to be placed on the mail-list and you will receive updates of the announcement.

Deadline for registration: 15/06/2024

Accommodation: Upon request, the organisers can facilitate information on student residence and standard hotels in Almería.

Lecturers: Hans Bloem (Dynastee), María José Jiménez (CIEMAT, ES), Peder Bacher (DTU, Lyngby, DK), Aitor Erkoreka, Irati Uriarte (University of the Basque Country, ES) & Richard Fitton (Salford University, UK).

Update on the ConstrucThor large scale test facility of KU Leuven, Belgium

By Tim Verhetsel

With the ConstrucThor project KU Leuven wants to accelerate research on climate neutral building with a new state-of-the-art test facility in Genk, Belgium. This project fits within the Covid-19 relance funding by the Flemish government, Flemish Resilience. This article gives an update on how the project is going.

From the presentation for the DYNASTEE Symposium in Salford onwards the design of the ConstrucThor project has been refined, from an initial design phase to the building permit design and now, towards the execution plans. During this period the building permit was granted and the construction is planned to start in March 2024.

In this design process a collaborative contract form is used. The architect, contractor and client are working closely together in a triangle to create as much value as possible within a strict defined timeline. If the budget or timing risks to derail, measures within the design are taken to get the project back within the known constraints. This was the case for our project. The estimations of the contractor indicated a much higher cost than foreseen. The goal was then to search for alternatives in building methods or materials, but were eventually found in reducing the size of the facility all together. The facility had grown from 1100m² in the initial application of the project to +/- 1700m² with all the research needs and wishes accounted for. We returned to a more sensible 1284m² while retaining all the research possibilities within a smaller envelope.

To sum up we have still 5 large areas to play with:

1. 3-storey office building with 3 different types of thermal inertia (heavy, medium and light) and all 3 equipped with different heating methods (underfloor heating, concrete core activation and air heating). On each floor there is space for six real occupants. The facades can be fully changed in line with the research.

2. The main test building with a large test façade and water retention roof. On the southwest façade 12 individual elements (3.6x3m) can be tested on hygrothermal performances or other parameters. The indoor climate will be held constant while the outdoor will be a normal Belgian climate. Every element can be mounted individually and doesn't have any influence on the neighboring elements.

3. A vacant building plot where new typologies of (prefabricated) housing can be fully tested, from construction towards energy performance during use and end-of-life deconstruction.

4. Three renovation typologies resemble the existing Belgian building stock: a 1970's apartment, an historical townhouse from the 1930's and a semi-detached house of the 1950's. All three will be rebuild with recuperated materials and following long lost traditional building methods, each with known problems. These houses will be inhabited by virtual inhabitants.

5. A major factor in this project are the redundant technical installations and more specifically the heating system. An air-water heat pump and a ground-water heat pump exist next to each other, each capable to heat/cool the entire building. The ground source heat pump will be linked to 16 boreholes, where research is possible on the thermal grouts used and the distance between the boreholes. A dry cooler is incorporated to cool down the system if needed. A collection of 3 thermal storage tanks are used on different temperatures (45°C, 15°C and 7°C) to be able to buffer and mix different systems. The opportunity exists to create a mini district heating network with all the buildings on site. The renovation houses will be heated individually, but can be linked to the main energy source as well.

The construction will start March 2024, the main construction will be completed May 2025 to start with the commissioning until December 2025. From January 2026 the first test and research can start to take place. As this seems far away, but also very near, we want to open up this facility and invite all interested stakeholders to propose research based on this facility.

New IEA-EBC Annex Proposal

By Richard Fitton

Earlier this month, the idea for a new IEA-EBC Annex has been approved. This joint application was made by: Prof. David Allinson (Loughborough University), Prof. Cliff Elwell (University College London) and Prof. Richard Fitton (University of Salford).

We proposed a new IEA-EBC Annex to extend and develop the work of Annex 58 and Annex 71, with the following objectives:

- Develop a methodology by which an HTC measurement technique can be validated/deemed suitable for a given scenario.
- Develop common methods for allocating uncertainty to in-situ measurements.
- Create a network of test buildings across the globe to provide access to different building types and climates (including cooling dominated climates).
- Provide new evidence on the efficacy of measuring HTC in high performing homes and blocks/apartments where research is currently absent.
- Develop a new research area on energy pathology topics, aiming to complement HTC estimates via additional information that diagnoses performance issues. This will include novel methods which can help disaggregate and apply forensic examination to the aggregated HTC figure.

The annex proposal has been approved in principle. We now have Until November 2024 to develop the proposal in collaboration with interested parties. The starting point will be an international workshop in London, during April 2024. We warmly welcome all those interested to submit details via this link: https://forms.office.com/e/39xXePeTME

We are hoping for a truly global collaboration between academia, industry and policy makers and look forward to your support.

