Research outputs:

**Occupant response to different correlated colour temperatures of white LED lighting**

Correlated Colour Temperature (CCT) of lighting may affect not only occupant visual perception, but also other indoor environment perceptions, such as perceptions of the thermal environment or the air quality. This study aimed at quantifying the association between CCT of white LED lighting and subjective perceptions and performance at operative temperatures at the upper and lower borders and in the middle of the comfort range. Higher CCT was significantly associated with decreasing thermal sensation, but only at the thermally neutral condition. Female subjects responded stronger to changes in CCT than male subjects. Under all temperature conditions, CCT was clearly associated with the perceived brightness of the light, and at 22 °C also with the perceived air quality and with subjectively assessed alertness. CCT had no effect on the measured performance of a d2 task. At 22 °C, the observed decrease in thermal sensation when CCT went from 2700 K to 6200 K was equivalent to a difference in operative temperature of 1.7 °C. With an assumed neutral CCT of 4500 K (middle of range), a decreased heating set point in an office building, corresponding to an equivalent shift in CCT from 4500 K to 2700 K, resulted in a reduction of around 8% of the building's total annual energy use. However, this assumes ideal conditions without influence from daylight, light from PC monitors, or coloured surfaces and other potentially disturbing factors.
ISSN (Print): 0360-1323

Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 5.22 SJR 2.169 SNIP 2.534
Web of Science (2017): Impact factor 4.539
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 4.51 SJR 1.998 SNIP 2.215
Web of Science (2016): Impact factor 4.053
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 4.37 SJR 2.067 SNIP 2.463
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 4.14 SJR 1.887 SNIP 2.742
Web of Science (2014): Impact factor 3.341
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 3.57 SJR 1.547 SNIP 2.551
Web of Science (2013): Impact factor 2.7
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 3.06 SJR 1.293 SNIP 2.857
Web of Science (2012): Impact factor 2.43
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): CiteScore 2.76 SJR 1.127 SNIP 2.279
Web of Science (2011): Impact factor 2.4
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 1.245 SNIP 2.058
Web of Science (2010): Impact factor 2.131
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 1.025 SNIP 1.889
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 0.938 SNIP 1.413
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 0.826 SNIP 1.771
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 1.016 SNIP 1.716
Scopus rating (2005): SJR 0.933 SNIP 1.296
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 0.572 SNIP 1.259
Scopus rating (2003): SJR 0.898 SNIP 0.963
Web of Science (2003): Indexed yes
Comparison of geometrical layouts for a multi-box aerosol model from a single-chamber dispersion study

General information
State: Published
Organisations: Department of Civil Engineering, Indoor Environment, National Research Center for the Working Environment, Institut National de Recherche et de Sécurité, Federal Institute for Occupational Safety and Health, University of Manchester, Institute of Occupational Medicine, Instituto Tecnológico del Embalaje Transporte y LOGÍSTICA, FORCE Technology, Tampere University of Technology
Publication date: 2018
Peer-reviewed: Yes

Publication information
Journal: Environments
Volume: 5
Issue number: 5
ISSN (Print): 0711-6780
Original language: English
Keywords: Aerosol modelling, Dispersion factor, Geometry, Chamber study, Multiple boxes, Occupational exposure
Electronic versions:
Untitled_2.pdf
DOIs:
10.3390/environments5050052
Development of the ASHRAE Global Thermal Comfort Database II

Recognizing the value of open-source research databases in advancing the art and science of HVAC, in 2014 the ASHRAE Global Thermal Comfort Database II project was launched under the leadership of University of California at Berkeley's Center for the Built Environment and The University of Sydney's Indoor Environmental Quality (IEQ) Laboratory. The exercise began with a systematic collection and harmonization of raw data from the last two decades of thermal comfort field studies around the world. The ASHRAE Global Thermal Comfort Database II (Comfort Database), now an online, open-source database, includes approximately 81,846 complete sets of objective indoor climatic observations with accompanying "right-here-right-now" subjective evaluations by the building occupants who were exposed to them. The database is intended to support diverse inquiries about thermal comfort in field settings. A simple web-based interface to the database enables filtering on multiple criteria, including building typology, occupancy type, subjects' demographic variables, subjective thermal comfort states, indoor thermal environmental criteria, calculated comfort indices, environmental control criteria and outdoor meteorological information. Furthermore, a web-based interactive thermal comfort visualization tool has been developed that allows end-users to quickly and interactively explore the data.

General information

State: Published
Organisations: Department of Civil Engineering, Indoor Environment
Number of pages: 11
Pages: 502-512
Publication date: 2018
Peer-reviewed: Yes

Publication information
Journal: Building and Environment
Volume: 142
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Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 5.22 SJR 2.169 SNIP 2.534
Web of Science (2017): Impact factor 4.539
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 4.51 SJR 1.998 SNIP 2.215
Web of Science (2016): Impact factor 4.053
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 4.37 SJR 2.067 SNIP 2.463
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 4.14 SJR 1.887 SNIP 2.742
Web of Science (2014): Impact factor 3.341
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Fifty years of Fanger's equation: Is there anything to discover yet?

This short communication to the Editor is completely devoted to a recent paper published by Broday et al. (2017) in which a comparative analysis of methods for determining the clothing surface temperature is reported. Contrarily to what our colleagues have found, we will demonstrate that the algorithms reported in ISO 7730 and ASHRAE 55 Standards from more than 30 years are reliable and consistent with other home-made codes based on different numerical techniques.

General information
State: Published
Organisations: Department of Civil Engineering, Section for Indoor Climate and Building Physics, University of Salerno, University of Naples Federico II
Contributors: d'Ambrosio Alfano, F. R., Palella, B. I., Riccio, G., Toftum, J.
Occupant response to controllable LED lighting
At three different ambient temperatures, human subjects were exposed to correlated colour temperatures (CCT) in the range 2750 to 6230 K at an illuminance of 1000 lux. Significant associations were found between CCT and thermal sensation and between CCT and perceived stuffiness of the air.

General information
State: Published
Organisations: Department of Civil Engineering, Indoor Environment, Department of Photonics Engineering, Diode Lasers and LED Systems, Aalborg University
Contributors: Toftum, J., Thorseth, A., Markvart, J., Logadóttir, Á.
Number of pages: 2
Publication date: 2018
Peer-reviewed: Yes
Keywords: Correlated Colour Temperature, Thermal sensation, Perceived air quality, Hue heat hypothesis
Electronic versions: Untitled.pdf

Bibliographical note
Paper no. 206.
Source: PublicationPreSubmission
Source-ID: 151266375
Research output: Research - peer-review › Paper – Annual report year: 2018

Retrofit of school ventilation and pupil well-being and performance being and performance – ASHRAE RP1624
This intervention study compared five solutions for retrofitting school ventilation. No systematic effect of the system operation mode (on or off) on pupils’ wellbeing, symptoms, or performance was observed, but there were significant associations between the performance of some tasks and the classroom CO2 concentration and temperature.

General information
State: Published
Organisations: Department of Civil Engineering, Indoor Environment
Contributors: Toftum, J., Wargocki, P.
Number of pages: 2
Publication date: 2018
Peer-reviewed: Yes
Keywords: Air quality, Temperature, Intervention study, Children
Electronic versions: School_ventilation.pdf

Bibliographical note
Paper no. 142
Source: PublicationPreSubmission
Source-ID: 151266355
Research output: Research - peer-review › Paper – Annual report year: 2018

Warm or Cold Feelings: Estimating Biases in Field Studies
1. Motivation, specific objective: Lighting systems with LEDs that allows for control of illumination, in terms of the correlated colour temperature (CCT) and illuminance intensity, is currently being introduced widely in buildings resulting in decreased energy use for lighting systems. There is a great focus on reducing the overall energy use for buildings and the major energy-consuming factor in buildings is related to the regulation of thermal sensation. An earlier laboratory study
with fewer biases showed that a shift in thermal sensation could occur when changing the lighting by altering the CCT. Using intelligent lighting control could therefore potentially benefit the overall energy use for buildings if being integrated in the thermal strategy. The overall objectives were to test if it is possible to detect an effect similar to the findings from the laboratory study on the thermal sensation when altering the CCT in real offices environments. The objective of this abstract is to discuss the experimental setup imposed in our field study where supplemental lighting is influenced by daylight and other strong biases. Differences that relate to biases should be estimated and accounted for, but the amount of controls are on the expenses of possible tests of the treatments in focus.

2. Methods: In a real office setting, we test the influence of three different CCT’s of 2800, 3100 and 4000 K on the workers thermal sensation and preferences. Three similar hallways and adjacent single or double offices at the Danish Technical University, Denmark (55°41’38.5”N 12°6’5.7”E) were used. These sections were equipped with LED lighting with central control of CCT and light levels. During the field study, the light was on at all times starting from 7 am and onwards unless the workers purposely turned off the light. The electric lighting system was adjusted to 650lx at table height in all CCT settings and it was not possible to regulate the light intensity. The offices had windows to the outside, facing East or West. The experiment was conducted primo January 2018 and lasted for seven weeks. The period was carefully selected leaving minimal influence of the daylight as a central bias and to strengthen the influence of the electric light treatment. The settings of CCT (treatments) was changed each Sunday in a rotation between the 3 sections having 1 week in between being used as an anchor with CCT of 3100 K in all sections. In this abstract we focus on the anchor weeks and the deviation that relates to the different sections and people answering our questionnaires. A total of 48 workers were encouraged to participate in the study. The thermal sensation and visual preference were assessed by an online questionnaire with ten (10) specific questions sent out once a week. The workers were asked to rate their individual sensation of the lighting and thermal comfort while situated in their office. Indoor climate measured as the temperature, RH and CO2 concentration in the offices during the experiment were logged every 5 minutes along with measurements of outdoor diffuse and direct radiation, temperature and humidity in order to exclude them as possible bias.

3. Results and discussion: This field study differed from (most) laboratory studies in its duration and number of biases. In real office settings, we investigate longer term effects of differences in supplemental lighting CCT on the workers. The workers and sections differed in various ways. Thus, the anchor weeks with CCT of 3100 K in all sections was imposed, to estimate the differences between sections, biases of dealing with different groups of people (sections) along with the influences of continuous changes in the outdoor radiation. The questionnaire lead to a relatively consistent response rate – resulting in between 28-31 answers the first three weeks and between 20-24 answers the last four weeks (out of 48 requests). The response rate on our questionnaire was in average around 50%, which partly reflect its' length. A short questionnaire, opposed to a more extensive questionnaire, did not allow us to ask question, of e.g. work related distractions, tiredness, stress or sound levels, to further include and account for such biases in later findings, but we do not find that a lower response rate would have been advantageous. The differences being present between the sections were by anchor weeks measured once for each rotation and at the end. However, imposing the anchor weeks compromised the amount of answers in relations to the treatments of 2800 and 4000 K and extended the test period. Our weekly sent questionnaires (7 weeks) were answered by 19, 135 and 26 workers (180 in total), in relation to treatment settings of 2800, 3100 and 4000 K, respectively. If the study was conducted without the four anchor weeks the test period alone would have been 3 weeks. Execution within 3 weeks would have resulted in a higher response-rate and a more balanced number of answers in relation to the imposed treatments. However, this would compromise the measure of differences that relates to biases influencing the treatment effects. The need of controls for biases will depend on the treatment strength.

4. Conclusions: Field experiments are characterized by having many biases and often a weaker response rate on questionnaire surveys. Our online questionnaire of 10 questions sent out once per week in a field study resulted in an average response rate around 50%. The response rate declined slightly after 3 weeks and varied between 42% and 65%. We are unsure of the need for imposed anchor weeks, since the need for controls of biases influencing the overall result will depend on the treatment strength and survey response rates. However, we stress that differences that relate to biases should be estimated and accounted for.

**General information**

State: Published

Organisations: Department of Photonics Engineering, Diode Lasers and LED Systems, Department of Civil Engineering, Indoor Environment, Aalborg University

Contributors: Markvart, J., Stoffer, S., Thorseth, A., Toftum, J.

Number of pages: 2

Publication date: 2018

Peer-reviewed: Yes

Event: Abstract from CIE Expert Tutorial and Workshop on Research Methods for Human Factors in Lighting, Copenhagen, Denmark.

**Bibliographical note**


Source: PublicationPreSubmission

Source-ID: 152463305

Research output: Research - peer-review » Conference abstract for conference – Annual report year: 2018
The aim of the present study was to extend the knowledge on the suitability and performance of different ventilation retrofit solutions for school buildings located in a temperate climate. A unique approach was used, where four similar and adjacent classrooms in the same school unit located north of Copenhagen, Denmark, were retrofitted either with a decentralized, balanced supply and exhaust mechanical ventilation unit with heat recovery; automatically operable windows with an exhaust fan; automatically operable windows with alternating counter-flow heat recovery through slots in the outside wall; or a visual feedback display unit showing the current classroom carbon dioxide concentration, thus advising when the windows should be opened. For comparison, one classroom retained the original approach for achieving ventilation by manual opening of windows. One year after retrofitting the classrooms carbon dioxide concentrations, temperatures, energy use, and window and door opening behavior were recorded during a four week period in the heating season in January. The measured carbon dioxide concentrations were significantly lower in the classrooms with the mechanical ventilation system and the system with automatic window opening and an exhaust fan as compared with the classrooms with automatic window opening and heat recovery, with visual carbon dioxide feedback and where windows were opened manually. The automatically controlled windows were open for 71% of the occupied time including breaks with an exhaust fan and for 49% with heat recovery. The façade windows were open up to 17% of the occupied time including breaks in the classrooms with manual window opening (with or without visual feedback). The classroom temperature was generally within the recommended thermal comfort range. The present results indicate that in temperate climates the mechanical ventilation system and both systems with automatic window opening are the recommended systems for classrooms in temperate climates. Providing simply visual feedback on the current carbon dioxide concentration, as a motivation for window opening, did not do so.
Assessing dermal exposure to nicotine - an interdisciplinary approach.

