

IEA-EBC Annex 58; Guidelines for data analysis from dynamic experimental campaigns; physical aspects.

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Analysis and modelling of data obtained from experiments under real climate conditions require special attention to the treatment of the data during all steps of the elaboration process. The interest for these techniques and their application has grown in recent years by industry. This interest has pushed standardisation activities such as CEN/TC 89/WG13 and research initiatives such as IEA EBC Annex 58. In general it concerns numerous observations by measurements at regular interval of physical processes that requires mathematical and statistical techniques for proper assessment of the searched physical parameters. So the main question is: How to get from many observations as input for the mathematical analysis process to one or a few limited output values for reporting?

In that process the accuracy of input data, the propagation of the errors in the calculation process and the required accuracy of the reported value are of high importance. Once data has been produced (raw data), from a dedicated experiment, it is assumed that these data contain all information describing the physical processes that a mathematical model is supposed to analyze.

Two documents have been made available from the IEA-EBC Annex 58 project on [www.dynastee.info/data-analysis](http://www.dynastee.info/data-analysis)

- The document [Guidelines\\_Analysis\\_BuildingPhysics\\_A58.pdf](#) focuses on criteria that must be considered to avoid mistakes in pre-processing data and constructing candidate models.
- The document [Guidelines\\_Analysis\\_StatisticalModelling\\_A58.pdf](#) presents criteria for selecting the optimal method and model to analyse the available data.

For the case of experimental work and analysis for the energy performance assessment of buildings the physical processes are importantly thermal transfer between a controlled indoor environment and a variable outdoor environment. In principle all these thermal transfer processes are well known physical ones, e.g. conduction, convection and radiation. On many occasions data is produced by people carrying out the technical work of setting up an experiment and controlling the process of data acquisition.

This document is the first part is mainly dealing with physical aspects and specific complexity and problems that may occur due to the experimental conditions. It may be considered as a question: what quality and what information does the data contain for analysis? Minimum steps to carry out data analysis are reported and different alternative analysis approaches are outlined. The document explains how to transfer the main features of the physical system to these modelling frameworks, in order to build candidate models.

Common exercises facilitated the identification of frequently made mistakes leading to unjustified high spread in the results and inaccurate parameter estimates. A case study is presented to facilitate the understanding of some of the recommendations given in this document. The presented case study consists of a round robin test box, designed in the framework of Annex 58. References in this document are given for additional case studies that help to understand the different aspects discussed.

As an introduction some basic information on temperature measurements is given as it is considered as important for a proper analysis of the measured data. The measurement of temperatures and thermal flows is performed by sensors based on the applied physical properties of the sensitive part of it: resistances (PT100), thermo-couples (like Cu-Co) and electronic devices. A correct measurement of the target temperature is required and a closer look will be given within the context of thermal performance of a building corresponding to the transfer of heat through the building envelope.

Radiation is the main source of wrong temperature measurements that give false signals from the sensor and hence false information to the mathematical models about the physical processes. The disturbing radiation may arrive from solar radiation, heat sources such as badly shielded electric heaters and incandescent light bulbs. Shielding of air- and surface temperature sensors is therefore

necessary in particular for those that could be hit by solar radiation near to window openings and those sensors that are placed in a space where electric heaters or light bulbs are used. Measured data is supposed to contain all information about the total physical process to be studied. As a consequence it is important also to have knowledge about the phenomena that are part of the physical process but that not could be measured, such as corner effects, air infiltration.

It is assumed that the reader is familiar with basic principles of heat transfer (many text books deal with this topic) and that the reader has some background on measurement techniques that are well described in the literature and standards.