DYNASTEE
DYNamic Analysis. Simulation and Testing applied to the Energy and Environmental performance of buildings

Free On-line Training Webinars | 2-9-16-23-30 September 2020

Dynamic Calculation Methods for Building Energy Performance Assessment

Technical University of Denmark DTU | GCU Glasgow Caledonian University | Universidad del País Vasco Euskal Herriko Unibertsitatea | Gobierno de España Ministerio de Economía y Competitividad | Ciemat Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas | University of Salford Manchester

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1

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Introduction

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DYNASTEE

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University of Salford Manchester

Webinar management

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2

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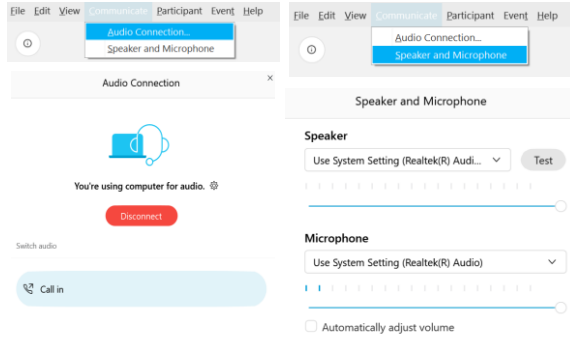
Make sure that Audio Connection is on by clicking on Communicate / Audio Connection

If you still can't hear, run a Speaker Audio Test to make sure the correct output is selected [To run the test, click on Communicate / Speaker and Microphone]



3

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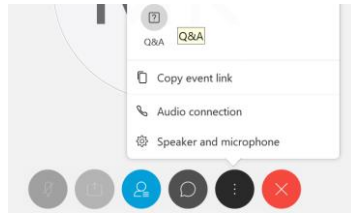
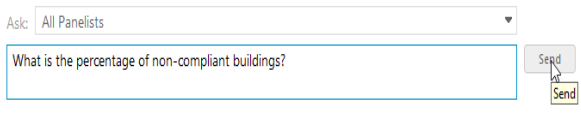
How to ask questions during the webinar

Locate the **Q&A box**



Select **All Panelists** | Type your question | Click on Send



Note: Please DO NOT use the chat box to ask your questions!

4

DYNASTEE DYNamic Analysis. Simulation and Testing applied to the Energy and Environmental performance of buildings

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Organized by https://dynastee.info/ Facilitated by INIVE

NOTES:

- The webinar will be recorded and published at https://dynastee.info/ within a couple of weeks, along with the presentation slides.
- In case your questions have not been answered please send them to: Luk Vandaele (luk.vandaele@inive.org), Richard Fitton (r.fitton@salford.ac.uk)

Disclaimer: The sole responsibility for the content of presentations and information given orally during DYNASTEE webinars lies with the authors. It does not necessarily reflect the opinion of DYNASTEE. Neither DYNASTEE nor the authors are responsible for any use that may be made of information contained therein.

5

DYNASTEE

DYNASTEE

Network for

- DYNamic
- Analysis
- Simulation and
- Testing of
- Energy and
- Environmental performance of buildings

6

HISTORY

1985	PASSYS I	*B, DK, F, D, I, NL, UK, JRC*
1990	PASSYS II	*+ GR, P, E*
1992	COMPASS PASLINK	
1994	European Economic Interest Grouping of Outdoor Test Centres	*+ FI*
1996	PV-HYBRID-PAS	
2000	IQ-TEST	*+ CH*
2002	DAME-BC	*+ New member states*
2005	DYNASTEE	*New sites in Spain, France, ...* ⇨ INIVE
2011	IEA Annex 58	
2016	IEA Annex 71	*Summer schools*
2020		

7

INTERNATIONAL NETWORK

INIVE

International Network for Information on Ventilation and Energy Performance

DYNASTEE

- operates under the umbrella of INIVE
  as an open platform for exchange of knowledge and experience
- facilitates ST5 Network of Excellence of IEA ECB Annex 71

8

DYNASTEE - OBJECTIVE

- Global leading network on dynamic testing and evaluation of Energy Performance in Buildings
- Consolidation of existing knowledge
- Bringing together academic, industry and governmental experts
  - on the **test environment and experimental setup** as well as on the **data analysis** and **performance prediction**.
- DYNASTEE - NoE: ST5 of IEA EBC Annex 71

Functioning

- DYNASTEE is the follow-up platform of PASLINK EEIG for information exchange
- DYNASTEE Fund
  - = the heritage of PASLINK EEIG after its dissolution in 2005
  - Governed by INIVE EEIG
  - + Sponsoring by Industry
  - + Voluntary work

Activities

- DYNASTEE SubTask 5 leader of Annex 71
- Facilitates interaction with target groups: CEN, Industry, IEA Annexes, EU projects, etc.
  - Organises Workshops
  - E.g. 10-11 April 2019 Bilbao “The building as the Cornerstone of our Future Energy Infrastructure”
- Organises training: 8 Summer Schools
- Communication
  - Publishes Newsletters; # 17
  - https://DYNASTEE.INFO website
  - Disseminates tools, data, reports, papers, ...