General information
State: Published
Organisations: Department of Civil Engineering, Section for Indoor Climate and Building Physics, Fraunhofer Wilhelm-Klauditz-Institut (WKI), Institute for Prevention and Occupational Medicine of the German Social Accident Insurance, Missouri University of Science and Technology
Publication date: 2017

Host publication information
Title of host publication: ISES 2017 Abstract Book
Article number: TH-PL-D2-649
Keywords: A-indoor environment, B-VOCs, C-air, A-biomonitoring, A-exposure models
Dermal uptake of benzophenone-3 from clothing
Benzophenone-3 (aka BP-3, oxybenzone) is added to sunscreens, plastics, and some coatings to filter UV radiation. A suspected endocrine disruptor, BP-3 has been widely detected and only in summertime, where a more intended use of sunscreen might be expected in the urine of Danish children (Frederiksen et al., 2016; Krause et al., 2016) and other populations. BP-3 has been found in the air and settled dust of homes (Wan et al., 2015) and is expected to redistribute from its original sources to other indoor compartments, including clothing. As has been previously observed for phthalates (Morrison et al., 2016), we hypothesized that dermal uptake from clothing would occur and could contribute to the body burden of this compound.

General information
State: Published
Organisations: Department of Civil Engineering, Section for Indoor Climate and Building Physics, Missouri University of Science and Technology, Fraunhofer Wilhelm-Klauditz-Institut (WKI), Copenhagen University Hospital
Number of pages: 2
Publication date: 2017

Host publication information
Title of host publication: Proceedings of Healthy Buildings 2017
Article number: 0229
ISBN (Print): 978-83-7947-232-1
Keywords: Benzophenone-3, Clothing, Dermal uptake, Exposure, Biomonitoring

Dermal Uptake of Benzophenone-3 from Clothing
Benzophenone-3 (also known as BP-3 or oxybenzone) is added to sunscreens, plastics, and some coatings to filter UV radiation. The suspected endocrine disruptor BP-3 has been detected in the air and settled dust of homes and is expected to redistribute from its original sources to other indoor compartments, including clothing. Given its physical and chemical properties, we hypothesized that dermal uptake from clothing could contribute to the body burden of this compound. First, cotton shirts were exposed to air at an elevated concentration of BP-3 for 32 days; the final air concentration was 4.4 μg/m$^3$. Next, three participants wore the exposed shirts for 3 h. After 3 h of exposure, participants wore their usual clothing during the collection of urine samples for the next 24 h. Urine was analyzed for BP-3, a metabolite (BP-1), and six other UV filters. The rate of urinary excretion of the sum of BP-1 and BP-3 increased for all participants during and following the 3 h of exposure. The summed mass of BP-1 and BP-3 excreted during the first 24 h attributable to wearing exposed t-shirts were 12, 9.9, and 82μg for participants 1, 2, and 3, respectively. Analysis of these results, coupled with predictions of steady-state models, suggest that dermal uptake of BP-3 from clothing could meaningfully contribute to overall body burden.

General information
State: Published
Organisations: Department of Civil Engineering, Section for Indoor Climate and Building Physics, Missouri University of Science and Technology, Fraunhofer Wilhelm-Klauditz-Institut (WKI), University of Copenhagen
Number of pages: 9
Pages: 11371-11379
Publication date: 2017
Peer-reviewed: Yes

Publication information
Journal: Environmental Science and Technology
Volume: 51
Issue number: 19
ISSN (Print): 0013-936X
Ratings:
Dermal uptake of nicotine from air and clothing: Experimental verification

This study aims to elucidate in greater detail the dermal uptake of nicotine from air or from nicotine-exposed clothes, which was demonstrated recently in a preliminary study. Six non-smoking participants were exposed to gaseous nicotine (between 236 and 304 μg/m³) over 5 hours while breathing clean air through a hood. Four of the participants wore only shorts and 2 wore a set of clean clothes. One week later, 2 of the bare-skinned participants were again exposed in the chamber, but they showered immediately after exposure instead of the following morning. The 2 participants who wore clean clothes on week 1 were now exposed wearing a set of clothes that had been exposed to nicotine. All urine was collected for 84 hours after exposure and analyzed for nicotine and its metabolites, cotinine and 3OH-cotinine. All participants except those wearing fresh clothes excreted substantial amounts of biomarkers, comparable to levels expected from inhalation intake. Uptake for 1 participant wearing exposed clothes exceeded estimated intake via inhalation by >50%. Biomarker excretion continued during the entire urine collection period, indicating that nicotine accumulates in the skin and is released over several days. Absorbed nicotine was significantly lower after showering in 1 subject but not the other. Differences in the normalized uptakes and in the excretion patterns were observed among the participants. The observed cotinine half-lives suggest that non-smokers exposed to airborne nicotine may receive a substantial fraction through the dermal pathway. Washing skin and clothes exposed to nicotine may meaningfully decrease exposure.

General information
State: Published
Organisations: Department of Civil Engineering, Section for Indoor Climate and Building Physics, Missouri University of Science and Technology, Institute for Prevention and Occupational Medicine of the German Social Accident Insurance, Fraunhofer Wilhelm-Klauditz-Institut (WKI)
Pages: 247-257
Publication date: 2017
Peer-reviewed: Yes

Publication information
Journal: Indoor Air
Volume: 28
Issue number: 2
ISSN (Print): 0905-6947
Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 3.9
Web of Science (2017): Impact factor 4.396
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 3.55
Web of Science (2016): Impact factor 4.383
Web of Science (2016): Indexed yes
Studies suggest that dermal uptake of certain semivolatile organic compounds (SVOC) directly from air can be a significant exposure pathway. This has been experimentally confirmed for two phthalates (Weschler et al., 2015). Morrison et al. (2016) showed that clean clothing can impede, while clothing that has previously absorbed/adsorbed indoor air pollutants can increase dermal uptake. A recent experiment demonstrated that dermal uptake of airborne nicotine directly from air or from clothing can occur (Bekö et al., 2017). The current study aims to expand our knowledge on the dermal
uptake of nicotine, by conducting more extensive experiments.

**Effective Energy-efficient Classroom Ventilation for Temperate Zones**

**General information**
State: Published
Organisations: Department of Civil Engineering, Section for Indoor Climate and Building Physics
Contributors: Toftum, J., Wargocki, P.
Number of pages: 188
Publication date: 2017

**Publication information**
Publisher: Technical University of Denmark, Department of Civil Engineering
Original language: English
Electronic versions:
Untitled.pdf

**Bibliographical note**
Final report ASHRAE Research Project 1624-RP.
Source: PublicationPreSubmission
Source-ID: 145407073
Research output: Research › Report – Annual report year: 2018

**FOMO, LOL, BSc og MSc**

**General information**
State: Published
Organisations: Department of Civil Engineering, Section for Indoor Climate and Building Physics
Contributors: Toftum, J.
Pages: 6-6
Publication date: 2017
Peer-reviewed: No

**Publication information**
Journal: HVAC Magasinet
Volume: 53
Issue number: 12
ISSN (Print): 1603-6913
Ratings:
ISI indexed (2013): ISI indexed no
ISI indexed (2012): ISI indexed no
ISI indexed (2011): ISI indexed no
Original language: English
Electronic versions:
Leder_Studerendes_engagement.pdf
IoT i bygninger

General information
State: Published
Organisations: Department of Civil Engineering, Section for Indoor Climate and Building Physics
Contributors: Toftum, J.
Pages: 6-6
Publication date: 2017
Peer-reviewed: Unknown

Publication information
Journal: HVAC Magasinet
Volume: 53
Issue number: 7
ISSN (Print): 1603-6913
Ratings:
ISI indexed (2013): ISI indexed no
ISI indexed (2012): ISI indexed no
ISI indexed (2011): ISI indexed no
Original language: Danish
Electronic versions:
Leder_IoT.pdf
URLs:
http://ipaper.ipapercms.dk/TechMedia/HVACMagasinet/

Kinetics of dermal uptake of nicotine from air

General information
State: Published
Organisations: Department of Civil Engineering, Section for Indoor Climate and Building Physics, Fraunhofer Wilhelm-Klauditz-Institut (WKI), Institute for Prevention and Occupational Medicine of the German Social Accident Insurance, Missouri University of Science and Technology
Publication date: 2017

Host publication information
Title of host publication: ISES 2017 Abstract Book
Article number: TH-PL-D2-650
Keywords: A-indoor environment, A-biomonitoring, A-second-hand smoke, B-VOCs, C-air
Electronic versions:
Untitled.pdf

Linking a dermal permeation and an inhalation model to a simple pharmacokinetic model to study airborne exposure to di(n-butyl) phthalate
Six males clad only in shorts were exposed to high levels of airborne di(n-butyl) phthalate (DnBP) and diethyl phthalate (DEP) in chamber experiments conducted in 2014. In two 6 h sessions, the subjects were exposed only dermally while breathing clean air from a hood, and both dermally and via inhalation when exposed without a hood. Full urine samples were taken before, during, and for 48 h after leaving the chamber and measured for key DnBP and DEP metabolites. The data clearly demonstrated high levels of DnBP and DEP metabolite excretions while in the chamber and during the first 24 h once leaving the chamber under both conditions. The data for DnBP were used in a modeling exercise linking dose models for inhalation and transdermal permeation with a simple pharmacokinetic model that predicted timing and mass of metabolite excretions. These models were developed and calibrated independent of these experiments. Tests included modeling of the “hood-on” (transdermal penetration only), “hood-off” (both inhalation and transdermal) scenarios, and a derived “inhalation-only” scenario. Results showed that the linked model tended to duplicate the pattern of excretion with regard to timing of peaks, decline of concentrations over time, and the ratio of DnBP metabolites. However, the
transdermal model tended to overpredict penetration of DnBP such that predictions of metabolite excretions were between 1.1 and 4.5 times higher than the cumulative excretion of DnBP metabolites over the 54 h of the simulation. A similar overprediction was not seen for the "inhalation-only" simulations. Possible explanations and model refinements for these overpredictions are discussed. In a demonstration of the linked model designed to characterize general population exposures to typical airborne indoor concentrations of DnBP in the United States, it was estimated that up to one-quarter of total exposures could be due to inhalation and dermal uptake.

**General information**

State: Published
Organisations: Department of Civil Engineering, Section for Indoor Climate and Building Physics, United States Environmental Protection Agency, Missouri University of Science and Technology, National Institute of Standards and Technology, Ruhr University Bochum, Fraunhofer Wilhelm-Klauditz-Institut (WKI)
Number of pages: 9
Pages: 601-609
Publication date: 2017
Peer-reviewed: Yes

**Publication information**

Journal: Journal of Exposure Science and Environmental Epidemiology
Volume: 27
Issue number: 6
ISSN (Print): 1559-0631

Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 2.82 SJR 1.346 SNIP 1.138
Web of Science (2017): Impact factor 3.083
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 2.8 SJR 1.223 SNIP 1.088
Web of Science (2016): Impact factor 2.927
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 2.77 SJR 1.292 SNIP 1.208
Web of Science (2015): Impact factor 3.141
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 3.07 SJR 1.61 SNIP 1.312
Web of Science (2014): Impact factor 3.185
BFI (2013): BFI-level 2
Scopus rating (2013): CiteScore 2.6 SJR 1.282 SNIP 1.127
Web of Science (2013): Impact factor 3.05
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): CiteScore 2.66 SJR 1.347 SNIP 1.177
Web of Science (2012): Impact factor 3.187
ISI indexed (2012): ISI indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): CiteScore 2.47 SJR 1.49 SNIP 1.364
Web of Science (2011): Impact factor 2.932
ISI indexed (2011): ISI indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 1.775 SNIP 1.206
Web of Science (2010): Impact factor 3.132
BFI (2009): BFI-level 2
Scopus rating (2009): SJR 1.85 SNIP 1.191
Measurements of dermal uptake of nicotine directly from air and clothing

In this preliminary study, we have investigated whether dermal uptake of nicotine directly from air or indirectly from clothing can be a meaningful exposure pathway. Two participants wearing only shorts and a third participant wearing clean cotton clothes were exposed to environmental tobacco smoke (ETS), generated by mechanically "smoking" cigarettes, for three hours in a chamber while breathing clean air from head-enveloping hoods. The average nicotine concentration (420 μg/m³) was comparable to the highest levels reported for smoking sections of pubs. Urine samples were collected immediately before exposure and 60 hour post-exposure for bare-skinned participants. For the clothed participant, post-exposure urine samples were collected for 24 hour. This participant then entered the chamber for another three-hour exposure wearing a hood and clothes, including a shirt that had been exposed for five days to elevated nicotine levels. The urine samples were analyzed for nicotine and two metabolites-cotinine and 3OH-cotinine. Peak urinary cotinine and 3OH-cotinine concentrations for the bare-skinned participants were comparable to levels measured among non-smokers in hospitality environments before smoking bans. The amount of dermally absorbed nicotine for each bare-skinned participant was conservatively estimated at 570 μg, but may have been larger. For the participant wearing clean clothes, uptake was similar to 20 μg, and while wearing a shirt previously exposed to nicotine, uptake was similar to 80 μg. This study demonstrates meaningful dermal uptake of nicotine directly from air or from nicotine-exposed clothes. The findings are especially relevant for children in homes with smoking or vaping.

