



Data for occupancy internal heat gain calculation in main building categories

Ahmed, Kaiser; Kurnitski, Jarek; Olesen, Bjarne W.

Published in:
Data in Brief

Link to article, DOI:
[10.1016/j.dib.2017.10.036](https://doi.org/10.1016/j.dib.2017.10.036)

Publication date:
2017

Document Version
Publisher's PDF, also known as Version of record

[Link back to DTU Orbit](#)

Citation (APA):
Ahmed, K., Kurnitski, J., & Olesen, B. W. (2017). Data for occupancy internal heat gain calculation in main building categories. *Data in Brief*, 15, 1030-1034. <https://doi.org/10.1016/j.dib.2017.10.036>

General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.



ELSEVIER

Contents lists available at ScienceDirect

Data in Brief

journal homepage: www.elsevier.com/locate/dib

Data Article

Data for occupancy internal heat gain calculation in main building categories

Kaiser Ahmed ^{a,*}, Jarek Kurnitski ^{a,b}, Bjarne Olesen ^c^a Aalto University, Department of Civil Engineering, Finland^b Tallinn University of Technology, Faculty of Civil Engineering, Estonia^c Technical University of Denmark, Department of Civil Engineering, Denmark

ARTICLE INFO

Article history:

Received 31 July 2017

Received in revised form

5 October 2017

Accepted 16 October 2017

Available online 7 November 2017

Keywords:

Body surface area

Metabolic rate

Dry heat loss

Total heat loss

Internal heat gain

ABSTRACT

Heat losses from occupant body by means of convection, radiation, vapor, and sweat are essential data for indoor climate and energy simulations. Heat losses depend on the metabolic activity and body surface area. Higher variations of body surface area of occupants are observed in day care centers, kinder gardens and schools compared to other building categories (Tables 2 and 3) and these variations need to be accounted, otherwise in these building categories heat gains, CO₂ and humidity generation are overestimated. Indoor temperature, humidity level, air velocity, and clothing insulation have significant influences on dry and total heat losses from occupant body leading to typical values for summer and winter. The data presented in this article are related to the research article entitled Occupancy schedules for energy simulation in new prEN16798-1 and ISO/FDIS 17772-1 standards (Ahmed et al., 2017) [1].

© 2017 The Authors. Published by Elsevier Inc. This is an open access article under the CC BY license

(<http://creativecommons.org/licenses/by/4.0/>).

Specification Table

Subject area	Construction & Building technology
More specific subject area	Energy and indoor climate

DOI of original article: <https://doi.org/10.1016/j.scs.2017.07.010>

* Correspondence to: Rakentajanaukio 4 A, FI-02150 Espoo, Finland.

E-mail address: kaiser.ahmed@aalto.fi (K. Ahmed).

<https://doi.org/10.1016/j.dib.2017.10.036>

2352-3409/© 2017 The Authors. Published by Elsevier Inc. This is an open access article under the CC BY license (<http://creativecommons.org/licenses/by/4.0/>).

Type of data	Calculated
How data was acquired	Calculated with Equations provided in the research article for main building categories
Data format	Table
Experimental factors	
Experimental features	
Data source location	Research article [1]
Related research article	Occupancy schedules for energy simulation in New prEN16798-1 and ISO/FDIS 17772-1 standards [1].

Value of the data

- The data provided in this paper may be used as occupancy related input data for indoor climate and energy simulations in main building categories.
- The data presented the effects of variation of body surface area of occupants in day care center, kinder garden, and school. These differences are to be accounted; otherwise the heat gains are overestimated.
- The data might support the researchers to get information about the heat losses from occupant by means of convection, radiation, vapor and sweat as well as humidity and CO₂ generation.
- The data provided the information about typical dry and total heat loss values from occupancy in main building categories during summer and winter.

1. Data

The data presented in this article are related to the research article entitled Occupancy schedules for energy simulation in new prEN16798-1 and ISO/FDIS 17772-1 standards [1]. The data allow to calculate the dry and total heat losses from occupant body in different building categories during summer and winter. Six parameters affect for estimating the heat losses from occupant body, namely metabolic rate, air temperature, radiant temperature, air velocity, humidity, and clothing insulation.

Activity level (Table 1) and body surface area (Table 2) is the starting point of heat losses calculation of occupant body. Activity level is presented in the form of metabolic rate and depends on the

Table 1
Metabolic rates of main building categories [2–5].

Institution			Metabolic rate (met)
Day care center	Children	2–4 yr	1.0
	Professional	Adult people	1.91
Kinder garden	Children	5–6 yr	1.39
School	Grade 1–6	7–12 yr	1.2
	Grade 7–12	13–18 yr	1.2
	Teacher	Adult people	1.46–1.72
Department store		Adult worker	1.6
Office, Meeting room		Adult office worker (Sedentary)	1.2
Detached house, Apartment building		Adult people	1.2
Hotel, Restaurant, Hospital		Adult people (Sedentary)	1.2
Sport, terminal, theatre		Adult people	1.6

Table 2
Body surface area (A_{DU}) of occupants in day care center, kinder garden, school [7].