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Background to Course

The course has two main objectives:

- Train a dynamic methodology to assess the thermal performance of a building such as a wall, and a whole buildings’ performance.
- Examine and understand the performance of nZEB and renewables

The approach to these will be a combination of **building physics, applied mathematics** and **statistical methods**

Who might find this useful?

We feel the following groups would have an interest this course:

- Anyone with an interest in the dynamic calculation/measurement of the performance of buildings e.g.:
  - Energy modellers
  - PhD students
  - Standard writers
  - Architectural Engineers
  - Building physicists

What approaches will be used in the sessions?

We will use data that has been collected by experts that is high quality:

- Data from realistic and full scale buildings and envelope systems, **not generated by models.**
- Realistic and reliable data taken by experts **in-situ**

Using this type of data we can begin to validate and examine performance of said elements with reduced uncertainty.

Context

Researchers and industry are quickly realising that the worlds of energy and environmental modelling and the real world often do not intersect. This has been shown in many studies globally. This is known as the “Performance Gap” (PG)

Country	Sample size (N)	Average Performance Gap	Country	Sample size (N)	Average Performance Gap	Reference
Canada	1	74%	Canada	1	74%	(Rouleau et al., 2018)
Germany	3400	30%	Germany	3400	30%	(Galvin, 2014)
United Kingdom	25	50%	United Kingdom	25	50%	(Johnston et al., 2015a)
Switzerland	50000	11%	Switzerland	50000	11%	(Cozza et al., 2020)
France			France			
Italy	6	45%	Italy	6	45%	(Ballarini & Corrado, 2009)

Context

Performance gap can be found in either the positive or negative side of the modelled value.

- Many researchers have tried to state wat may cause PG.
- The PG is actually caused by a number of different reasons.
- A typical reason could be the gap between a default value entered into an energy model that wasn’t included in the actual building

Context

This can explain some issues, but as researchers we dig deeper:

- The way we model may not be perfect, but modelling should be accepted as a simplification of a building and not reality itself.
- Also many people will criticise a model after analysing results form a poorly measured /sensored measurement campaign, with consideration for uncertainty etc.

The Measurement Gap

It may be that the way that we measure things is incorrect, and not comparable other peoples studies/or the values that are used in models (which are often the results of experiments).

One of the simplest and most common value is the U value (the thermal efficiency of an element, the higher the value the quicker heat will pass thorough it)

The Measurement Gap

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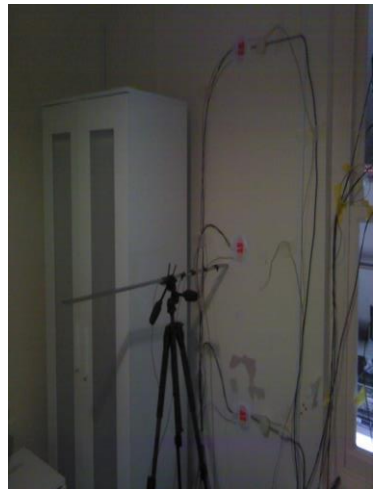
The Measurement Gap



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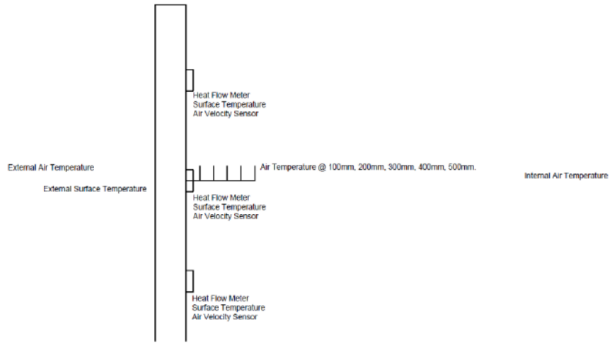
The Measurement Gap



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The Measurement Gap

Average R-values, U-values (average method) and U-values (dynamic method): No Fan