General information
State: Published
Organisations: Department of Civil Engineering, Section for Indoor Climate and Building Physics, Missouri University of Science and Technology, Institute for Prevention and Occupational Medicine of the German Social Accident Insurance, Fraunhofer Wilhelm-Klauditz-Institut (WKI)
Number of pages: 7
Pages: 427-433
Publication date: 2017
Peer-reviewed: Yes

Publication information
Journal: Indoor Air Online
Volume: 27
Issue number: 2
ISSN (Print): 1600-0668
Ratings:
Web of Science (2018): Indexed yes
Scopus rating (2017): CiteScore 3.9
Web of Science (2017): Impact factor 4.396
Web of Science (2017): Indexed yes
Renovering af skoleventilation – Elevernes velvære og præstationer

General information
State: Published
Organisations: Department of Civil Engineering, Section for Indoor Climate and Building Physics
Contributors: Toftum, J., Wargocki, P.
Pages: 20-23
Publication date: 2017
Peer-reviewed: Unknown

Publication information
Journal: H V A C Magasinet
Volume: 53
Issue number: 12
Today, face-to-face meetings are frequently replaced by video conferences in order to reduce costs and carbon footprint related to travels and to increase the company efficiency. Yet, complaints about the difficulty of understanding the speech of the participants in both rooms of the video conference occur. The aim of this study is to find out the main causes of difficulties in speech communication. Correlation studies between subjective perceptions were conducted through questionnaires and objective acoustic and indoor climate parameters related to video conferencing. Based on four single-room and three combined-room measurements, it was found that the traditional measure of speech, such as the speech transmission index, was not correlated with the subjective classifications. Thus, a correlation analysis was conducted as an attempt to find the hidden factors behind the subjective perceptions, revealing the speech intelligibility during video conferencing was highly correlated to EDT, D50, and MTI in the 125 Hz frequency band.
Diurnal and seasonal variation in air exchange rates and interzonal airflows measured by active and passive tracer gas in homes

Outdoor air delivery to buildings is an important parameter in the assessment of pollutant exposure indoors. Detailed and well controlled measurements of air exchange rates (AER) and interzonal airflows in residential environment are scarce. We measured the outdoor AERs in up to six rooms in five dwellings across four seasons using active tracer gas. Night time AERs were also estimated in the bedrooms based on occupant-generated CO$_2$. Passive tracer gas measurements were performed for comparison. AERs changed frequently during the day. Differences in outdoor AERs were observed between individual rooms. Window opening behavior had a strong influence on AERs, which were highest during occupied daytime periods, lowest in the night; highest in the summer, lowest in the winter. Significant differences were found between AERs measured by the different techniques. The median nighttime AER in all bedrooms across the four seasons was 0.49 h$^{-1}$ with the active tracer gas technique and 1.20 h$^{-1}$ with the CO2 method. The average winter AER in the five homes with the passive tracer (0.63 h$^{-1}$) differed substantially from the corresponding AER measured with the active tracer gas (0.25 h$^{-1}$). Additionally, we studied the pollutant distribution from one room (source room) and interzonal airflows across the dwellings. The air within a given floor was well mixed, with the average tracer gas concentration in the non-source rooms reaching approximately 70% of the source room concentration. There was less air movement between different floors. The position of the internal doors had a strong influence on the air movement.
Diurnal and seasonal variation in air exchange rates and interzonal flows measured by active tracer gas in five Danish homes

We measured the air exchange rates (AER) in up to six rooms in five naturally ventilated dwellings across four seasons using active tracer gas. Night time AER was also estimated in all bedrooms based on occupant-generated CO2. Additionally, we studied the pollutant distribution across the dwellings and airflows between rooms. AERs changed rapidly during the day and differed between rooms. Occupant behavior (window opening) strongly influenced the AERs. AERs were highest in the summer, lowest in the winter. Interzonal airflow measurements indicated that the air within a given floor is well mixed, while there is less air movement between different floors. The position of the internal doors (open/closed) had a strong influence on the air movements within the dwelling.

Effect of Set-point Variation on Thermal Comfort and Energy Use in a Plus-energy Dwelling

When designing buildings and space conditioning systems, the occupant thermal comfort, health, and productivity are the main criteria to satisfy. However, this should be achieved with the most energy-efficient space conditioning systems (heating, cooling, and ventilation). Control strategy, set-points, and control dead-bands have a direct effect on the thermal environment in and the energy use of a building. The thermal environment in and the energy use of a building are associated with the thermal mass of the building and the control strategy, including set-points and control dead-bands. With thermally active building systems (TABS), temperatures are allowed to drift within the comfort zone, while in spaces with air-conditioning, temperatures in a narrower interval typically are aimed at. This behavior of radiant systems provides certain advantages regarding energy use, since the temperatures are allowed to drift, and it also allows the occupants to benefit from adaptive opportunities. This study presents the results of thermal environment measurements and energy use in a single-family dwelling during a one year period. A radiant floor heating and cooling system was used to condition the indoor space and the operative temperature set-points were varied during the heating and cooling seasons. The results show that a lower temperature set-point will result in a decreased energy use but it might require the occupants to adapt to slightly lower temperatures in the heating season, and vice versa in the cooling season. The terminal unit and the thermal mass of the building have significant effects on the applicability of lowered indoor temperature set-points.
Effects on pupil well-being and performance of classroom ventilation retrofits – ASHRAE RP1624
This study examines the effect on classroom indoor climate, pupil well-being, school performance, and energy consumption of four different retrofit solutions to improve classroom ventilation.

General information
State: Published
Organisations: Department of Civil Engineering, Section for Indoor Climate and Building Physics
Contributors: Toftum, J., Wargocki, P.
Number of pages: 2
Publication date: 2016

Host publication Information
Title of host publication: Proceedings of Indoor Air 2016
Article number: 502
Source: PublicationPreSubmission
Source-ID: 125224081
Research output: Research - peer-review › Article in proceedings – Annual report year: 2016

Energiforbrug til ventilation på operationsstuer
Der stilles høje krav til indeklimaet på operationsstuer, både i forhold til hygiejne og termiske forhold. Dette stiller samtidig krav til de tekniske installationer og kan medføre et højt energiforbrug til drift af operationsstuerne. En af de mest energiforbrugende installationer er ventilationen, som typisk enten er Turbulent Air Flow (TAF) eller Laminar Air Flow (LAF). Denne artikel fokuserer på forskellene i energiforbrug ved anvendelse af de to ventilationsprincipper. En tidligere artikel beskrev fordelene ved brugen af LAF frem for TAF i forhold til en reduceret kontamineringsrisiko under operationer. Der er dog betænkeligheder omkring brugen af LAF frem for TAF, da kravet om højere luftmængder for LAF medfører et større energiforbrug.

General information
State: Published
Organisations: Department of Civil Engineering, Section for Indoor Climate and Building Physics, Technical University of Denmark
Contributors: Nielsen, L., Rosenbeck, K., Toftum, J.
Pages: 14-16
Publication date: 2016
Peer-reviewed: Unknown

Publication information
Journal: HVAC Magasinet
Issue number: 6; suppl. CLIMA 2016
ISSN (Print): 1603-6913
Ratings:
ISI indexed (2013): ISI indexed no
ISI indexed (2012): ISI indexed no
ISI indexed (2011): ISI indexed no
Original language: Danish
Source: PublicationPreSubmission
Source-ID: 125224028
Research output: Communication › Journal article – Annual report year: 2016

Indeklima, energiforbrug og brugeradfærd

General information
State: Published
Organisations: Department of Civil Engineering, Section for Indoor Climate and Building Physics
Contributors: Toftum, J.
Number of pages: 1
Pages: 6-6
Publication date: 2016
Peer-reviewed: Unknown
Indeklima og bygningers totalværdi

General information
State: Published
Organisations: Department of Civil Engineering, Section for Indoor Climate and Building Physics
Contributors: Toftum, J.
Pages: 6
Publication date: 2016
Peer-reviewed: No

Large-scale CO₂ measurement campaigns in Danish schools
In two large measurement campaigns performed in 2009 and 2014 more than 1500 spot measurements of CO₂ were made by pupils in Danish primary school classes. In 2009 56% of the measurements exceeded the recommended value of 1000 ppm CO₂. This percentage had increased to 60% in 2014. Changing the behaviour of the pupils had a positive effect, as the proportion of classrooms exceeding 1000 ppm CO₂ in separate measurement (students outside and airing in the break preceding the measurement lesson in which the measurement was made) was 39%. The principle of ventilation had a substantial impact on the measured CO₂ concentrations. In 80% of the classrooms with natural ventilation the concentration of CO₂ exceeded 1000 ppm, whereas the fraction was 40% in classrooms with balanced mechanical ventilation.

General information
State: Published
Organisations: Department of Civil Engineering, Section for Indoor Climate and Building Physics
Contributors: Clausen, G., Toftum, J., Bekö, G.
Number of pages: 2
Publication date: 2016

Host publication information
Title of host publication: Proceedings of Indoor Air 2016
Luftkvalitet i skoler, skolebygningernes karakteristika og elevernes indlæring
Vi har efterhånden ret god dokumentation for, at der er utilstrækkelig ventilation og dårlig luftkvalitet i mange danske klasseværelser. Artiklen oprider nyere undersøgelser af luftkvaliteten i danske folkeskoler og dets betydning for eleverne. Endvidere beskrives de hyppigste renoveringsinitiativer og udvalgte bygningsmæssige egenskaber sammenkædes med klasseværelsets luftkvalitet.

General information
State: Published
Organisations: Department of Civil Engineering, Section for Indoor Climate and Building Physics
Contributors: Toftum, J., Dam-Krogh, E. P., Bekö, G., Clausen, G.
Pages: 44-48
Publication date: 2016
Peer-reviewed: Unknown

Managed airing behaviour and the effect on pupil perceptions and indoor climate in classrooms
An intervention study with four different scenarios for airing classrooms were carried out in a school where manual opening of windows was the main source of ventilation. Two scenarios included a visual CO2 display unit to signal to the pupils and teachers when to open windows. The other two scenarios used two different window opening schedules. Measurements of CO2, temperature and periods with open windows were recorded, and pupils expressed their perception of the indoor environment in the classroom. With a visual CO2 display unit in the classroom, pupils were able to modify their behavior and reduce by approximately 40-60% the duration when the CO2 concentration was above 1000 ppm. With only scheduled window opening, a similar improvement was not observed. Although not significant, pupils’ perception of the air quality seemed better when the intervention was running, but they also perceived the temperature as being colder.

General information
State: Published
Organisations: Department of Civil Engineering, Section for Indoor Climate and Building Physics, Sweco Denmark Inc., DEAS
Contributors: Toftum, J., Wohlgemuth, M. M., Christensen, U. S., Bekö, G., Clausen, G.
Number of pages: 8
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Article number: 500
Keywords: School environment, Ventilation, CO2, Intervention
Source: PublicationPreSubmission
Source-ID: 125224068
Research output: Research - peer-review › Article in proceedings – Annual report year: 2016

Measurements of dermal uptake of nicotine directly from air and clothing
Dermal uptake directly from air is a significant contributor to total exposure for certain organic compounds, and has been recently experimentally verified for two phthalates. The objective of the current study was to investigate whether airborne nicotine can be dermally absorbed. Two bare-skinned subjects together with a subject wearing clean clothes were dermally exposed to environmental tobacco smoke (ETS) for three hours in a climate chamber; during the exposure all
three subjects breathed clean air through hoods covering their heads. The clothed subject later repeated his exposure wearing a shirt previously exposed to tobacco smoke. Urine samples were subsequently analyzed for nicotine and two of its metabolites. The results demonstrate that nicotine can be dermally absorbed directly from air at rates comparable to passive smoking. Wearing clean clothes significantly decreases uptake, while wearing exposed clothes results in substantial uptake.

General information
State: Published
Organisations: Department of Civil Engineering, Section for Indoor Climate and Building Physics, Institute for Prevention and Occupational Medicine of the German Social Accident Insurance, Fraunhofer Wilhelm-Klauditz-Institut (WKI), Missouri University of Science and Technology
Number of pages: 2
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Source: PublicationPreSubmission
Source-ID: 125224293
Research output: Research - peer-review » Article in proceedings – Annual report year: 2016

Measurements of Dermal Uptake of Nicotine Directly from Air and Clothing

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State: Published
Organisations: Department of Civil Engineering, Section for Indoor Climate and Building Physics, Institute for Prevention and Occupational Medicine of the German Social Accident Insurance, Fraunhofer Wilhelm-Klauditz-Institut (WKI), Missouri University of Science and Technology
Contributors: Bekö, G., Morrison, G., Weschler, C. J., Koch, H., Salthammer, T., Schripp, T., Toftum, J., Clausen, G.
Pages: 356-356
Publication date: 2016

Host publication information
Title of host publication: Abstracts of the 26th Annual meeting of the International Society of Exposure Science
Electronic versions:
Beko_2016_ISES_Abstract_Nicotine_Dermal_exposure.pdf
Source: PublicationPreSubmission
Source-ID: 127822466
Research output: Research - peer-review » Conference abstract in proceedings – Annual report year: 2016

Nearly-zero energy buildings

General information
State: Published
Organisations: Department of Civil Engineering, Section for Indoor Climate and Building Physics, Oak Ridge National Laboratory
Contributors: Toftum, J., Baxter, V.
Number of pages: 2
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Publication date: 2016
Peer-reviewed: No

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Journal: Science and Technology for the Built Environment
Volume: 22
Issue number: 7
ISSN (Print): 2374-4731
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 1.05
Web of Science (2017): Impact factor 1.183
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 1.01
Web of Science (2016): Impact factor 0.88
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Web of Science (2015): Impact factor
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 0.514 SNIP 0.731
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 0.561 SNIP 0.891
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 0.544 SNIP 1.104
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 0.498 SNIP 0.742
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 0.93 SNIP 0.956
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 1.614 SNIP 1.187
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 0.791 SNIP 0.903
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 0.677 SNIP 1.639
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 0.843 SNIP 1.29
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 1.4 SNIP 1.26
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 1.054 SNIP 2.001
Scopus rating (2003): SJR 1.055 SNIP 1.28
Web of Science (2003): Indexed yes
Scopus rating (2002): SJR 0.917 SNIP 1.739
Web of Science (2002): Indexed yes
Scopus rating (2001): SJR 1.637 SNIP 2.271
Scopus rating (2000): SJR 0.67 SNIP 2.027
Scopus rating (1999): SJR 0.357 SNIP 0.753
Original language: English
DOIs:
10.1080/23744731.2016.1217137
Source: FindIt
Source-ID: 2343151236
Research output: Research › Editorial – Annual report year: 2016
Organophosphate esters in dust samples collected from Danish homes and daycare centers

Organophosphates are used in a wide range of materials and consumer products and are ubiquitous in indoor environments. Certain organophosphates have been associated with various adverse health effects. The present paper reports mass fractions of organophosphates in dust samples collected from 500 bedrooms and 151 daycare centers of children living in Odense, Denmark. The identified compounds include: tris(isobutyl) phosphate (TIBP), tri-n-butyl phosphate (TNBP), tri(2-chloroethyl) phosphate (TCEP), tris(2-chloroisopropyl) phosphate (TCIPP), tris(1,3-dichloroisopropyl) phosphate (TDCIPP), tris(2-butoxyethyl) phosphate (TBOEP), triphenylphosphate (TPHP), 2-ethylhexyl-diphenyl phosphate (EHDPP), tris(2-ethylhexyl) phosphate (TEHP) and tris(methylphenyl) phosphate (TMPP). Both the number of organophosphates with median values above the limit of detection and the median values were higher for samples from daycare centers than for samples from homes. Organophosphates with median mass fractions above the limit of detection were: TCEP from homes (6.9 μg g⁻¹), and TCEP (16 μg g⁻¹), TCIPP (5.6 μg g⁻¹), TDCIPP (7.1 μg g⁻¹), TBOEP (26 μg g⁻¹), TPHP (2.0 μg g⁻¹) and EHDPP (2.1 μg g⁻¹) from daycare centers. When present, TBOEP was typically the most abundant of the identified OPs. The sum of the organophosphate dust mass fractions measured in this study was roughly in the mid-range of summed mass fractions reported for dust samples collected in other countries. On a global scale, the geographical distribution of organophosphates in indoor dust is quite variable, with higher concentrations in industrialized countries. This trend differs from that for phthalate esters, whose geographic distribution is more homogeneous. Exposure to organophosphates via dust ingestion is relatively low, although there is considerable uncertainty in this assessment.

