DYNASTEE
NEWSLETTER ISSUE 2022/18

# Foreword

The measurement of building (energy) performance has always been of major interest. Since the 1980s, Paul Baker – who is leaving DYNASTEE now to go on pension – has been involved with the PASSYS and PASLINK test facilities. In June 2021, a new test facility was opened at Saxion University of Applied Sciences (Netherlands). And the Energy House 2.0 will be opened this summer, allowing the measurement of various types of homes in a broad range of climate conditions.

After the completion of measurements and collection of data, comes the vital task of analysis. We are happy to announce that after two years of online summer schools, the DYNASTEE Summer School on *whole building analysis from in-situ measurements and metering data* will for the 9th time take place physically in Alméria, Spain.

Twan Rovers, Saxion University of Applied Sciences

*Entrance to the Energy House 2.0*

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## Announcement Summer School 2022 in Almeria, Spain, 7 - 14 September 2022

### Towards whole building analysis from in-situ measurements and metering data

After eight Summer Schools and two training Webinars DYNASTEE is proud to announce that for the 9th time it will organise a physical Summer School in 2022. More than 190 PhD students and researchers have participated to the 8 preceding physical Summer Schools and their enthusiastic response has made us to decide after a 2 year interruptions due to the covid restrictions, to continue organising this dedicated course.

**What is new**: 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. New is also 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 to 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. We have learned that a break is very much welcomed and a social event will be organised during the break.

**Dates**: 7 - 14 September 2022. Note that the Summer School will end on Wednesday 14 September at 17:00

**Venue**: CIESOL at the University of Almeria, Spain. Almeria 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.

**Fee**: The participation fee will be 500 euro. This covers: Presentations and data of the lectures and relevant papers. During the lecture period, lunches and coffee breaks. Participation to the social event and diner during the weekend. See details of the announcement on www.dynastee.info

**Deadline for registration**: 15/06/2022

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

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

**Accommodation**: the organisers will announce a special booking arrangement for early registrations together with the participation fee.

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

*Left: CIESOL at University of Almeria - Right: Students at the Summer School in Almeria 2018*

## Paul H. Baker leaving DYNASTEE to go on pension

Paul Baker has over 40 year experience in Building Science research, including air infiltration measurement and ventilation issues, passive solar energy use and moisture related problems in buildings. He has been a task leader in IEA and European projects involved with the assessment, measurement and analysis of the performance of building envelopes and components and participated in CEN working groups. He is author and co-author of many publications on the afore mentioned topics. About 20 years ago Paul moved from BRE to GCU - Glasgow Caledonian University.

He started in 1986 and became responsible for the PASSYS test site at BRE - Building Research Establishment in East Kilbride. Four test cells were available for the testing of wall components, indoor environmental conditions, such as humidity but also the integration of photovoltaic elements. The work was not been only setting up the outdoor experiments but included the analysis of the collected data. The PASLINK test facilities and analysis procedures aim to obtain the thermal and solar characteristics of building components under real dynamic outdoor conditions. Improving the quality of experimental work and data analysis has been always given the highest priority in all related European projects. Paul has contributed importantly to this quality aspect in particular the IQTEST project. Both the analysis and the test methodology have evolved since the start of the PASSYS Project in 1985, now >35 years ago. During several European projects Paul contributed in the development of software routines and lectured in training workshops and since 2011 in the Summer Schools on “Dynamic Methods for whole Building Energy Assessment”

His research activities at GCU included: The development of sensors for the measurement of conditions in micro-environments to improve our understanding of the life-cycle of bio-contaminants such as dust mites in carpets.

With Paul leaving, entering retirement his expertise will be greatly missed in the DYNASTEE network. We wish him and his family all the best for the future.

*Testcell at BRE in 1986*

*Paul Baker*

*Outdoor testing of facades*

## Seeking new DYNASTEE board members

The DYNASTEE board looks for enthusiastic people that like to help organising the events that the informal network undertakes. DYNASTEE will have to say goodbye to two of the co-founders of the original network, PASLINK eeig. Peter Wouters and Luk Vandaele have decided after so many successful years working for the network, to enjoy their retirement by the end of 2022. Note that the PASLINK eeig was been converted in 2005 into the actual informal network: DYNASTEE that runs under auspices of the INIVE eeig.

DYNASTEE was involved in many European research projects and more recently the IEA EBC projects Annex 58 on Reliable Building Energy Performance Characterisation Based on Full Scale Dynamic Measurements and Annex 71 on Building Energy Performance Assessment Based on In-situ Measurements.