Location	Internal	External	Average R Value (m^2K/W)	Average U-value (Average Method) (W/m^2K)	Average U-value (Dynamic Method) (W/m^2K)
Top	Air	Air	0.642	1.557	1.561
	Air	Surface	0.523	1.912	1.920
	HFT	Air	0.657	1.522	1.596
	HFT	Surface	0.537	1.861	1.971
	Surface	Air	0.666	1.502	1.582
	Surface	Surface	0.546	1.830	1.952
Middle	Air 100mm	Air	0.662	1.510	1.500
	Air 200mm	Air	0.531	1.883	1.880
	Air 300mm	Air	0.659	1.518	1.511
	Air 400mm	Air	0.495	2.020	2.012
	Air 500mm	Air	0.646	1.548	1.546
	Air 100mm	Surface	0.540	1.850	1.846
	Air 200mm	Surface	0.409	2.446	2.435
	Air 300mm	Surface	0.537	1.863	1.859
	Air 400mm	Surface	0.373	2.680	2.654
	Air 500mm	Surface	0.524	1.909	1.906
	HFT	Air	0.664	1.505	1.572
	HFT	Surface	0.544	1.839	1.953
	Surface	Air	0.652	1.533	1.586
	Surface	Surface	0.537	1.864	1.970
Bottom	Air	Air	0.590	1.694	1.686
	Air	Surface	0.475	2.107	2.098
	HFT	Air	0.624	1.603	1.682
	HFT	Surface	0.508	1.968	2.090
	Surface	Air	0.596	1.679	1.701
	Surface	Surface	0.488	2.051	2.113

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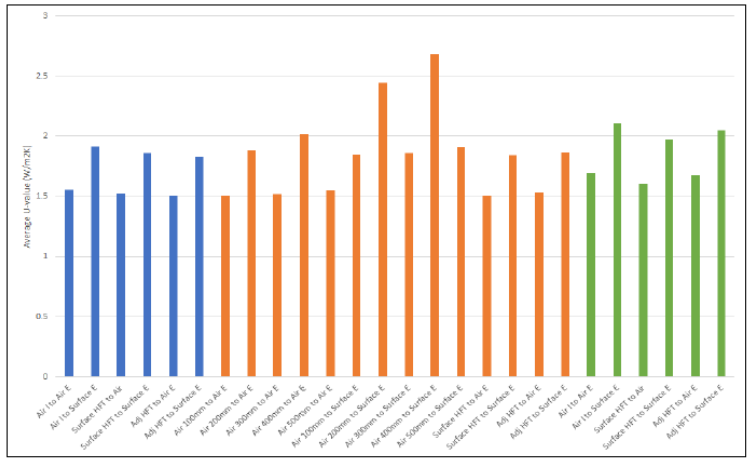
The Measurement Gap

Average U-values (average method) for each permutation: No fan



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The Measurement Gap

Highest U value = 2.446W/m2K

Lowest U value = 1.502W/m2K

When we use these two different values, for a small 2 bedroom house in the UK, the differences are huge.

This is only from three points of measurement (top/middle/bottom), on one single wall.

Let us do even more digging:

DB Appraisal: No Fan

Weather File: Manchester

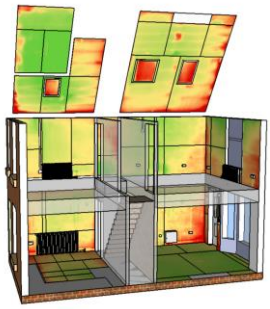
Highest U-value: 2.446 W/m^{2}K
Annual Space Heating Energy Consumption: 8084.81 kW
Annual Space Heating Energy Cost: £395.35
{British Gas 12/16 @0.0489p/kWh}

Lowest U-value: 1.502 W/m^{2}K
Annual Space Heating Energy Consumption: 5971.13kW
Annual Space Heating Energy Cost: £291.99
{British Gas 12/16 @0.0489p/kWh}

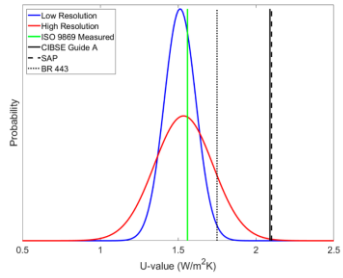
Consumption Difference: 2113.68 kWh
Cost Difference: £103.36

The Measurement Gap

Reference	CIBSE Guide A [7]	SAP [12]	BR 443 [6]
U-value (W/m^2K)	2.09	2.1	1.75



IR Measured U values visualised



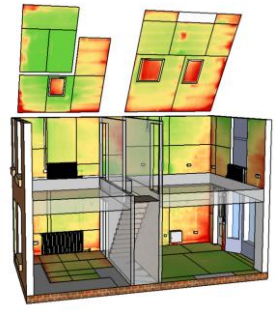
Graphical representation of results

26

The Measurement Gap

- We need to simplify our models, analytics and findings to make sense of extremely complicated physics situations.
- We need to understand the fundamentals of measurements and create scenarios that are repeatable
- Understand our data in > out of analysis
- We need to produce measurements that can be compared to models if required
- We need to make sensible choices about having too much/too complex data.