**General information**

State: Published
Organisations: Department of Civil Engineering, Section for Indoor Climate and Building Physics, Swedish Environmental Research Institute, Rutgers University, University of Gothenburg
Contributors: Langer, S., Fredricsson, M., Wesclicher, C. J., Bekö, G., Strandberg, B., Remberger, M., Toftum, J., Clausen, G.
Number of pages: 8
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**Publication information**

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Ratings:
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- Web of Science (2018): Indexed yes
- BFI (2017): BFI-level 2
- Scopus rating (2017): CiteScore 4.62 SJR 1.435 SNIP 1.448
- Web of Science (2017): Impact factor 4.427
- Web of Science (2017): Indexed yes
- BFI (2016): BFI-level 2
- Scopus rating (2016): CiteScore 4.39 SJR 1.447 SNIP 1.625
- Web of Science (2016): Impact factor 4.208
- Web of Science (2016): Indexed yes
- BFI (2015): BFI-level 2
- Scopus rating (2015): CiteScore 4.04 SJR 1.497 SNIP 1.567
- Web of Science (2015): Indexed yes
- BFI (2014): BFI-level 2
- Scopus rating (2014): CiteScore 3.76 SJR 1.59 SNIP 1.639
- Web of Science (2014): Impact factor 3.34
- Web of Science (2014): Indexed yes
- BFI (2013): BFI-level 2
- Scopus rating (2013): CiteScore 3.92 SJR 1.721 SNIP 1.751
- Web of Science (2013): Impact factor 3.499
- ISI indexed (2013): ISI indexed yes
- Web of Science (2013): Indexed yes
- BFI (2012): BFI-level 2
- Scopus rating (2012): CiteScore 3.5 SJR 1.794 SNIP 1.618
Role of clothing in both accelerating and impeding dermal absorption of airborne SVOCs

To assess the influence of clothing on dermal uptake of semi-volatile organic compounds (SVOCs), we measured uptake of selected airborne phthalates for an individual wearing clean clothes or air-exposed clothes and compared these results with dermal uptake for bare-skinned individuals under otherwise identical experimental conditions. Using a breathing hood to isolate dermal from inhalation uptake, we measured urinary metabolites of diethylphthalate (DEP) and di-n-butylphthalate (DnBP) from an individual exposed to known concentrations of these compounds for 6 h in an experimental chamber. The individual wore either clean (fresh) cotton clothes or cotton clothes that had been exposed to the same chamber air concentrations for 9 days. For a 6-h exposure, the net amounts of DEP and DnBP absorbed when wearing fresh clothes were, respectively, 0.017 and 0.007 μg/kg/(μg/m3); for exposed clothes the results were 0.178 and 0.261 μg/kg/(μg/m3), respectively (values normalized by air concentration and body mass). When compared against the average results for bare-skinned participants, clean clothes were protective, whereas exposed clothes increased dermal uptake for DEP and DnBP by factors of 3.3 and 6.5, respectively. Even for non-occupational environments, wearing clothing that has
adsorbed/absorbed indoor air pollutants can increase dermal uptake of SVOCs by substantial amounts relative to bare skin.

**General information**

*State:* Published

*Organisations:* Department of Mechanical Engineering, Department of Civil Engineering, Section for Indoor Climate and Building Physics, Missouri University of Science and Technology, Ruhr-Universität Bochum, Fraunhofer Wilhelm-Klauditz-Institut (WKI)

*Contributors:* Morrison, G. C., Weschler, C. J., Bekö, G., Koch, H. M., Salthammer, T., Schripp, T., Toftum, J., Clausen, G.

*Pages:* 113-118

*Publication date:* 2016

*Peer-reviewed:* Yes

**Publication information**

*Journal:* Journal of Exposure Science and Environmental Epidemiology

*Volume:* 26

*Issue number:* 1

*ISSN (Print):* 1559-0631

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BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 2.82 SJR 1.346 SNIP 1.138
Web of Science (2017): Impact factor 3.083
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 2.8 SJR 1.223 SNIP 1.088
Web of Science (2016): Impact factor 2.927
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 2.77 SJR 1.292 SNIP 1.208
Web of Science (2015): Impact factor 3.141
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 3.07 SJR 1.61 SNIP 1.312
Web of Science (2014): Impact factor 3.185
BFI (2013): BFI-level 2
Scopus rating (2013): CiteScore 2.6 SJR 1.282 SNIP 1.127
Web of Science (2013): Impact factor 3.05
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): CiteScore 2.66 SJR 1.347 SNIP 1.177
Web of Science (2012): Impact factor 3.187
ISI indexed (2012): ISI indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): CiteScore 2.47 SJR 1.49 SNIP 1.364
Web of Science (2011): Impact factor 2.932
ISI indexed (2011): ISI indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 1.775 SNIP 1.206
Web of Science (2010): Impact factor 3.132
BFI (2009): BFI-level 2
Scopus rating (2009): SJR 1.85 SNIP 1.191
BFI (2008): BFI-level 2
Scopus rating (2008): SJR 1.628 SNIP 1.105
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 1.409 SNIP 1.316
Scopus rating (2006): SJR 1.511 SNIP 1.377
Ultrafine particle exposure in Danish residencies
We measured ultrafine particle concentrations in 56 Danish residences, estimated the daily integrated exposure of the occupants and apportioned this exposure to source events. The residential daily integrated particle number (PN) exposure in the homes was substantial and source events, especially candle burning, cooking, toasting and unknown activities, were responsible on average for ~65% of the residential integrated exposure. Residents of another 60 homes were then asked to carry a backpack equipped with a GPS recorder and a portable monitor to measure real-time individual exposure over ~48 h. UFP exposure occurring in various microenvironments was estimated. The fractional contribution of each microenvironment to the daily integrated personal exposure corresponded to the fractions of the day the subjects spent in each microenvironment. The home environment accounted for 50% of the daily personal exposure, indoor environments other than home or vehicles contributed with ~40%, and being in transit or outdoors contributed 5% or less.

A model to predict concentrations of DnBP metabolites in urine from a vapor-phase exposure
We developed a model to predict concentrations of DnBP metabolites in urine from a vapor-phase exposure.
Association between classroom ventilation mode and learning outcome in Danish schools

Associations between learning, ventilation mode, and other classroom characteristics were investigated with data from a Danish test scheme and two widespread cross-sectional studies examining air quality in Danish schools. An academic achievement indicator as a measure of the learning outcome was calculated from the scores of a standardized Danish test scheme adjusted for a socioeconomic reference index. Pupils in schools with balanced mechanical ventilation had significantly higher achievement indicators than pupils in schools with natural ventilation, where airing took place mostly by manual window opening. Also, the carbon dioxide concentration was lower in classrooms with balanced mechanical ventilation. There was no consistent association between the achievement indicators and the person specific room volume, construction/renovation year, or the occupancy. Measurements of carbon dioxide concentrations and temperatures in 820 classrooms in 389 schools were available. In 56% and 66% of the classrooms included in the two studies, the measured CO₂ concentration was higher than 1000ppm. The findings of this study add to the growing evidence that insufficient classroom ventilation have impacts on learning outcomes.

General information
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Organisations: Department of Civil Engineering, Section for Indoor Climate and Building Physics, Section for Indoor Environment, Technical University of Denmark
Contributors: Toftum, J., Kjeldsen, B. U., Wargocki, P., Menå, H. R., Hansen, E. M., Clausen, G.
Number of pages: 10
Pages: 494-503
Publication date: 2015
Peer-reviewed: Yes

Publication information
Journal: Building and Environment
Volume: 92
ISSN (Print): 0360-1323
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 5.22 SJR 2.169 SNIP 2.534
Web of Science (2017): Impact factor 4.539
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 4.51 SJR 1.998 SNIP 2.215
Web of Science (2016): Impact factor 4.053
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 4.37 SJR 2.067 SNIP 2.463
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 4.14 SJR 1.887 SNIP 2.742
Web of Science (2014): Impact factor 3.341
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 3.57 SJR 1.547 SNIP 2.551
Web of Science (2013): Impact factor 2.7
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 3.06 SJR 1.293 SNIP 2.857
Web of Science (2012): Impact factor 2.43
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
Comfort and performance impact of personal control over thermal environment in summer: Results from a laboratory study

Field studies suggest that the availability of adjustable thermostats, operable windows and other controls has a positive impact on comfort, the incidence of building related symptoms and productivity. This laboratory study was designed to further investigate how having or not having control over the thermal environment affects human responses to the indoor environment. The study was conducted in summer in a field laboratory that was kept at 28°C. A total of 23 subjects were exposed twice for about 2.5h. During the first session (A) subjects were able to fine-tune their local thermal environment at any given time with a personal desk fan with continuous, stepless adjustable control. During the second session (B) subjects still had the desk fans, but this time the fans were controlled from an adjacent room by the researchers who adjusted the individual air speed profiles so they were identical to those recorded during the first session. Thus, each subject was exposed to two customized conditions with identical exposure, only different from a psychological point of view. During the two sessions identical questionnaires and performance tests were used to evaluate subjects' comfort, SBS symptom incidence and performance. As expected, perceived control over the environment was significantly higher during session A, but there were no differences in perceived comfort and SBS symptom intensity. Both self-assessed and objectively measured performance was significantly better during session B. About two-thirds of the subjects indicated to prefer the situation as during the first session when they themselves controlled the air movement.

General information
State: Published
Organisations: Department of Civil Engineering, Section for Indoor Environment, Eindhoven University of Technology, Maastricht University, Technical University of Denmark
Contributors: Boerstra, A. C., te Kulve, M., Toftum, J., Loomans, M. G., Olesen, B. W., Hensen, J. L.
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Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
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Scopus rating (2017): CiteScore 5.22 SJR 2.169 SNIP 2.534
Web of Science (2017): Impact factor 4.539
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 4.51 SJR 1.998 SNIP 2.215
Web of Science (2016): Impact factor 4.053
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 4.37 SJR 2.067 SNIP 2.463
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 4.14 SJR 1.887 SNIP 2.742
Web of Science (2014): Impact factor 3.341
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 3.57 SJR 1.547 SNIP 2.551
Web of Science (2013): Impact factor 2.7
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
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Web of Science (2012): Impact factor 2.43
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): CiteScore 2.76 SJR 1.127 SNIP 2.279
Web of Science (2011): Impact factor 2.4
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 1.245 SNIP 2.058
Web of Science (2010): Impact factor 2.131
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 1.025 SNIP 1.889
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 0.938 SNIP 1.413
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 0.826 SNIP 1.771
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 1.016 SNIP 1.716
Contribution of various microenvironments to the daily personal exposure to ultrafine particles: Personal monitoring coupled with GPS tracking

Exposure to ultrafine particles (UFP) may have adverse health effects. Central monitoring stations do not represent the personal exposure to UFP accurately. Few studies have previously focused on personal exposure to UFP. Sixty non-smoking residents living in Copenhagen, Denmark were asked to carry a backpack equipped with a portable monitor, continuously recording particle number concentrations (PN), in order to measure the real-time individual exposure over a period of similar to 48 h. A GPS logger was carried along with the particle monitor and allowed us to estimate the contribution of UFP exposure occurring in various microenvironments (residence, during active and passive transport, other indoor and outdoor environments) to the total daily exposure. On average, the fractional contribution of each microenvironment to the daily integrated personal exposure roughly corresponded to the fractions of the day the subjects spent in each microenvironment. The home environment accounted for 50% of the daily personal exposure. Indoor environments other than home or vehicles contributed with similar to 40%. The highest median UFP concentration was obtained during passive transport (vehicles). However, being in transit or outdoors contributed 5% or less to the daily exposure. Additionally, the subjects recorded in a diary the periods when they were at home. With this approach, 66% of the total daily exposure was attributable to the home environment. The subjects spent 28% more time at home according to the diary, compared to the GPS. These results may indicate limitations of using diaries, but also possible inaccuracy and miss-classification in the GPS data. (C) 2015 Elsevier Ltd. All rights reserved.
Web of Science (2016): Impact factor 3.629
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 3.73 SJR 1.754 SNIP 1.615
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 3.55 SJR 1.612 SNIP 1.661
Web of Science (2014): Impact factor 3.281
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 3.52 SJR 1.766 SNIP 1.62
Web of Science (2013): Impact factor 3.062
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 3.47 SJR 1.981 SNIP 1.674
Web of Science (2012): Impact factor 3.11
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): CiteScore 3.84 SJR 1.971 SNIP 1.78
Web of Science (2011): Impact factor 3.465
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 1.907 SNIP 1.485
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 1.979 SNIP 1.46
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 1.877 SNIP 1.579
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 1.999 SNIP 1.547
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 1.87 SNIP 1.571
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 1.872 SNIP 1.588
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 2.007 SNIP 1.77
Web of Science (2004): Indexed yes
Scopus rating (2003): SJR 1.896 SNIP 1.597
Web of Science (2003): Indexed yes
Scopus rating (2002): SJR 2.155 SNIP 1.591
Web of Science (2002): Indexed yes
Scopus rating (2001): SJR 1.829 SNIP 1.682
Web of Science (2001): Indexed yes
Scopus rating (2000): SJR 1.892 SNIP 1.615
Web of Science (2000): Indexed yes
Scopus rating (1999): SJR 1.947 SNIP 1.381
Original language: English
Effects of diffuser airflow minima on occupant comfort, air mixing, and building energy use (RP-1515)

There is great energy-saving potential in reducing variable air volume box minimum airflow set-points to about 10% of maximum. Typical savings are on the order of 10%-30% of total HVAC energy, remarkable for an inexpensive controls set-point change that properly maintains outside air ventilation. However, there has long been concern whether comfort and room air mixing are maintained under low flows through diffusers, and this concern has prompted variable air volume minima to be typically set at 20%-50% of maximum. RP 1515 evaluated occupants' thermal comfort and air quality satisfaction in operating buildings under both conventional and reduced minimum variable air volume flow set-points, and measured the air diffusion performance index and air change effectiveness for typical diffuser types in the laboratory. The hypotheses were that lowered flow operation would not significantly reduce comfort or air quality and that HVAC energy savings would be substantial. The hypotheses were almost entirely confirmed for both warm and cool seasons. But beyond this, the reduction of excess airflow during low-load periods caused occupants' cold discomfort in the warm season to be halved, a surprising improvement. It appears that today's widespread overcooling of buildings can be corrected without risk of discomfort by lowering conventional variable air volume minimum flow set-points.