The DYNASTEE board is composed presently of 5 members and would like to continue as soon as possible with 2 extra persons. The activities of DYNASTEE network encompass:

To maintain the expertise developed in European research projects and lately the IEA-EBC projects available to the community of builders, designers, industrial developers, scientists and public authorities.

The DYNASTEE platform will continue to act as the information exchange medium for

- Training Exercises, software and data
- Summer School: Dynamic Methods For Whole Building Energy Assessment
- Collaboration with other international projects

Interested people can contact Hans Bloem at: hans.bloem@inive.org

# The effect of secondary pollutants with respect to indoor air quality and health

*By Jeroen van 't Ende*

With the aim to limit greenhouse gas emissions, energy efficiency measures are applied at large scale resulting in buildings to become more airtight. Indoor environmental quality depends strongly on ventilation rates. Whilst controlled ventilation contributes to a reduced use of fossil fuel, too little ventilation increases the risk of health damaging concentrations of pollutants in the indoor environment.

There are three primary sources for pollutants indoors (1) ventilated outside air, (2) emissions from activities such as cooking and cleaning and (3) longitudinally emitted pollutants from people, building components and furnishings. Some accepted primary pollutants to asses indoor air quality are $CO_2$, Volatile Organic Compounds (VOC) and OH. However, indoor chemistry studies indicate the presence of large amounts of complementary secondary pollutants with potentially health damaging effects. Secondary pollutants indoors are the result of chemical reactions of pollutants with solar radiation as energy source and ozone/other oxidants. Little is known about the type of resultant secondary pollutants and their effect on human health. One approach to assess the effect of secondary pollutants on indoor environmental quality is to integrate chemical box models with building simulation models, e.g. computational fluid dynamics.

In this contribution the authors provide a conceptual framework that allows one to quantify the amount of inhaled pollutants by simulating a breathing pattern in the integral simulation software OpenFOAM. The results contain primary pollutants and secondary pollutants after reactions. Furthermore, an index was created to compare inhaled toxicity of different chemical species. The python code to do this has been published under MIT license.

The combination of CFD, chemical simulations and a breathing mannequin gives unique insights in the distribution of pollutants in the indoor environment. Figures 1 and 2 show CFD simulations of the Smart TinyLab at Saxion UAS in Enschede without mannequin, and Figure 3 shows the same geometry with a mannequin added in.

Adding in the mannequin allows insights into (1) convective airflows caused by body-heat, (2) temperature differences in respired air, (3) the respiration can be monitored in order to determine exposure to the different chemical components of air and (4) even a static mannequin drastically changes the distribution of pollutants in a room.

Figure 1 shows the simulated geometry, the colored planes denote the different Formaldehyde ($CH_2O$) concentrations. Which color equals what concentration can be seen on the bar to the right of the image. It is visible that the concentration goes down rapidly from the left (1.5e-6 %) to the right (0.5e-6 %). It can also be seen that the concentration at the air-inlet is substantially lower (1.8e-10 %).

Figure 2 shows the concentrations for Limonene ($C_{10}H_{16}$), Formaldehyde ($CH_2O$), Ozone ($O_3$) and Reaction product ($C_{10}H_{16}$). These concentrations are clipped to a maximum concentration (see figure annotation) and colored homogeneous. The reaction product cloud is most concentrated at the intersection of the 2 preceding chemicals, this plane of intersection is strongly dependent on ventilation configuration.

Figure 3 shows that the $CO_2$ concentrations (the ISO-surface) throughout the room do not differ greatly ($3.97e^{-3}$ % to $4.0e^{-3}$ %). It can also be seen that air speeds increase from the bottom to the top of the mannequin, as described in literature, a buoyancy driven flow causes an upward draft around the mannequin. The hot respired air will be carried away of the mannequin towards the ceiling. The ceiling also contains the air outlet, the pressure difference between inlet and outlet rapidly carries away the respired $CO_2$.

For more information, and the python (source)code see: https://pypi.org/project/aaei/

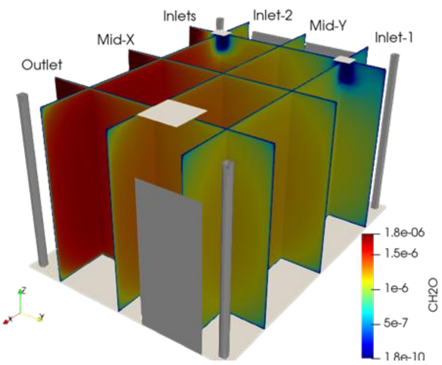


*Figure 1: Geometry of case study: Saxion's Smart TinyLab. The inlets, outlets, door and columns are shown in grey, the annotations are placed in-line with the planes that intersect the mentioned feature*