We can no longer rely on plasterboard, mastic and foam! The Future of Airtight Buildings

By Barry Cope

The revised Approved Document L of the Building Regulations in England and Wales mark a significant transformation in the construction industry, especially in achieving airtightness in buildings, more so than the industry may realise. This change signals the end of the long-standing practice where contractors predominantly used internal plasterboard as an air barrier, supplemented by sealants like mastic and foam to control air leakage. The revised regulations introduce more stringent airtightness targets by default, necessitating a comprehensive re-evaluation of these traditional methods.

Traditionally, plasterboard has been a favoured choice in construction due to its cost-effectiveness, ease of installation, and versatility. In terms of air barriers, it offered a straightforward solution to meet the previously less stringent airtightness requirements. The combination of plasterboard with sealants allowed for a relatively simple method to decrease air leakage in buildings, particularly during the finishing stages of construction, "what you see is what you deal with". However, this method falls short under the new, more stringent airtightness targets.

The revised Approved Document L, though the maximum benchmark of air tightness has only slightly reduced (from 10.00 $m^3.h^{-1}.m^{-2}$@50Pa down to 8.00 $m^3.h^{-1}.m^{-2}$@50Pa), realistically the target will now move from an average of 4.36 $m^3.h^{-1}.m^{-2}$@50Pa to around 3.00 $m^3.h^{-1}.m^{-2}$@50Pa depending on the building construction and varying factors. This change is aligned with global efforts to enhance energy efficiency and environmental sustainability in the construction sector. Lowering air leakage is a critical step in reducing buildings' energy consumption and carbon footprint, emphasising the need for more effective air sealing methods from the initial stages of construction.

This regulatory shift presents both challenges and opportunities for contractors. The main challenge lies in moving away from the traditional plasterboard and mastic approach and adopting new materials and techniques that provide superior airtightness. Contractors will need to explore advanced sealing technologies and integrate them early into the construction process.

Conversely, there is an opportunity for contractors to align with sustainable building practices. Meeting the new airtightness standards ensures buildings with better thermal performance, leading to energy savings and reduced environmental impact. This transition could open new markets for contractors who adapt effectively to these changes.

A critical aspect of the new standards is incorporating airtightness considerations early in the design phase. This approach ensures that airtightness is not an add-on but a fundamental aspect of the building's design. Architects and designers will need to collaborate closely with contractors to choose appropriate materials and design strategies that comply with the new standards.

The construction industry must also focus on education and training to equip professionals with the necessary knowledge and skills. Training programs emphasizing the latest materials and techniques for achieving airtightness will be crucial for the workforce to adapt to these new standards.

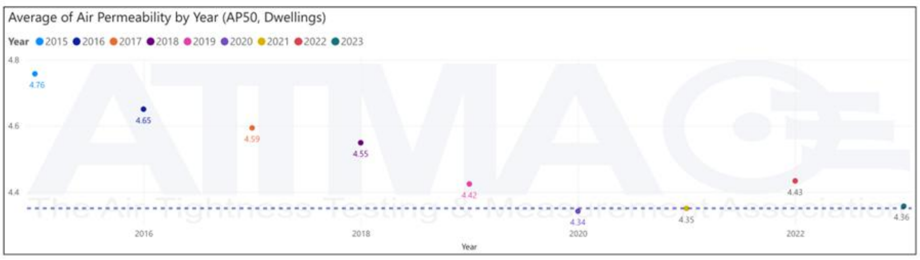
The push towards lower airtightness targets is likely to drive innovation in construction materials and methods. New products designed to meet these stringent requirements are expected to emerge. Moreover, the use of advanced technologies like building information modelling (BIM) can significantly aid in planning and executing projects that adhere to these new airtightness standards.

Three of these technologies will be demonstrated at the Future of Airtightness event, as previously discussed:

1. SIGA (membranes and moisture control)
2. Passive Purple (airtight 'paint', reduces leakage in porous materials)
3. Aerobarrier (aerosol liquid membranes finds the gaps in construction and seals them).

In conclusion, the new airtightness targets in Approved Document L represent a pivotal shift in building practices in England and Wales. Moving away from traditional methods like plasterboard and mastic, the construction industry must adopt a holistic approach that integrates airtightness from the design stage. While challenging, this transition is a step towards more sustainable and energy-efficient construction, in line with global environmental goals. The industry must embrace these changes, prioritising innovation, education, and collaboration to achieve these new standards.

For further details, please register for, and attend the ATTMA Future of Airtightness event on the 10th January 2024 at The Building Performance Hub, High Wycombe.



