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Thermal performance of buildings - In situ testing of building test structures - Part 2: Steady-state data analysis for aggregate heat loss test

Performance thermique des bâtiments - Essais in situ des structures de bâtiments d'essai - Partie 2 : Analyse des données en régime stationnaire pour l'essai de déperdition thermique globale

Wärmetechnisches Verhalten von Gebäuden - In-situ-Messung an Bauwerksprüfkörpern - Teil 2: Auswertung stationärer Daten für die Prüfung des Gesamtwärmeverlustes

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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European foreword

This document (FprEN 17888-2:2023) has been prepared by Technical Committee CEN/TC 89 “Thermal performance of buildings and building components”, the secretariat of which is held by SIS.

This document is currently submitted to the Formal vote.

Introduction

FprEN 17888-1 describes a test methodology that enables the actual *in situ* building test structure aggregate heat loss (building heat transfer coefficient) to be quantified. This test method is termed the aggregate heat loss test method. This document (Part 2) principally covers numerical methods based on steady-state linear regression techniques. The results obtained using these methods are only valid under the assumption that, in first approximation, the data can be described by these mathematical and physical laws. Statistical tests to check the validity of these assumptions are therefore given. It also results in the determination of an aggregate building heat transfer coefficient for the tested building structure, along with the uncertainty associated with this coefficient. Both the aggregate building test structure heat transfer coefficient and its uncertainty can be calculated as an output of this document. The reporting format relating to the test data and the resulting analysis is also described.

This document is highly linked with FprEN 17888-1 to which it applies exclusively. It is also complimentary to FprEN 17887-1 which deals exclusively with completed buildings.

In first instance, real building co-heating tests and associated data analysis help on determining the global performance of the building that usually take advantage of free solar gains through well oriented glazing surfaces. In this case these solar gains are welcome and contribute in reducing the energy demand for heating of the building. Aggregate heat loss coefficient extracted from data analysis on such real building is then minimized by associated solar gains and may help to better understand the real energy demand of the studied building structure regarding weather conditions.

In second instance it is from interest (as example) to concentrate on aggregate thermal performance of opaque building structures, for more precisely undertake the analysis of the thermal response of the building structure linked to these same climatic patterns. For that purpose, direct solar gains through glazing surfaces are excluded of the study by testing preferatelly opaque structures. In most of the cases, in winter periods, solar gain through opaque insulated surfaces remain poor so that the energy demand for heating become mostly dependent on temperature difference between internal and external environments. Nevertheless, this also offers the opportunity to undertake *in situ* testing with the aim to evaluate efficiency of passive solar systems that would contribute to minimize the energy demand of the tested building structure.

This document describes the input data required to undertake the analysis, various statistical methods that can be used to analyse the data, the uncertainty associated with the measurements, and the reporting format.

Detailed requirements concerning the test procedure and the data recording are specified in FprEN 17888-1.

1 Scope

This document specifies the steady-state data analysis methods to evaluate the data from ‘the aggregate heat loss test method’. These analysis methods enable the actual *in situ* aggregate heat loss (building heat transfer coefficient) to be estimated.

NOTE The aggregate heat loss method is specified in FprEN 17888-1:2023.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

<std>ISO 5479, *Statistical interpretation of data — Tests for departure from the normal distribution*</std>

<unknown>FprEN 17888-1:2023, *Thermal performance of buildings — In situ testing of building test structure — Part 1: Data collection for aggregate heat loss test*</unknown>

3 Terms, definitions and symbols

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at https://www.electropedia.org/

— ISO Online browsing platform: available at https://www.iso.org/obp

3.1 Terms and definitions

3.1.1
aggregate heat transfer coefficient
sum of the transmission and infiltration component of the ventilation heat transfer coefficient based upon measurement according to this test standard

3.1.2
external (internal) air temperature
temperature of the external (internal) air measured by external (internal) air temperature sensor

3.1.3
heat transfer coefficient
heat flow rate divided by temperature difference between two environments; specifically used for heat transfer coefficient by transmission or ventilation

[SOURCE: EN ISO 13789:2017, 3.5]

3.1.4
internal room temperature
air temperature measured at the geometric centre of the room

3.1.5
internal whole building temperature
mean air temperature of all of the measured internal room temperatures

3.1.6
solar heat gain
heat provided by solar radiation entering, directly or indirectly (after absorption in building elements,) into the building through windows, opaque walls and roofs, or passive solar devices such as sunspaces, transparent insulation and solar walls

Note 1 to entry: Active solar devices such as solar collectors are considered part of the technical building system.

[SOURCE: ISO 52000-1:2017, 3.6.10]

3.1.7
global solar irradiance
measured or calculated solar irradiance related to the south vertical wall or façade that is expected to receive the highest proportion of solar gains

Note 1 to entry: Longwave and shortwave radiation exchanges to the sky are not included

3.1.8
temperature difference
difference between the internal whole building temperature and external air temperature

3.1.9
transmission heat transfer coefficient
heat flow rate due to thermal transmission through the fabric of a building, divided by the difference between the environment temperatures on either side of the construction

Note 1 to entry: By convention, if the heat is transferred between a conditioned space and the external environment, the sign is positive if the heat flow is from the space to outside (heat loss).

[SOURCE: EN ISO 13789:2017, 3.6]

3.1.10
ventilation heat transfer coefficient
heat flow rate due to air entering a conditioned space by infiltration or ventilation, divided by the temperature difference between the internal air and the supply air temperature

Note 1 to entry: The supply temperature for infiltration is equal to the external temperature.

Note 2 to entry: In this analysis, the intended ventilation component of the ventilation heat transfer coefficient is typically omitted and only the infiltration component is included in the heat transfer coefficient, as intended ventilation routes are sealed during the test.

[SOURCE: EN ISO 13789:2017, 3.7, modified – Note 2 to entry has been added]

3.2 Symbols

Table 1 summaries the symbols and units referred to within this standard.

Table 1 - Symbols and units

Symbol	**Description**	**Unit**
Inputs for the regression analyses		
P_h	Electrical heating power	W
P_h	Electrical heating power	W
q_{sw}	Global solar irradiance (measured or calculated solar irradiance related to the south vertical wall or façade that is expected to receive the highest proportion of solar gains)	W/m²
T_i	Internal air temperature	°C
T_e	External air temperature	°C
ΔT	Temperature difference between the internal whole building and external air	K
Parameters		
H	Heat transfer coefficient (global, including losses by transmission and ventilation or air infiltration)	W/K
H_{agg}	Aggregate heat transfer coefficient	W/K
H_{tr}	Transmission heat transfer coefficient	W/K
H_v	Ventilation heat transfer coefficient	W/K
H_i	Internal gain coefficient	W/K
H_e	External gain coefficient	W/K
B_0	Bias term	W/K
A_{sw}	Equivalent solar aperture	m²
θ	Vector of the parameters of the model	-
X	Explicative matrix of the model	-
Y	Vector of the explicated values of the model	-
Intermediary quantities		
B'_0	Intercept for the inverted linear regression	W/m²
B'_1	Slope for the inverted linear regression	m²
β^*_1	Dimensionless slope	-
A, H, d, λ_1,λ_2	Internal parameter	-
SF	Scale factor	-