Age	Girl/Female					Boy/Male					
	Weight, W		Height, H		Body surface area, A_{DU}	Weight, W		Height, H		Body surface area, A_{DU}	
	(lb)	(kg)	(in.)	(m)		(m ²)	(lb)	(kg)	(in.)		(m)
Day care center											
2	26.5	12.0	33.5	0.9	0.52	27.5	12.5	34.2	0.9	0.53	
3	31.5	14.3	37.0	0.9	0.60	31.0	14.1	37.5	1.0	0.60	
4	34.0	15.5	39.5	1.0	0.65	36.0	16.4	40.3	1.0	0.67	
Kinder garden											
5	39.5	18.0	42.5	1.1	0.73	40.5	18.4	43.0	1.1	0.74	
6	44.0	20.0	45.5	1.2	0.80	45.5	20.7	45.5	1.2	0.81	
School											
G-1	7	49.5	22.5	47.7	1.2	0.87	50.5	23.0	48.0	1.2	0.88
G-2	8	57.0	25.9	50.5	1.3	0.96	56.5	25.7	50.4	1.3	0.96
G-3	9	62.0	28.2	52.5	1.3	1.03	63.0	28.6	52.5	1.3	1.04
G-4	10	70.5	32.0	54.5	1.4	1.12	70.5	32.0	54.5	1.4	1.12
G-5	11	81.5	37.0	56.7	1.4	1.22	78.5	35.7	56.5	1.4	1.20
G-6	12	91.5	41.6	59.0	1.5	1.32	88.0	40.0	58.7	1.5	1.29
G-7	13	101.0	45.9	61.7	1.6	1.42	100.0	45.5	61.5	1.6	1.41
G-8	14	105.0	47.7	62.5	1.6	1.46	112.0	50.9	64.5	1.6	1.54
G-9	15	115.0	52.3	62.9	1.6	1.52	123.5	56.1	67.0	1.7	1.65
G-10	16	118.0	53.6	64.0	1.6	1.56	134.0	60.9	68.3	1.7	1.73
G-11	17	120.0	54.5	64.0	1.6	1.57	142.0	64.5	69.0	1.8	1.78
G-12	18	125.0	56.8	64.2	1.6	1.60	147.0	66.8	69.2	1.8	1.81
Other		139.9	63.5	65.3	1.6	1.71	159.8	72.5	70.8	1.8	1.91

Table 3
The average body surface area (A_{DU}) used in the calculations of occupant heat emission [1].

Building type	Body surface area, A_{DU} (m ²)
Detached house	1.80
Apartment building	1.80
Office building	1.80
Department store	1.80
Hotel	1.80
Restaurant	1.80
Sport, terminal, theatre	1.80
School	1.68
Daycare center (2–4 yr)	0.66
Kinder garden (5–6 yr)	0.77
Hospital	1.80

muscular activities. Met is the unit of metabolism that equivalent to 58.15 W/m² per body surface area. According to different building categories, the metabolism rate is illustrated in Table 1.

Body surface area (A_{DU}) is a unique parameter for an individual that depends on the individual height (H) and weight (W). It is considered as the most significant parameter that may responsible for different heat losses from the body, though occupants have the same muscular activity. Also, this is used as an input variable to estimate the heat losses from occupant body by means of convection, radiation, vapor, sweat. The body surface area (A_{DU}) is estimated from the Du Bois formula [6]. Maximum variations of body surface area (A_{DU}) of occupants occur in day care centers, kinder gardens, and schools, shown in Table 2. Other building categories, mostly occupied by the adults, are shown in Table 3.

2. Materials and method

Seasonal effect are to be accounted to estimate the heat losses from occupant body, because the set point of indoor air temperature as well as humidity levels depend on the seasons. Also, clothing insulation, acceptance of air velocity is changed according to the season. To estimate the heat losses from the body, the input values during summer and winter are presented in the research article, Table 1 [1].

The corresponding heat losses equations are presented in the research article entitled Occupancy schedules for energy simulation in new prEN16798-1 and ISO/FDIS 17772-1 standards [1]. The convection heat losses ($Q_{Convection}$), radiation heat losses ($Q_{Radiation}$), vapor heat losses (Q_{Vapor}), and sweat heat losses (Q_{Sweat}) during summer and winter are shown in Tables 4 and 5, respectively.

Dry (sensible) heat losses (Q_{Dry}) is the summation of convection heat losses ($Q_{Convection}$), and radiation heat losses ($Q_{Radiation}$), whereas total heat losses (Q_{Total}) include all losses from occupant body. The obtained dry and total heat losses are presented in research article [1], which obtained from Tables 4 and 5.

Occupants are the main source of CO₂ and humidity generation in indoor environment. Metabolic rate and body surface area are the key variables to estimate the CO₂ and humidity generation [8] and the values for main building categories are shown in Table 6.