General information

State: Published
Organisations: Department of Civil Engineering, University of California at Berkeley, Taylor Engineering, Price Industries
Number of pages: 16
Pages: 1075-1090
Publication date: 2015
Peer-reviewed: Yes

Publication information

Journal: Science and Technology for the Built Environment
Volume: 21
Issue number: 8
ISSN (Print): 2374-474x
Ratings:
Web of Science (2018): Indexed yes
Scopus rating (2017): CiteScore 1.05
Web of Science (2017): Impact factor 1.183
Web of Science (2017): Indexed yes
Scopus rating (2016): CiteScore 1.01
Web of Science (2016): Impact factor 0.88
Web of Science (2016): Indexed yes
Scopus rating (2015): SJR 0.644 SNIP 0.888
Web of Science (2015): Impact factor
Web of Science (2015): Indexed yes
Scopus rating (2014): SJR 0.578 SNIP 0.846
Web of Science (2014): Indexed yes
Scopus rating (2013): SJR 0.618 SNIP 0.89
Web of Science (2013): Indexed yes
Scopus rating (2012): SJR 0.587 SNIP 1.109
Web of Science (2012): Indexed yes
Scopus rating (2011): SJR 0.541 SNIP 0.74
Web of Science (2011): Indexed yes
Scopus rating (2010): SJR 1.027 SNIP 0.955
Web of Science (2010): Indexed yes
Scopus rating (2009): SJR 1.767 SNIP 1.187
Web of Science (2009): Indexed yes
Field measurements of perceived air quality and concentration of volatile organic compounds in four offices of the university building

Field measurements of perceived air quality were conducted in four refurbished offices at the Czech Technical University in Prague. The offices were refurbished as part of the research project Clear-up to serve as a field test facility. The present paper describes measurements conducted to investigate the perceived air quality, sensory pollution load and concentration of Volatile Organic Compounds (VOCs) in the offices. As the refurbishment comprised also installation of demand controlled ventilation (DCV), its influence on the perceived air quality was also tested. Measurements comprised the assessments of perceived air quality and objective measurements of operative temperature, relative humidity, CO₂ and VOCs concentrations. Results showed that the mean sensory pollution load in unoccupied offices was 0.09±0.01 olf/m² (mean±SEM). This falls into the category of a low-polluting building according to CEN Report CR 1752. The acceptability of the air quality was worst in unoccupied offices ventilated with minimum air change rate (0.4 h⁻¹).
Application of DCV decreased the CO₂ concentration, but did not result in statistically significant improvement of perceived air quality.
Field study of the indoor environment in a Danish prison
The indoor environment in a Danish prison was evaluated based on measurements made during the summer season of temperature, relative humidity and carbon dioxide, as well as through carefully conducted surveys among the inmates. The temperatures in the cells were high and well beyond common levels in Danish buildings. The mean CO₂ concentrations were generally low, but reached high maximum levels up to 5000 ppm. Thirty-one inmates responded to the questionnaire. They spent on average 19 h in the cell per day (range 12–23 h). Sixty-nine percent of the inmates expressed dissatisfaction with their general indoor environment and all responding inmates expressed dissatisfaction with the thermal climate. Dissatisfaction was mostly caused by a lack of airflow and air movement in the space as well as excessive direct sunlight from the windows. Security is a leading factor in the design of prisons, so a compromise must be found to ensure that the building can comply with minimum health and comfort standards. The findings of this study can be used as background for recommendations for renovation of prison buildings.

General information
State: Published
Organisations: Department of Civil Engineering, Section for Building Design, Section for Indoor Environment, Technical University of Denmark
Contributors: Dogbeh, A., Jomaas, G., Bjarløv, S. P., Toftum, J.
Pages: 20-26
Publication date: 2015
Peer-reviewed: Yes
Early online date: 2014

Publication information
Journal: Building and Environment
Volume: 88
ISSN (Print): 0360-1323
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 5.22 SJR 2.169 SNIP 2.534
Web of Science (2017): Impact factor 4.539
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 4.51 SJR 1.998 SNIP 2.215
Web of Science (2016): Impact factor 4.053
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 4.37 SJR 2.067 SNIP 2.463
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 4.14 SJR 1.887 SNIP 2.742
Indeklimaet i danske skoler er fortsat udfordret

General information
State: Published
Organisations: Department of Civil Engineering, Section for Indoor Climate and Building Physics
Contributors: Toftum, J., Clausen, G.
Pages: 18-20
Laminar airflow significantly reduced microbial air contamination during simulated total hip arthroplasty surgery in comparison to turbulent airflow

Operative temperature drifts and occupant satisfaction with thermal environment in three office buildings using radiant heating/cooling system

The objective of this study was to analyse operative temperature drifts and occupant satisfaction with thermal environment in office buildings utilizing embedded radiant heating/cooling systems. Three office buildings were investigated: Town Hall in Viborg, Denmark (floor area 19400 m²), IDOM, Madrid, Spain (16000 m²), TIFS, Padua, Italy (2200 m²). Continuous measurements of operative temperature were conducted at four workplaces in each building for one year. Occupants' satisfaction was assessed by internet based questionnaire. Results showed that mostly exceeded limits were those for 4-hour drift (0.8 K/h), which were exceeded at least in 2% and up to 52% of occupied time in investigated buildings. Limits for hourly and 2-hour drifts were exceeded in max. 2% of occupied time. Median values were in ranges of 0.12-0.29 K/h, 0.18-0.52 K/h and 0.27-0.84 K/h for 1, 2 and 4-hour drifts respectively. Occupants' in all buildings were rather satisfied with temperature conditions. Median temperature satisfaction (0="Clearly satisfied" - 5="Clearly dissatisfied") was 2, 1 and 1 for Viborg, Madrid and Padua respectively. Temperature satisfaction slightly decreased when rate of temperature change increased, thus higher temperature drifts seemed to lead to higher dissatisfaction, however the collected data did not allow for robust statistical analysis.
OPVent projektrapport – 2015: Resultater af OP Vent projektet

General information
State: Published
Organisations: Department of Civil Engineering, Section for Indoor Climate and Building Physics, Odense University Hospital, JRV A/S, Fournais Energi APS, Technical University of Denmark
Number of pages: 42
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Original language: Danish
Electronic versions:
OP_vent_rapport_051015_FINAL.pdf
Source: PublicationPreSubmission
Source-ID: 119503424
Research output: Research - peer-review › Report – Annual report year: 2015

Phthalate exposure through different pathways and allergic sensitization in preschool children with asthma, allergic rhinoconjunctivitis and atopic dermatitis

Studies in rodents indicate that phthalates can function as adjuvants, increasing the potency of allergens. Meanwhile, epidemiological studies have produced inconsistent findings regarding relationships between phthalate exposures and allergic disease in humans. The present study examined phthalate exposure and allergic sensitization in a large group of 3-5 year old children: 300 random controls and 200 cases with asthma, rhinoconjunctivitis or atopic dermatitis as reported in questionnaires. The children were clinically examined to confirm their health status. Blood samples were analyzed for IgE sensitization to 20 allergens. Adjusted logistic regressions were used to look for associations between phthalate exposure indicators (mass fractions in dust from children's homes and daycares, metabolites in urine, and estimated daily indoor intakes from dust ingestion, inhalation and dermal absorption) and sensitization and allergic disease. No direct associations were found between phthalate exposures and asthma, rhinoconjunctivitis or atopic dermatitis. However, among children with these diseases, there were significant associations between non-dietary exposures to DnBP, BBzP and DEHP in the indoor environment (mass fractions in dust or daily indoor intakes from dust ingestion, inhalation and dermal absorption) and allergic sensitization. Some exposure pathways were more strongly associated with sensitization than others, although the results are not conclusive and require confirmation. A number of the associations depended on accounting for a child's exposure in more than one environment (i.e., daycare facility as well as home). Significant associations were not observed between phthalate metabolites in urine, which reflected exposure from diet as well as indoor pathways, and allergic sensitization. (C) 2015 Elsevier Inc. All rights reserved.

Phthalate exposure through different pathways and allergic sensitization in preschool children with asthma, allergic rhinoconjunctivitis and atopic dermatitis

General information
State: Published
Organisations: Department of Civil Engineering, Section for Indoor Environment, Odense University Hospital, Swedish Environmental Research Institute, Aarhus University, University of Southern Denmark
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Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 4.59 SJR 1.605 SNIP 1.413
Web of Science (2017): Impact factor 4.732
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 4.12 SJR 1.413 SNIP 1.326
Web of Science (2016): Impact factor 3.835
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 3.71 SJR 1.424 SNIP 1.317
Web of Science (2015): Impact factor 3.088
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 4.32 SJR 1.794 SNIP 1.76
Web of Science (2014): Impact factor 4.373
BFI (2013): BFI-level 2
Scopus rating (2013): CiteScore 3.75 SJR 1.569 SNIP 1.597
Web of Science (2013): Impact factor 3.951
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): CiteScore 3.31 SJR 1.541 SNIP 1.362
Web of Science (2012): Impact factor 3.238
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): CiteScore 3.7 SJR 1.703 SNIP 1.53
Web of Science (2011): Impact factor 3.398
ISI indexed (2011): ISI indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 1.664 SNIP 1.474
Web of Science (2010): Impact factor 3.5
BFI (2009): BFI-level 2
Scopus rating (2009): SJR 1.506 SNIP 1.384
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 2
Scopus rating (2008): SJR 1.372 SNIP 1.39
Scopus rating (2007): SJR 1.318 SNIP 1.601
Scopus rating (2006): SJR 1.198 SNIP 1.506
Scopus rating (2005): SJR 1.094 SNIP 1.341
Scopus rating (2004): SJR 0.824 SNIP 0.973
Scopus rating (2003): SJR 0.752 SNIP 1.195
Scopus rating (2002): SJR 0.928 SNIP 1.263
Scopus rating (2001): SJR 0.923 SNIP 1.25
Scopus rating (2000): SJR 0.431 SNIP 1.115
Scopus rating (1999): SJR 0.708 SNIP 1.278

Original language: English

Keywords: allergic rhinoconjunctivitis Conjunctivitis, Allergic (MeSH) respiratory system disease, eye disease, immune system disease epidemiology, asthma Asthma (MeSH) respiratory system disease, immune system disease epidemiology, atopic dermatitis Dermatitis, Atopic (MeSH) congenital disease, genetic disease, immune system disease, integumentary system disease epidemiology, Primates Mammalia Vertebrata Chordata Animalia (Animals, Chordates, Humans, Mammals, Primates, Vertebrates) - Hominidae [86215] human common child, Rodentia Mammalia Vertebrata Chordata Animalia (Animals, Chordates, Mammals, Nonhuman Vertebrates, Nonhuman Mammals, Rodents, Vertebrates) - Muridae [86375] rat common, BBzP allergen, DEHP allergen, DnBP allergen, IgE, phthalate 3198-29-6 allergen, 03506, Genetics - Animal, 03508, Genetics - Human, 10064, Biochemistry studies - Proteins, peptides and amino acids, 15002, Blood - Blood and lymph studies, 15004, Blood - Blood cell studies, 15504, Urinary system - Physiology and biochemistry, 16006, Respiratory system - Pathology, 18506, Integumentary system - Pathology, 20006, Sense organs - Pathology, 25000, Pediatrics, 25503, Development and Embryology - Pathology, 34502, Immunology - General and methods, 34508, Immunology - Immupathology, tissue immunology, 35500, Allergy, Allied Medical Sciences, Clinical Immunology, Human Medicine, Medical Sciences, Human Medicine, Medical Sciences, blood blood and lymphatics, urine excretory system, logistic regression mathematical and computer techniques, questionnaire clinical techniques, diagnostic
techniques, Allergy, Dermatology, Medical Genetics, Ophthalmology, Pediatrics, Pulmonary Medicine, ENVIRONMENTAL, PUBLIC, DAY-CARE-CENTERS, IN-HOUSE DUST, DI-(2-ETHYLHEXYL) PHthalate, PRENATAL EXPOSURE, URBAN COHORT, HEALTH, ASSOCIATION, URINE, METABOLITES, SYMPTOMS, Allergic diseases, Clinical examination, Written questionnaire, Eczema, Indoor environment

DOIs:
10.1016/j.envres.2015.01.012
Source: FindIt
Source-ID: 274768731
Research output: Research - peer-review › Journal article – Annual report year: 2015

