Data for occupancy internal heat gain calculation in main building categories

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

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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].

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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

| Institution                          | Metabolic rate | Metabolic rate |
|--------------------------------------|----------------|----------------|
| Day care center                      |                |                |
| Children                             | 2–4 yr         | 1.0            |
| Professional                         | Adult people   | 1.91           |
| Kinder garden                        |                |                |
| Children                             | 5–6 yr         | 1.39           |
| 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   | 1.2            |
| Sport, terminal, theatre             | Adult people   | 1.6            |
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.

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

| Age | Girl/Female | Boy/Male |
|-----|-------------|----------|
|     | Weight, W (lb) | Height, H (in.) | Body surface area, $A_{DU}$ (m²) | Weight, W (lb) | Height, H (in.) | Body surface area, $A_{DU}$ (m²) |
|     | Height, H (kg) | (m) |     | Height, H (kg) | (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, $A_{DU}$ (m²) |
|---------------|----------------------------------|
| 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 |
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 ($Q_{\text{Convection}}$), radiation heat losses ($Q_{\text{Radiation}}$), vapor heat losses ($Q_{\text{Vapor}}$), and sweat heat losses ($Q_{\text{Sweat}}$) during summer and winter are shown in Tables 4 and 5, respectively.

Dry (sensible) heat losses ($Q_{\text{Dry}}$) is the summation of convection heat losses ($Q_{\text{Convection}}$), and radiation heat losses ($Q_{\text{Radiation}}$), whereas total heat losses ($Q_{\text{Total}}$) 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 CO$_2$ and humidity generation in indoor environment. Metabolic rate and body surface area are the key variables to estimate the CO$_2$ 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] | $Q_{\text{Convection}}$ (W) | $Q_{\text{Radiation}}$ (W) | $Q_{\text{Vapor}}$ (W) | $Q_{\text{Sweat}}$ (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] | $Q_{\text{Convection}}$ (W) | $Q_{\text{Radiation}}$ (W) | $Q_{\text{Vapor}}$ (W) | $Q_{\text{Sweat}}$ (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
Occipant CO₂ and humidity generation in main building categories.

| Building type         | Metabolic rate (met) [2–5] | Body surface area, $A_{BD}$ (m²) [1] | CO₂ generation (l/h) | Humidity generation (g/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                     |

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Transparency document. Supporting information

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