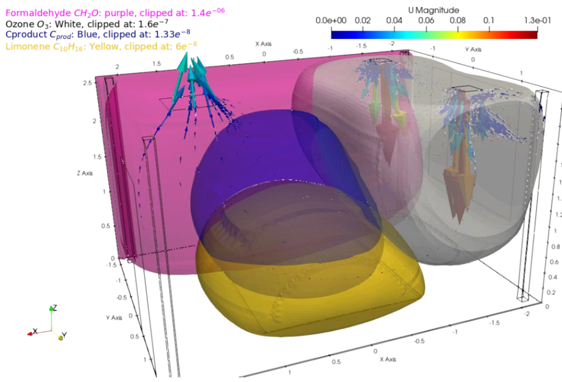


*Figure 2: Integral simulation in OpenFOAM, visualized with Paraview. The arrows are scaled with magnitude and denote air speed and directionality. The Yellow cloud shows Limonene clipped at a concentration of $6e^{-8}$ % (emitted when mopping the floor). The white cloud shows Ozone clipped at $1.6e^{-7}$ % (originating from outside, inlets). The purple cloud shows Formaldehyde clipped at $1.4e^{-6}$ % (emitted from wood, construction materials). The blue cloud shows reaction product between Ozone and Limonene clipped at $1.33e^{-8}$ % (Limonene + Ozone -> C_product*

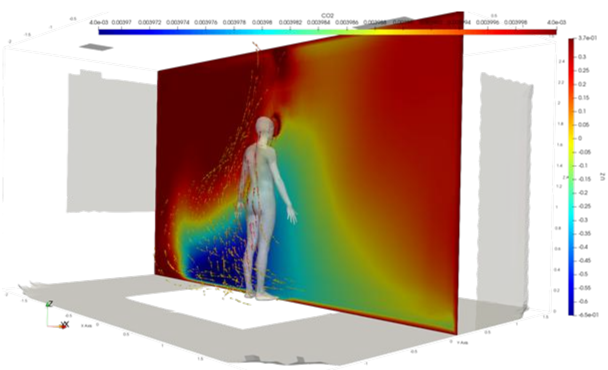

*Figure 3: The mannequin has a body temperature of 306.95 [K], the exhaled air has a temperature of 309.15 [K]. The color-bar at the top shows $CO_2$ concentrations linked to the ISO-surface. The color-bar to the right shows the speed Z-component and applies to the arrows around the mannequin. Buoyancy driven flow can be observed clearly.*

## Energy House 2.0 Update

The Energy House 2.0 build program is now complete, March 2022. We have 2 chambers capable of delivering climatic conditions as follows:

- Air temperature -20° C to +40° C
- Controllable humidity
- Wind
- Rain
- Snow
- Solar Radiation

The ranges of these climates can represent 95% of the globally populated land mass. The next part of the project is to construct four homes inside these chambers; these will be a range of types, from Passive house apartments, volumetric modular builds and timber framed homes.

We will research the buildings over a series of different climatic conditions included overheating scenarios and using climate change predictions for short- and medium-term predictions.

The facility will be formally opened in the Summer 2022 with an industry and academic engagement event, with all the houses being constructed by then.

For details of this event or to find out more please email R.Fitton@salford.ac.uk.

*Snow and rain installations*

*The EH2.0 building*

## Opening of Smart TinyLab at Saxion UAS

European Union
European Regional Development Fund

*By Twan Rovers & Christian Struck*

On June 2, 2021, the Smart TinyLab was opened at Saxion University of Applied Sciences in Enschede (Netherlands). As a lab for system integration in the construction industry, it allows construction companies, contractors, manufactures and suppliers to further develop, test, validate and demonstrate their products in practice.

The Smart TinyLab consists of three rooms: a plant room housing the installations for climate and energy control, a reference room and an intervention room. These can be used to test and characterize different system components, such as walls, windows, air treatment systems and heat pumps by comparative analysis. The lab is equipped with a broad range of sensors to perform various measurements and to quantify system performance. Furthermore, the lab can be rotated 305° both manually and automatically to control the influence of solar radiation on the experiments.

The first research projects focus on (i) dynamic performance monitoring of wooden façade elements (ii) glazing as an active heat regulator, (iii) smart building – user interactions, (iv) value creation through data-driven services in the built environment, and (v) energy distribution through DC grids in residential and office environments. For more information, please visit the website: https://www.saxion.nl/onderzoek/labs/smart-tinylab

The project is co-financed by the European Regional Development Fund of the European Union.


*Entrance to the Smart TinyLab*

*The reference room and intervention room*

## 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'.

DYNASTEE