Smart green and healthy buildings

General information
State: Published
Organisations: Department of Civil Engineering, National University of Singapore
Contributors: Sekhar, C., Wai, D. C. K., Toftum, J.
Number of pages: 2
Pages: 1073-1074
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Peer-reviewed: Yes

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Ratings:
Web of Science (2018): Indexed yes
Scopus rating (2017): CiteScore 1.05
Web of Science (2017): Impact factor 1.183
Web of Science (2017): Indexed yes
Scopus rating (2016): CiteScore 1.01
Web of Science (2016): Impact factor 0.88
Web of Science (2016): Indexed yes
Scopus rating (2015): SJR 0.644 SNIP 0.888
Web of Science (2015): Impact factor
Web of Science (2015): Indexed yes
Scopus rating (2014): SJR 0.578 SNIP 0.846
Web of Science (2014): Indexed yes
Scopus rating (2013): SJR 0.618 SNIP 0.89
Web of Science (2013): Indexed yes
Scopus rating (2012): SJR 0.587 SNIP 1.109
Web of Science (2012): Indexed yes
Scopus rating (2011): SJR 0.541 SNIP 0.74
Web of Science (2011): Indexed yes
Scopus rating (2010): SJR 1.027 SNIP 0.955
Web of Science (2010): Indexed yes
Scopus rating (2009): SJR 1.767 SNIP 1.187
Web of Science (2009): Indexed yes
Scopus rating (2008): SJR 0.866 SNIP 0.903
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 0.804 SNIP 1.625
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 0.907 SNIP 1.302
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 1.471 SNIP 1.257
Web of Science (2005): Indexed yes
The effects of acoustical refurbishment of classrooms on teachers' perceived noise exposure and noise-related health symptoms

Objectives: To investigate whether acoustical refurbishment of classrooms for elementary and lower secondary grade pupils affected teachers' perceived noise exposure during teaching and noise-related health symptoms. Methods: Two schools (A and B) with a total of 102 teachers were subjected to an acoustical intervention. Accordingly, 36 classrooms (20 and 16 in school A and school B, respectively) were acoustically refurbished and 31 classrooms (16 and 15 in school A and school B, respectively) were not changed. Thirteen classrooms in school A were interim "sham" refurbished. Control measurements of RT and activity sound levels were measured before and after refurbishment. Data on perceived noise exposure, disturbance attributed to different noise sources, voice symptoms, and fatigue after work were collected over a year in a total of six consecutive questionnaires. Results: Refurbished classrooms were associated with lower perceived noise exposure and lower ratings of disturbance attributed to noise from equipment in the class compared with unrefurbished classrooms. No associations between the classroom refurbishment and health symptoms were observed. Before acoustical refurbishment, the mean classroom reverberation time was 0.68 (school A) and 0.57 (school B) and 0.55 s in sham refurbished classrooms. After refurbishment, the RT was approximately 0.4 s in both schools. Activity sound level measurements confirmed that the intervention had reduced the equivalent sound levels during lessons with circa 2 dB(A) in both schools. Conclusion: The acoustical refurbishment was associated with a reduction in classroom reverberation time and activity sound levels in both schools. The acoustical refurbishment was associated with a reduction in the teachers' perceived noise exposure, and reports of disturbance from equipment in the classroom decreased. There was no significant effect of the refurbishment on the teachers' voice symptoms or fatigue after work.

General information
State: Published
Organisations: Department of Civil Engineering, National Research Center for the Working Environment, Akustik Aps, AB Akustik, Lund University, Danish Centre of Educational Environment
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Publication date: 2015
Peer-reviewed: Yes

Publication information
Journal: International Archives of Occupational and Environmental Health
ISSN (Print): 0340-0131
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 2.18 SJR 1.018 SNIP 1.139
Web of Science (2017): Impact factor 2.148
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 1.98 SJR 0.888 SNIP 1.292
Web of Science (2016): Impact factor 2.177
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 1.98 SJR 0.941 SNIP 1.209
Transdermale Aufnahme von Diethyl- und Di(n-butyl)phtalat über die Luft: Kammerexperimente an Freiwilligen mit Biomonitoring-Messungen unter Ein und Ausschluss der inhalativen Aufnahme

Original language: English
Keywords: Public Health, Environmental and Occupational Health, Acoustical working environment, Classroom acoustics, Extra-auditory effects of noise exposure, Intervention, Noise exposure, Well-being

DOIs: 10.1007/s00420-015-1077-3
Source: Findit
Source-ID: 2280395171
Research output: Research - peer-review; Journal article – Annual report year: 2015

General information
State: Published
Organisations: Department of Civil Engineering, Department of Mechanical Engineering, Section for Indoor Climate and Building Physics
Publication date: 2015
Peer-reviewed: Yes

Bibliographical note
Transdermal uptake of diethyl phthalate and di(n-butyl) phthalate directly from air: Experimental verification

Background: Fundamental considerations indicate that, for certain phthalate esters, dermal absorption from air is an uptake pathway that is comparable to or greater than inhalation. Yet this pathway has not been experimentally evaluated and has been largely overlooked when assessing uptake of phthalate esters. Objectives: This study investigated transdermal uptake, directly from air, of diethyl phthalate (DEP) and di(n-butyl) phthalate (DnBP) in humans. Methods: In a series of experiments, six human participants were exposed for 6 hr in a chamber containing deliberately elevated air concentrations of DEP and DnBP. The participants either wore a hood and breathed air with phthalate concentrations substantially below those in the chamber or did not wear a hood and breathed chamber air. All urinations were collected from initiation of exposure until 54 hr later. Metabolites of DEP and DnBP were measured in these samples and extrapolated to parent phthalate intakes, corrected for background and hood air exposures.

Results: For DEP, the median dermal uptake directly from air was 4.0 μg/(μg/m3 in air) compared with an inhalation intake of 3.8 μg/(μg/m3 in air). For DnBP, the median dermal uptake from air was 3.1 μg/(μg/m3 in air) compared with an inhalation intake of 3.9 μg/(μg/m3 in air).

Conclusions: This study shows that dermal uptake directly from air can be a meaningful exposure pathway for DEP and DnBP. For other semivolatile organic compounds (SVOCs) whose molecular weight and lipid/air partition coefficient are in the appropriate range, direct absorption from air is also anticipated to be significant.
Ventilation på operationsstuer og kontamineringsrisiko

General information
State: Published
Organisations: Department of Civil Engineering, Section for Indoor Climate and Building Physics, Technical University of Denmark
Contributors: Rosenbeck, K., Nielsen, L., Toftum, J.
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Peer-reviewed: Unknown

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Volume: 51
Issue number: 9
ISSN (Print): 1603-6913
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Original language: Danish
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http://ipaper.ipapercms.dk/TechMedia/HVACMagasinet/2015/9/

Bibliographical note
Source: PublicationPreSubmission
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Research output: Communication › Journal article – Annual report year: 2015

A model for estimating particle concentration indoors – based on information from occupants’ questionnaires, indoor sources emission factors, outdoor concentration and building characteristics

General information
State: Published
Organisations: Department of Civil Engineering, Section for Indoor Environment, Aarhus University, University of Jordan, Lund University, University of Copenhagen
Number of pages: 2
Publication date: 2014

Host publication information
Title of host publication: Proceedings of Indoor Air 2014
Publisher: International Society of Indoor Air Quality and Climate
Article number: HP1191
Keywords: Personal exposure, Modelling, Indoor activities

Bibliographical note
Topic A10: Public health and exposure studies.
Research output: Research - peer-review › Article in proceedings – Annual report year: 2015
An intervention study of the acoustical environment’s effects on teachers’ well-being

General information
State: Published
Organisations: Department of Civil Engineering, Section for Indoor Environment, National Research Center for the Working Environment, Akustik Aps, Danish Centre of Educational Environment
Contributors: Kristiansen, J., Lund, S. P., Persson, R., Toftum, J., Møberg Nielsen, P., Challi, R.
Number of pages: 1
Publication date: 2014
Peer-reviewed: Yes
Event: Abstract from 7th Forum Acusticum, Krakow, Poland.
Research output: Research - peer-review › Conference abstract for conference – Annual report year: 2015

Association between Noise levels and CO₂ Concentrations in Classrooms

General information
State: Published
Organisations: Department of Civil Engineering, Section for Indoor Environment, Technical University of Denmark, Akustik Aps, National Research Center for the Working Environment
Contributors: Toftum, J., Hillig, K., Lund, S. P., Nielsen, P. M., Kristiansen, J.
Number of pages: 3
Publication date: 2014

Host publication information
Title of host publication: Proceedings of Indoor Air 2014
Publisher: International Society of Indoor Air Quality and Climate
Article number: HP0251
Keywords: Acoustics, Schools, Ventilation, Monitoring, Air quality
Electronic versions:
Article_IA2014_Noise_CO2_ver_2.pdf

Bibliographical note
Topic (A9). Indoor air acoustics and lighting.
Research output: Research - peer-review › Article in proceedings – Annual report year: 2015

Associations between selected allergens, phthalates, nicotine, polycyclic aromatic hydrocarbons, and bedroom ventilation and clinically confirmed asthma, rhinoconjunctivitis, and atopic dermatitis in preschool children

Previous studies, often using data from questionnaires, have reported associations between various characteristics of indoor environments and allergic disease. The aim of this study has been to investigate possible associations between objectively assessed indoor environmental factors and clinically confirmed asthma, rhinoconjunctivitis, and atopic dermatitis. The study is a cross-sectional case-control study of 500 children aged 3-5years from Odense, Denmark. The 200 cases had at least two parentally reported allergic diseases, while the 300 controls were randomly selected from 2835 participating families. A single physician conducted clinical examinations of all 500 children. Children from the initially random control group with clinically confirmed allergic disease were subsequently excluded from the control group and admitted in the case group, leaving 242 in the healthy control group. For most children, specific IgE's against various allergens were determined. In parallel, dust samples were collected and air change rates were measured in the children's bedrooms. The dust samples were analyzed for phthalate esters, polycyclic aromatic hydrocarbons (PAH), nicotine, and various allergens. Among children diagnosed with asthma, concentrations of nicotine were higher (P

General information
State: Published
Organisations: Department of Civil Engineering, Section for Indoor Environment, Odense University Hospital, Aarhus University, Odense City Government and Administration
Number of pages: 12
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Peer-reviewed: Yes

Publication information
Journal: Indoor Air
Volume: 24
Classroom ventilation type and pupil learning

General information
State: Published
Organisations: Department of Civil Engineering, Section for Indoor Environment, Deloitte, Technical University of Denmark
Publication date: 2014

Host publication information
Title of host publication: Proceedings of Indoor Air 2014
Publisher: International Society of Indoor Air Quality and Climate
Article number: HP0252
Keywords: Schools, CO2, Schoolwork, Performance
Electronic versions:
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Bibliographical note
Topic A6: Health and Indoor air epidemiology.
Source: PublicationPreSubmission
Source-ID: 104828868
Research output: Research - peer-review › Article in proceedings – Annual report year: 2015

De bløde gevinster ved energirenovering

General information
State: Published
Organisations: Department of Civil Engineering, Section for Indoor Environment
Contributors: Toftum, J.
Number of pages: 1
Pages: 6
Publication date: 2014
Peer-reviewed: No

Publication information
Journal: H V A C Magasinet
Issue number: 4
ISSN (Print): 1603-6913
Ratings:
ISI indexed (2013): ISI indexed no
ISI indexed (2012): ISI indexed no
ISI indexed (2011): ISI indexed no
Original language: Danish
Electronic versions:
bl_de_gevinster.pdf
Source: PublicationPreSubmission
Source-ID: 104829110
Research output: Research › Editorial – Annual report year: 2015
**Igen stor søgning til ingeniøruddannelserne**

**General information**
State: Published  
Organisations: Department of Civil Engineering, Section for Indoor Environment  
Contributors: Toftum, J.  
Number of pages: 1  
Pages: 6  
Publication date: 2014  
Peer-reviewed: No  

**Publication information**
Journal: H V A C Magasinet  
Issue number: 11  
ISSN (Print): 1603-6913  
Ratings:  
ISI indexed (2013): ISI indexed no  
ISI indexed (2012): ISI indexed no  
ISI indexed (2011): ISI indexed no  
Original language: Danish  
Electronic versions:  
Stor_s_gning.pdf  
Source: PublicationPreSubmission  
Source-ID: 104829093  
Research output: Research › Editorial – Annual report year: 2015

**Indeklimaforskere fra hele verden samlet i Hong Kong**

**General information**
State: Published  
Organisations: Department of Civil Engineering, Section for Indoor Environment  
Contributors: Toftum, J.  
Pages: 18-20  
Publication date: 2014  
Peer-reviewed: Unknown  

**Publication information**
Journal: H V A C Magasinet  
Issue number: 9  
ISSN (Print): 1603-6913  
Ratings:  
ISI indexed (2013): ISI indexed no  
ISI indexed (2012): ISI indexed no  
ISI indexed (2011): ISI indexed no  
Original language: Danish  
Electronic versions:  
Indoor_Air_2014.pdf  
Source: PublicationPreSubmission  
Source-ID: 104829102  
Research output: Communication › Journal article – Annual report year: 2015

**Indoor temperatures for optimum thermal comfort and human performance: Reply to the letter by Wyon and Wargocki**
A response by R. J. de Dear et al to a letter to the editor in response to their article “Progress in thermal comfort research over the last 20 years,” published in a 2013 issue.

**General information**
State: Published  
Organisations: Department of Civil Engineering, University of Sydney, University of California at Berkeley, Tsinghua University, Delft University of Technology, National University of Singapore  
Pages: 554-555  
Publication date: 2014
Investigation of the Indoor Environment in a Passive House Apartment Building Heated by Ventilation Air

Experience has shown that appropriate design of very low energy dwellings can be a large challenge and that the final design may result in insufficient heating in winter and overheating in summer. The 126 certified Passive House apartments (Ravnsborghusene) in Køge, Denmark are a low energy building project finished medio 2012. The design challenge was met with a concept of air heating that is individually controlled in every room. It also applies external solar shading. This study used indoor climate measurements and dynamic simulations in one of these apartment buildings to evaluate thermal comfort and the performance of the air heating system and solar shading. Thermal comfort category B according to ISO 7730 was obtained in the building during field measurements, indicating that the air heating system was able to maintain comfort conditions in winter, when the outdoor temperature had been unusual low for a longer period. The dynamic simulations also indicated that air heating during winter can provide a comfortable thermal environment. Dynamic simulations also demonstrated that during summer, apartments with automatic external solar screens had no serious overheating, whereas in apartments with south oriented windows, static shadings by the balcony overhangs and low ventilation rates, resulted in excessive hours of overheating.