- The webinar series will help you prepare for these types of activities.



27

Summer School (Pre- COVID-19)

One week session, held in different locations throughout the EU. However this time it will be sat from the comfort of your armchair/office!

- Dynastee have taken a view that for the safe of health and safety this year the summer school will not take place and the sessions have been edited down to small seminars.
- These session will all be delivered online over the course of September 2020. In **five two hour sessions**
- 2nd of September to 30th of September
- Every Wednesday, 10AM to Noon. GMT Summer Time

Overall Topic of Sessions

- Building physics to support the development of mathematical models for energy performance assessment.
- Knowledge of thermodynamic processes, heat transfer and the impact of solar radiation.
- Thermal conduction, convection, radiation and thermal mass.
- Using benchmark data for analysis
- Complexity of the physical process and how to translate the available information in mathematical models,
- Importance of model simplification of building physics represented by measured signals.
- Variability of the environments and the uncertainty of data
- Measured data and not-measured phenomena and how to build a mathematical model based on the available input.

The Experts

Presentations by

- María José Jiménez (CIEMAT, Spain),
- Irati Uriarte (UPV-EHU, Bilbao, Spain),
- Hans Bloem (INIVE-DYNASTEE, Brussels),
- Paul Baker (GCU, Glasgow, UK),
- Aitor Erkoreka (UPV-EHU, Bilbao, Spain),
- Peder Bacher (DTU, Lyngby, Denmark),
- Richard Fitton (University of Salford, UK),
- Luk Vandaele (INIVE-DYNASTEE, Brussels)

Programme

- Webinar 1 – This one – An introduction

Programme

Webinar 2 - 9th September 1000-1200

10:00 Hans Bloem; General approach

- Introduction to general approach of different analysis techniques used to perform the thermal characterisation for elements (walls, roofs etc) through to the whole building.
- We will discuss, the measurement process, processing of data, available tools for analysis, how to understand the results found, uncertainty and what this means in terms of performance and the gap between an exiting model.
- We will introduce 2 software tools that will be used during series of webinars; LORD, and CTSM-R

11:00 Paul Baker; Dynamic Calculations & LORD

- This session will provide an introduction to dynamic analysis methods
- A practical demonstration will be given of the software tool LORD
- An easy exercise will be presented with the correct result given this will help you to build confidence in your analytics skills

32

Programme

Webinar 3 - 16th September 1000-1200

10:00 Aitor Erkoreka; building physics, sensors and instruments

- Introduction to measured data, specific sensors for buildings physics and energy performance and what is important to know.

11:00 Maria-Jose Jimenez; Experimental set up and data

- This session will present the experimental set up and measurement of the Plataforma Solar de Almeria (PSA), an explanation and demonstration of the data available will be given.
- An exercise that will allow of a study to be analysed with and without solar radiation .
- *Data series 16-17 will be presented here which will be used in further sessions.*

33

Programme

Webinar 4 - 23rd September 1000-1200

10:00 Peder Bacher Combining two disciplines building physics and mathematical techniques

- Introduction to discrete time and continuous time methods
- Using CTSM-R with statistical tools

11:00 Irati Uriarte; application of CTSM-R to real world data

- Demonstration of the CTSM-R software will take place on data series 16, 17 from PSA

Programme

Webinar 5 - 30th September 1000-1200

After the 4th Webinar we invite all attendees to submit questions/queries via email on all of the sessions. These will be collated and presented to the panel to provide answers at Webinar 5

Future

This year is atypical, the decision was made to postpone the complete summer school for good reasons.

However we are already planning the next summer school to take place in Almeria in Spain in June 2021, this will be a full summer school with classroom-based learning sessions and interactive sessions.

Future

We will be using the forthcoming year to work on new topics for the summer school as follows:

- **Use of online data platforms such as weather API, renewable energy data**
- **Use of on-board systems such as connected thermostats**
- **Use of smart metering data for energy input**

Most countries now have access to at least most of this data, and some, all of it.

- **The work and findings of IEA Annex 71 which focus on the data mentioned above to deem the energy performance of a dwelling.** https://dynastee.info/new-iea-ebc-annex-71-building-energy-performance-assessment-based-on-in-situ-measurements/
- **We will provide learning on not only the acquisition of this data using live API access to smart meter and controls, but the analytical tools to deem the energy performance.**