Table 4
Heat loss components of occupancy during summer.

Building type	Metabolic rate (met) [2–5]	$Q_{Convection}$ (W)	$Q_{Radiation}$ (W)	Q_{Vapor} (W)	Q_{Sweat} (W)
Detached house	1.2	44.1	38.7	25.9	9.7
Apartment building	1.2	44.1	38.7	25.9	9.7
Office building	1.2	44.1	38.7	25.9	9.7
Department store	1.6	41.7	36.0	27.8	52.4
Hotel	1.2	44.1	38.7	25.9	9.7
Restaurant	1.2	44.1	38.7	25.9	9.7
Sport, terminal, theatre	1.6	41.7	36.0	27.8	52.4
School	1.2	39.6	32.7	25.2	19.4
Daycare center (2–4 yr)	1.0	16.1	13.4	9.5	0.0
Kinder garden (5–6 yr)	1.39	17.6	14.4	11.9	18.1
Hospital	1.2	44.1	38.7	25.9	9.7

Table 5
Heat loss components of occupancy during winter.

Building type	Metabolic rate (met) [2–5]	$Q_{Convection}$ (W)	$Q_{Radiation}$ (W)	Q_{Vapor} (W)	Q_{Sweat} (W)
Detached house	1.2	38.3	39.5	33.4	7.1
Apartment building	1.2	38.3	39.5	33.4	7.1
Office building	1.2	38.3	39.5	33.4	7.1
Department store	1.6	36.9	37.3	35.9	47.6
Hotel	1.2	38.3	39.5	33.4	7.1
Restaurant	1.2	38.3	39.5	33.4	7.1
Sport, terminal, theatre	1.6	36.9	37.3	35.9	47.6
School	1.2	37.8	38.9	32.9	7.2
Daycare center (2–4 yr)	1.0	15.1	15.8	12.5	0.0
Kinder garden (5–6 yr)	1.39	17.1	17.4	15.7	11.9
Hospital	1.2	38.3	39.5	33.4	7.1

Table 6
Occupant CO₂ and humidity generation in main building categories.

Building type	Metabolic rate (met) [2–5]	Body surface area, A_{DU} (m ²) [1]	CO ₂ generation ($\frac{l}{h}$)	Humidity generation ($\frac{\%}{h}$)	
				Summer	Winter
Detached house	1.2	1.80	18.8	55.7	63.7
Apartment building	1.2	1.80	18.8	55.7	63.7
Office building	1.2	1.80	18.8	55.7	63.7
Department store	1.6	1.80	25.1	125.7	131.2
Hotel	1.2	1.80	18.8	55.7	63.7
Restaurant	1.2	1.80	18.8	55.7	63.7
Sport, terminal, theatre	1.6	1.80	25.1	125.7	131.2
School	1.2	1.68	17.6	52.0	59.3
Daycare center	1.0	0.66	5.8	14.4	18.5
Kinder garden	1.39	0.77	9.3	38.1	40.9
Hospital	1.2	1.80	18.8	55.7	63.7

Acknowledgements

The research was supported by Grants from K.V. Lindholms Stiftelse Foundation, Säätiö L.V.Y. Foundation and by the Estonian Centre of Excellence in Zero Energy and Resource Efficient Smart Buildings and Districts, ZEBE, Grant 2014–2020.4.01.15–0016 funded by the European Regional Development Fund.

Transparency document. Supporting information

Transparency data associated with this article can be found in the online version at <https://doi.org/10.1016/j.dib.2017.10.036>.

References

- [1] K. Ahmed, A. Akhondzada, J. Kurnitski, B. Olesen, Occupancy Schedules for Energy Simulation in New prEN16798-1 and ISO/FDIS 17772-1 Standards, vol. 35, 2017, pp. 134–144.
- [2] Applied Research Cancer Control and Population Science, National Cancer Institute, 2016. (<http://appliedresearch.cancer.gov/atus-met/met.php>). (Accessed 27 June 2016).
- [3] ISO 7730, Ergonomics of the Thermal Environment – Analytical Determination and Interpretation of Thermal Comfort Using Calculation of the PMV and PPD Indices and Local Thermal Comfort Criteria, 2005.
- [4] ISO 8996, Ergonomics of Thermal Environments – Determination of Metabolic Heat Production, 1989.
- [5] H. Havtun, P. Bohdanowicz, Sustainable Energy Utilization, KTH Energy technology, Stockholm, 2011.
- [6] D. Du Bois, E.F. Du Bois, A formula to estimate the approximate surface area if height and weight be known. 1916, *Nutrition* 5 (5) (1989) 303–311 (discussion 312–3).
- [7] Height and Weight Charts for Children, 2016. (<http://www.buzzle.com/articles/height-and-weight-chart-for-children.html>). (Accessed 9 January 2016).
- [8] SFS-EN ISO 8996, Ergonomics of the Thermal Environment, Determination of Metabolic Rate, 2005.