General information
State: Published
Organisations: Department of Civil Engineering, Section for Indoor Environment, Technical University of Denmark
Contributors: Lysholt Hansen, M. B., Koulani, C. S., Peuhkuri, R. H., Toftum, J.
Number of pages: 8
Publication date: 2014

Host publication information
Title of host publication: Proceedings of 10th Nordic Symposium of Building Physics
Publisher: Lund University
Editors: Arfvidsson, J., Harderup, L., Kumlin, A., Rosencrantz, B.
Article number: A2809
Keywords: Low energy building, Passive House, Warm air heating, Thermal comfort, Solar shading, Field measurements, Dynamic building simulation
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Lysholt_Hansen_et_al_2014.pdf
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Research output: Research - peer-review › Article in proceedings – Annual report year: 2015

Noise and stress in open-plan offices

General information
State: Published
Organisations: Department of Civil Engineering, Section for Indoor Environment, National Research Center for the Working Environment
Contributors: Lund, S. P., Kristiansen, J., Persson, R., Shibua, H., Toftum, J., Clausen, G.
Number of pages: 1
Publication date: 2014
Peer-reviewed: Yes
Event: Abstract from 7th Forum Acusticum, Krakow, Poland.
Source: PublicationPreSubmission
Source-ID: 104829080
Phthalate metabolites in urine and asthma, allergic rhinoconjunctivitis and atopic dermatitis in preschool children

Phthalate esters are among the most ubiquitous of indoor pollutants and have been associated with various adverse health effects. In the present study we assessed the cross-sectional association between eight different phthalate metabolites in urine and allergic disease in young children. As part of the Danish Indoor Environment and Children's Health study, urine samples were collected from 440 children aged 3-5 years, of whom 222 were healthy controls, 68 were clinically diagnosed with asthma, 76 with rhinoconjunctivitis and 81 with atopic dermatitis (disease subgroups are not mutually exclusive; some children had more than one disease). There were no statistically significant differences in the urine concentrations of phthalate metabolites between cases and healthy controls with the exception of MnBP and MECCP, which were higher in healthy controls compared with the asthma case group. In the crude analysis MnBP and MIP were negatively associated with asthma. In the analysis adjusted for multiple factors, only a weak positive association between MEP in urine and atopic dermatitis was found; there were no positive associations between any phthalate metabolites in urine and either asthma or rhinoconjunctivitis. These findings appear to contradict earlier studies. Differences may be due to higher exposures to certain phthalates (e.g., BBzP) via non-dietary pathways in earlier studies, phthalates serving as surrogates for an agent associated with asthma (e.g., PVC flooring) in previous studies but not the present study or altered cleaning habits and the use of "allergy friendly" products by parents of children with allergic disease in the current study in contrast to studies conducted earlier.

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State: Published
Organisations: Department of Civil Engineering, Section for Indoor Environment, Odense University Hospital, Swedish Environmental Research Institute, SP Technical Research Institute of Sweden, Aarhus University, University of Southern Denmark
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Publication information
Journal: International Journal of Hygiene and Environmental Health
Volume: 217
Issue number: 6
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Ratings:
  BFI (2018): BFI-level 2
  Web of Science (2018): Indexed yes
  BFI (2017): BFI-level 1
  Scopus rating (2017): CiteScore 4 SJR 1.334 SNIP 1.262
  Web of Science (2017): Impact factor 4.848
  Web of Science (2017): Indexed yes
  BFI (2016): BFI-level 1
  Scopus rating (2016): CiteScore 4.22 SJR 1.437 SNIP 1.482
  Web of Science (2016): Impact factor 4.643
  BFI (2015): BFI-level 1
  Scopus rating (2015): CiteScore 3.84 SJR 1.452 SNIP 1.278
  BFI (2014): BFI-level 1
  Scopus rating (2014): CiteScore 3.61 SJR 1.32 SNIP 1.652
  Web of Science (2014): Impact factor 3.829
  Web of Science (2014): Indexed yes
  BFI (2013): BFI-level 1
  Scopus rating (2013): CiteScore 3.3 SJR 1.175 SNIP 1.417
  Web of Science (2013): Impact factor 3.276
  ISI indexed (2013): ISI indexed yes
  Web of Science (2013): Indexed yes
  BFI (2012): BFI-level 1
  Scopus rating (2012): CiteScore 3.62 SJR 1.505 SNIP 1.641
Socioeconomic and health impacts among the elderly of their dwelling environment

General information
State: Published
Organisations: Department of Civil Engineering, Section for Indoor Environment
Contributors: Toftum, J., Andersen, R. K.
Pages: 77-80
Publication date: 2014

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Title of host publication: Proceedings of the 2nd International Symposium on the Interaction between Human and Building Environment
Electronic versions:
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Source: PublicationPreSubmission
Source-ID: 104829012
Research output: Research - peer-review › Journal article – Annual report year: 2014

Ultrafine particles in 60 danish homes: measurements in the homes and personal monitoring

General information
State: Published
Organisations: Department of Civil Engineering, Section for Indoor Environment, University of Copenhagen, Lund University
Contributors: Bekö, G., Kjeldsen, B. U., Olsen, Y., Wierzbicka, A., Karottki, D. G., Toftum, J., Loft, S., Clausen, G.
Number of pages: 3
Publication date: 2014

Host publication information
Children's Phthalate Intakes and Resultant Cumulative Exposures Estimated from Urine Compared with Estimates from Dust Ingestion, Inhalation and Dermal Absorption In Their Homes and Daycare Centers.

Total daily intakes of diethyl phthalate (DEP), di(n-butyl) phthalate (DnBP), di(isobutyl) phthalate (DiBP), butyl benzyl phthalate (BBzP) and di(2-ethylhexyl) phthalate (DEHP) were calculated from phthalate metabolite levels measured in the urine of 431 Danish children between 3 and 6 years of age. For each child the intake attributable to exposures in the indoor environment via dust ingestion, inhalation and dermal absorption were estimated from the phthalate levels in the dust collected from the child's home and daycare center. Based on the urine samples, DEHP had the highest total daily intake (median: 4.42 µg/d/kg-bw) and BBzP the lowest (median: 0.49 µg/d/kg-bw). For DEP, DnBP and DiBP, exposures to air and dust in the indoor environment accounted for approximately 100%, 15% and 50% of the total intake, respectively, with dermal absorption from the gas-phase being the major exposure pathway. More than 90% of the total intake of BBzP and DEHP came from sources other than indoor air and dust. Daily intake of DnBP and DiBP from all exposure pathways, based on levels of metabolites in urine samples, exceeded the Tolerable Daily Intake (TDI) for 22 and 23 children, respectively. Indoor exposures resulted in an average daily DiBP intake that exceeded the TDI for 14 children. Daily intake of BBzP and DEHP from all exposure pathways, based on levels of metabolites in urine samples, exceeded the Tolerable Daily Intake (TDI) for 22 and 23 children, respectively. Indoor exposures resulted in an average daily DiBP intake that exceeded the TDI for 14 children. Using the concept of relative cumulative Tolerable Daily Intake (TDI_{cum}), which is applicable for phthalates that have established TDIs based on the same health endpoint, we examined the cumulative total exposure to DnBP, DiBP and DEHP from all pathways; it exceeded the tolerable levels for 30% of the children. From the three indoor pathways alone, several children had a cumulative intake that exceeded TDI_{cum}. Exposures to phthalates present in the air and dust indoors meaningfully contribute to a child's total intake of certain phthalates. Such exposures, by themselves, may lead to intakes exceeding current limit values.
Effect of Personal Control over Thermal Environment in a Laboratory Setting
Field studies have demonstrated that personal control over the indoor climate may increase comfort and could reduce SBS symptoms. A laboratory study was performed to investigate if being in control over the thermal environment influences comfort, symptoms and performance. The central hypothesis was that human responses to a thermal indoor environment depend on the availability of control opportunities.
This was tested in a field lab where subjects had a personal desk fan with a stepless controller at their workplace. Two conditions were tested: one (the first) with individual control and one without, but with identical indoor climate exposure as recorded during the first session. During both experimental conditions, 23 subjects were exposed for 120 min to an operative temperature of 28 °C and they were provided with a personal desk fan. During the first exposure subjects were allowed to adjust air velocity (and therefore local thermal environment) at any moment. For each subject the adjustments were recorded. In the second experiment, subjects were exposed to identical indoor environment conditions as recorded during the first experiment, but without individual control of the desk fan (control knob was hidden). During both conditions identical questionnaires and performance tests were used to evaluate comfort, symptom intensity and performance. Limited differences were found when comparing the ‘with control’ and ‘without control situation’. For the investigated case, the availability of control opportunities does not directly influence human perception to the thermal environment, symptoms or performance. However, personal preferences for the air velocity of the fan differ a lot. This confirms the need for personal indoor climate systems to satisfy the need of individuals.

General information
State: Published
Organisations: Department of Civil Engineering, Section for Indoor Environment, Eindhoven University of Technology, BBA Binnenmilieu
Contributors: Kulve, M. T., Boerstra, A. C., Toftum, J., Loomans, M. G. L. C.
Number of pages: 11
Publication date: 2013
Peer-reviewed: Yes
Event: Paper presented at Clima 2013, Prague, Czech Republic.

Bibliographical note
Paper id 220
Field Measurements of Perceived Air Quality in the Test-Bed for Innovative Climate Conditioning Technologies

Field measurements of perceived air quality were conducted in an experimental test bed for innovative building technologies situated at the Czech Technical University in Prague. The technologies included photocatalytically active paint, vacuum porous insulation and wall plaster containing phase change material. Technologies were installed in eight offices as part of the research project Clear-up. The offices were primarily used to carry out comparative tests for individual technologies. The present paper describes measurements done in parallel to the comparative tests to investigate the potential influence of aforementioned technologies on the perceived air quality. Additionally, the effect of Demand Controlled Ventilation (DCV) on the perceived air quality was tested. Measurements comprised of the assessments of perceived air quality and objective measurements of operative temperature, relative humidity and CO₂ concentration. Results showed that the mean sensory pollution load in the tested offices was 0.09±0.02 olf/m² (mean±SEM). This refers to a low-polluting building according to CEN Report CR 1752. The acceptability of the air quality was worst in unoccupied offices ventilated at 20 m³/h. Application of DCV decreased the CO₂ concentration, but did not result in statistically significant improvement of the perceived air quality. It was not possible to quantify the influence on the sensory pollution load of particular technologies tested as part of the Clear-up. However, the sensory pollution load in unoccupied offices equipped with those technologies was on average 0.07 olf/m² lower than in the reference office.

General information
State: Published
Organisations: Department of Civil Engineering, Section for Indoor Environment, Czech Technical University, Technical University of Denmark
Contributors: Kolarik, J., Toftum, J., Kabrhel, M., Jordan, F., Bokiewicz, K., Kabele, K.
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Keywords: Perceived air quality, Field measurements, Sensory pollution load

Healthy Buildings 2012: Ventilation and Thermal Comfort

An introduction is presented in which the editors discuss various reports within the issue on topics including the International Society of Indoor Air Quality and Climate (ISIAQ) conference, three different types of personalized exhaust (PE) devices, and personalized ventilation.
Phthalate metabolites in urine samples from Danish children and correlations with phthalates in dust samples from their homes and daycare centers

Around the world humans use products that contain phthalates, and human exposure to certain of these phthalates has been associated with various adverse health effects. The aim of the present study has been to determine the concentrations of the metabolites of diethyl phthalate (DEP), di(n-butyl) phthalate (DnBP), di(iso-butyl) phthalate (DiBP), butyl benzyl phthalate (BBzP) and di(2-ethylhexyl) phthalate (DEHP) in urine samples from 441 Danish children (3–6 years old). These children were subjects in the Danish Indoor Environment and Children's Health study. As part of each child's medical examination, a sample from his or her first morning urination was collected. These samples were subsequently analyzed for metabolites of the targeted phthalates. The measured concentrations of each metabolite were approximately log-normally distributed, and the metabolite concentrations significantly correlated with one another. Additionally, the mass fractions of DEP, DnBP, DiBP and BBzP in dust collected from the children's bedrooms and daycare centers significantly correlated with the concentrations of these phthalates' metabolites (monoethyl phthalate (MEP), mono-n-butyl phthalate (MnBP), mono-isobutyl phthalate (MiBP) and monobenzyl phthalate (MBzP), respectively) in the children's urine. Such correlations indicate that indoor exposures meaningfully contributed to the Danish children's intake of DEP, DnBP, DiBP and BBzP. This was not the case for DEHP. The urine concentrations of the phthalate metabolites measured in the present study were remarkably similar to those measured in urine samples from children living in countries distributed over four continents. These similarities reflect the globalization of children's exposure to phthalate containing products.

General information
State: Published
Organisations: Department of Civil Engineering, Section for Indoor Environment, Department of Mechanical Engineering, Swedish Environmental Research Institute, SP Technical Research Institute of Sweden, Odense University Hospital
Contributors: Langer, S., Bekö, G., Weschler, C. J., Brive, L. M., Toftum, J., Callesen, M., Clausen, G.
Pages: 78-87
Publication date: 2013
Peer-reviewed: Yes
Progress in thermal comfort research over the last twenty years

Climate change and the urgency of decarbonizing the built environment are driving technological innovation in the way we deliver thermal comfort to occupants. These changes, in turn, seem to be setting the directions for contemporary thermal comfort research. This article presents a literature review of major changes, developments, and trends in the field of thermal comfort research over the last 20 years. One of the main paradigm shift was the fundamental conceptual reorientation that has taken place in thermal comfort thinking over the last 20 years; a shift away from the physically based determinism of Fanger’s comfort model toward the mainstream and acceptance of the adaptive comfort model. Another noticeable shift has been from the undesirable toward the desirable qualities of air movement. Additionally, sophisticated models covering the physics and physiology of the human body were developed, driven by the continuous challenge to model thermal comfort at the same anatomical resolution and to combine these localized signals into a coherent, global thermal perception. Finally, the demand for ever increasing building energy efficiency is pushing technological innovation in the way we deliver comfortable indoor environments. These trends, in turn, continue setting the directions for contemporary thermal comfort research for the next decades.