Update on National Advocates

Following our call in the previous (20th) DYNASTEE Newsletter, we are glad to announce the new National Advocates for DYNASTEE:

- Spain: **Alexander Martín-Garín**
- Portugal: **Paulo Santos**
- Ireland: **Archie O'Donnell**
- Romania: **Ligia Moga**
- Italy: **Elena Lucchi**

The role involves promoting DYNASTEE and publicising our events to your network. If you are interested in becoming a National Advocate for your European country (including ones already listed above) or would like to know more, please contact Dr. Aimee Byrne: aimee.byrne@tudublin.ie

HEAT3D – Rapid U-value Assessment

By Grant Henshaw

HEAT3D® is a novel iOS application which rapidly measures the U-values of external building elements. Utilising Apple's Augmented Reality (AR) kit, the application creates a 3D model of the room, then maps the infrared (IR) image of each surface to the model, using either the FLIR One Pro or the FLIR One Edge. Utilising quantitative infrared thermography, the application is able to calculate the heat transfer, and therefore the U-value of the external surface.

HEAT3D® aims to offer rapid and accurate U-value assessment of building elements. A key issue in building energy assessment is the use of predetermined U-values. Although well established in-situ measurement methods exists, such as the ISO 9869-1 heat flux plate method, these are expensive, require specialist kit, take a minimum of 72h, and are intrusive to occupants. As such, traditional measurements are not feasible to do on a mass scale.

To conduct a HEAT3D® survey, the user first enters a pre-heated room and sets up an air and reflective temperature targets against the building element which is to be measured. The user must then map out the area of the room, creating the 3D model, before taking a thermal survey of the entire building element. The application automatically detects the temperature targets, which then are used to either calculate the instantaneous heat flux, or the U-value across the entire building element if the timelapse feature is used (typically lasting 60 mins).

HEAT3D® has been developed by Build Test Solutions and Electric Pocket; and validated by Energy House Labs at the University of Salford, UK.

The application was first tested at the Salford Energy House in 2019. The Salford Energy House is a replica pre-1920's solid wall end terrace, constructed within an environmental chamber.

The application was subject to a 4-week testing campaign, consisting of 200+ individual surveys under a variety of both steady state and dynamic internal and external conditions. The applications successfully measured the instantaneous heat flux of the dwelling's external walls, with over 90% of the HEAT3D® measurements being within the combined uncertainty of a calibrated heat flux plate. Over the 2019-20 winter heating season, a field trial consisting of 20+ UK properties was conducted, to assess how this instantaneous heat flux measurement of the application compared with that of the traditional heat flux plate under different building constructions and weather conditions. A total of 295 HEAT3D® surveys were conducted throughout the filed trail, with 90% again agreeing with the heat flux plate measurements. It was found that HEAT3D® can measure the heat flux to an accuracy of ±0.6 Wm^{-2}.

Having validated the application can successfully measure the heat flux through an external wall, the next phase of the application development was to yield a rapid U-value assessment using the application. To do this, a timelapse method was implemented, where the application takes a thermal image every minute over the course of an hour, yielding a U-value measurement at the end. This method was tested over the 2020-21 winter heating period through a second field trial. The application yielded good U-value results, with 95% of the 42 HEAT3D® surveys being within the combined confidence interval of the ISO9869-1 measured U-value.

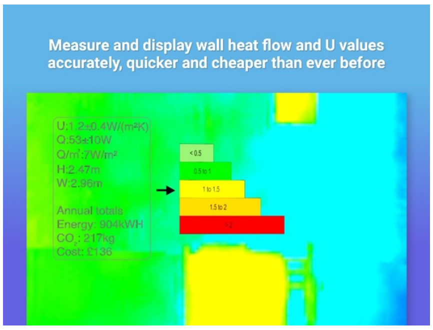
Further development of HEAT3D®is still underway, with the next phase focusing on accurate U-value measurements of ceiling and floors, as well as use with other thermal cameras. Initial testing of this function at the Salford Energy House in the summer of 2023 yielded promising results, with further validation work scheduled for early 2024.

A validation report of the initial Salford Energy House testing and 2019-2021 field trials is available on the Build Test Solutions website, with academic publications available in 2024.

HEAT3D(R) Infrared U-value Measurement - Thermographic Survey (buildtestsolutions.com)

The application is available on the Apple App Store here:

HEAT3D on the App Store (apple.com)



ABOUT DYNASTEE

DYNASTEE stands for: "DYNamic Analysis, Simulation and Testing applied to the Energy and Environmental 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 subjects.

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 network profiled itself as a scientific community of experts on Testing, Analysis and Modelling. In 1998, PASLINK EEIG started a new project: PVHYBRID-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), focusing 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 network 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 more recently the IEA-EBC Annex 71 'Building energy performance assessment based on in-situ measurements'.