General information
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Organisations: Department of Civil Engineering, Section for Indoor Environment, University of Sydney, Shibaura Institute of Technology, University of California, Chongqing University, University of the Sacred Heart (Japan), Waseda University, Tsinghua University, National University of Singapore
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BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
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Scopus rating (2017): CiteScore 3.9
Web of Science (2017): Impact factor 4.396
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 3.55
Web of Science (2016): Impact factor 4.383
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 3.88
Web of Science (2015): Impact factor 4.33
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 4.57
Web of Science (2014): Impact factor 4.904
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 3.63
Web of Science (2013): Impact factor 4.202
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 2.72
Web of Science (2012): Impact factor 3.302
Ultrafine particles: Exposure and source apportionment in 56 Danish homes

Particle number (PN) concentrations (10-300 nm in size) were continuously measured over a period of ~45 h in 56 residences of nonsmokers in Copenhagen, Denmark. The highest concentrations were measured when occupants were present and awake (geometric mean, GM: $22.3 \times 10^3$ cm$^{-3}$), the lowest when the homes were vacant (GM: $6.1 \times 10^3$ cm$^{-3}$) or the occupants were asleep (GM: $5.1 \times 10^3$ cm$^{-3}$). Diary entries regarding occupancy and particle related activities were used to identify source events and apportion the daily integrated exposure among sources. Source events clearly resulted in increased PN concentrations and decreased average particle diameter. For a given event, elevated particle concentrations persisted for several hours after the emission of fresh particles ceased. The residential daily integrated PN exposure in the 56 homes ranged between $37 \times 10^3$ and $6.0 \times 10^6$ particles per cm$^3$·h/day (GM: $3.3 \times 10^5$ cm$^{-3}$·h/day). On average, ~90% of this exposure occurred outside of the period from midnight to 6 a.m. Source events, especially candle burning, cooking, toasting, and unknown activities, were responsible on average for ~65% of the residential integrated exposure (51% without the unknown activities). Candle burning occurred in half of the homes where, on average, it was responsible for almost 60% of the integrated exposure. © 2013 American Chemical Society.
Window opening behaviour modelled from measurements in Danish dwellings
A method of defining occupants' window opening behaviour patterns in simulation programs, based on measurements is proposed. Occupants' window opening behaviour has a strong effect on indoor environment and the energy consumed to sustain it. Only few models of window opening behaviour exist and these are solely based on the thermal indoor/outdoor environment. Consequently, users of simulation software are often left with little or no guidance for the modelling of occupants' window opening behaviour, resulting in potentially large discrepancies between real and simulated energy consumption and indoor environment. Measurements of occupants' window opening behaviour were conducted in 15 dwellings in Denmark during eight months. Indoor and outdoor environmental conditions were monitored in an effort to relate the behaviour of the occupants to the environmental conditions. The dwellings were categorized in four groups according to ventilation type (natural/mechanical) and ownership (owner-occupied/rented) in order to investigate common patterns of behaviour. Logistic regression was used to infer the probability of opening and closing a window. The occupants' window opening behaviour was governed by different but distinct habits in each dwelling. However, common patterns were also identified in the analysis: Indoor CO2 concentration (used as indicator of indoor air quality) and outdoor temperature were the two single most important variables in determining the window opening and closing probability, respectively. The models could be implemented into most simulation programs, which would enable a better chance of mimicking the behaviour of the occupants in the building and thus simulating the indoor environment and energy consumption correctly. © 2013 Elsevier Ltd.

General information
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Organisations: Department of Civil Engineering, Section for Indoor Environment, Polytechnic University of Turin
Contributors: Andersen, R. K., Fabi, V., Toftum, J., Corgnati, S. P., Olesen, B. W.
Pages: 101-113
Publication date: 2013
Peer-reviewed: Yes

Publication information
Journal: Building and Environment
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ISSN (Print): 0360-1323
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BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 5.22 SJR 2.169 SNIP 2.534
Web of Science (2017): Impact factor 4.539
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 4.51 SJR 1.998 SNIP 2.215
Web of Science (2016): Impact factor 4.053
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Keywords: Occupant behaviour, Building controls, Adaptation, Window opening, Building energy performance simulation, Air quality

Scopus rating (2015): CiteScore 4.37 SJR 2.067 SNIP 2.463
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 4.14 SJR 1.887 SNIP 2.742
Web of Science (2014): Impact factor 3.341
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 3.57 SJR 1.547 SNIP 2.551
Web of Science (2013): Impact factor 2.7
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 3.06 SJR 1.293 SNIP 2.857
Web of Science (2012): Impact factor 2.43
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): CiteScore 2.76 SJR 1.127 SNIP 2.279
Web of Science (2011): Impact factor 2.4
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 1.245 SNIP 2.058
Web of Science (2010): Impact factor 2.131
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 1.025 SNIP 1.889
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 0.938 SNIP 1.413
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 0.826 SNIP 1.771
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 1.016 SNIP 1.716
Scopus rating (2005): SJR 0.933 SNIP 1.296
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 0.572 SNIP 1.259
Scopus rating (2003): SJR 0.898 SNIP 0.963
Web of Science (2003): Indexed yes
Scopus rating (2002): SJR 1.216 SNIP 1.436
Web of Science (2002): Indexed yes
Scopus rating (2001): SJR 0.809 SNIP 1.065
Scopus rating (2000): SJR 0.585 SNIP 1.086
Scopus rating (1999): SJR 0.54 SNIP 1.137

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Source-ID: n:oai:DTIC-ART:compendex/391889242::31911

Research output: Research - peer-review › Journal article – Annual report year: 2013
Associations between multiple indoor environmental factors and clinically confirmed allergic disease in early childhood

Background: Previous studies, mainly questionnaires have reported associations between some indoor environmental factors and allergic diseases. Our aim was to investigate the possible association between objectively assessed indoor environmental factors and clinically confirmed asthma, rhinoconjunctivitis and atopic dermatitis.

Method: A crosssectional case-cohort study (n = 500) based on 2835 children, aged 3–5 years, responding to a questionnaire, consisted of 300 subjects randomly selected and 200 cases with at least two parentally reported doctor diagnosed allergic diseases (asthma, allergic rhinoconjunctivitis or atopic dermatitis). The same physician conducted a clinical examination of all the 500 children including structured interview on allergic heredity, clinical and medical history. Specific s-IgE against inhalant and food allergens was determined. The homes were investigated by inspectors assessing air change rates, relative humidity, temperature, CO2, and dust samples were collected for analyses of indoor allergens, phthalates, nicotine and polyaromatic hydrocarbons. The diagnosis of allergic disease was based on internationally accepted criteria.

Result: In the base group (n = 300) asthma was clinically diagnosed in 5.1%, rhinoconjunctivitis in 5.1% and atopic dermatitis in 11.0%. Air change rates were below the recommended 0.5 in 56% of all the homes. Air change rates were higher among children asthma/rhinoconjunctivitis (P < 0.05). Stratified analyses showed lower air change rates (P < 0.05) in sensitized children with asthma. Concentrations of nicotine and house dust mite allergens were higher (P < 0.05) and cat allergens lower (P < 0.05) in the asthma group. When the diagnosis of allergic disease was based solely on questionnaire data no significant associations between environmental factors and allergic disease were found.

Conclusion: Air change rates were insufficient in the majority of the homes, and low rates were associated with higher concentrations of HDM allergens and sensitization in children with asthma. Asthma was associated with higher levels of nicotine and phthalates in dust. Pet keeping history proved an active avoidance behavior against cats. The lower levels of cat allergens among asthmatics may reflect avoidance behavior against ‘visible’ allergen sources (cat) but not to ‘invisible’ allergens (HDM). Questionnaire studies are inappropriate for evaluation for analysis of interaction between indoor.

General information
State: Published
Organisations: Department of Civil Engineering, Section for Indoor Environment, Odense University Hospital, Aarhus University, University of Southern Denmark, Municipality of Odense
Pages: 630
Publication date: 2012
Peer-reviewed: Yes

Publication information
Journal: Allergy: European Journal of Allergy and Clinical Immunology
Volume: 67
Issue number: Issue Supplement s96
ISSN (Print): 0105-4538
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 6.23 SJR 2.702 SNIP 2.332
Web of Science (2017): Impact factor 6.048
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 6.23 SJR 2.841 SNIP 2.521
Web of Science (2016): Impact factor 7.361
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 5.73 SJR 3.17 SNIP 2.17
Web of Science (2015): Impact factor 6.335
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 5.51 SJR 2.529 SNIP 2.161
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Children's health and its association with indoor environments in Danish homes and daycare centres – methods

The principle objective of the Danish research program Indoor Environment and Childrens Health (IECH) was to explore associations between various exposures that children experience in their indoor environments (specifically their homes and daycare centers) and their well-being and health. The targeted health endpoints were allergy, asthma, and certain respiratory symptoms. The study was designed with two stages. In the first stage, a questionnaire survey was distributed to more than 17 000 families with children between the ages of 1 and 5. The questionnaire focused on the childrens health and the environments within the homes they inhabited and daycare facilities they attended. More than 11 000 questionnaires were returned. In the second stage, a subsample of 500 children was selected for more detailed studies, including an extensive set of measurements in their homes and daycare centers and a clinical examination; all clinical examinations were carried out by the same physician. In this study, the methods used for data collection within the IECH research program are presented and discussed. Furthermore, initial findings are presented regarding descriptors of the study population and selected characteristics of the childrens dwellings and daycare centers.
Cognitive test performance following exposure to noise in an open-office simulation study

Objective: Noise in open-plan offices may increase mental fatigue of the employees at the end of the day. Measurements: 225 employees completed a screening questionnaire. Of these, 50 persons (33 females) who normally worked in open-plan offices agreed to participate in the experiment. All who participated completed two counter balanced experimental sessions, one with exposure to simulation of office noise (Leq=55 dB(A)) and one without noise (Leq=50 dB(A)). To simulate a workday, each session lasted about 7 hours, where the participants engaged in different computerised work tasks. Before and after each simulated workday, the participants performed different tests, including Choice Reaction Time (CRT) test, Sustained Attention to Response Task (SART) test, and a Two-Back Task (TBT) test. Results: Working in noise did not affect the number of correct trials in the cognitive test after work. Yet, there were differences in performance between subgroups that were defined with respect to the degree of disturbance to noise they experienced in their normal work conditions. Conclusion: There were no signs of increased mental fatigue during the experimental sessions. However, there were slight differences in test performance between groups reporting being disturbed by noise for more or less than 50% of the time in their normal open office environment.

Effect of open-plan office noise on occupant comfort and performance

This study investigated effects on comfort, symptoms, and office work performance of exposure to office noise. Forty-nine subjects who were employees working in open-plan offices participated in two full-day experiments simulating an ordinary work day; one day with and one day without exposure to pre-recorded office noise. Exposure to office noise affected negatively ratings of adverse perceptions, selected symptoms, and self-assessed performance, but not the performance of the simulated office tasks. Occupants who in their daily work were disturbed by open-plan office noise were less tolerant to the noise exposure than those who were not.
Bibliographical note
Paper no. 6E.1.
Source: dtu
Source-ID: u::6175
Research output: Research - peer-review › Paper – Annual report year: 2012

Estimates of total phthalate intakes for Danish children and the contributions to these intakes from dust ingestion, inhalation and dermal absorption in homes and daycare centers

General information
State: Published
Organisations: Department of Civil Engineering, Section for Indoor Environment, Swedish Environmental Research Institute, H. C. Andersen Children's Hospital
Contributors: Bekö, G., Weschler, C. J., Langer, S., Callesen, M., Toftum, J., Clausen, G.
Number of pages: 2
Publication date: 2012
Peer-reviewed: Yes
Keywords: Biomarkers, Exposure pathways, Phthalate metabolites, Tolerable daily intake

Bibliographical note
Paper No.: 7B.1
Research output: Research - peer-review › Paper – Annual report year: 2012

Healthy Buildings 2012: indeklima med hovedet nedad

General information
State: Published
Organisations: Department of Civil Engineering, Section for Indoor Environment
Contributors: Toftum, J.
Pages: 44
Publication date: 2012
Peer-reviewed: Unknown

Publication information
Journal: HVAC Magasinet
Issue number: 9
ISSN (Print): 1603-6913
Ratings:
ISI indexed (2013): ISI indexed no
ISI indexed (2012): ISI indexed no
ISI indexed (2011): ISI indexed no
Original language: Danish

Bibliographical note
Source: dtu
Source-ID: u::6180
Research output: Communication › Journal article – Annual report year: 2012

Hvordan er det nu med de der luftstrømninger?

General information
State: Published
Organisations: Department of Civil Engineering, Section for Indoor Environment
Interzonal airflows in five Danish homes during two seasons

General information
State: Published
Organisations: Department of Civil Engineering, Section for Indoor Environment
Contributors: Gustavsen, S., Bekö, G., Toftum, J., Clausen, G.
Number of pages: 2
Publication date: 2012
Peer-reviewed: Yes
Keywords: CO2 concentration, Active tracer gas, Residences, Redistribution, Occupant behavior

Bibliographical note
Paper No.: 8A.7
Research output: Research - peer-review » Paper – Annual report year: 2012

Øredutterne er den nye støjvæg

General information
State: Published
Organisations: Department of Civil Engineering, Section for Indoor Environment
Contributors: Toftum, J.
Number of pages: 1
Pages: 6
Publication date: 2012
Peer-reviewed: No

Publication information
Journal: HVAC Magasinet
Issue number: 7
ISSN (Print): 1603-6913
Ratings:
ISI indexed (2013): ISI indexed no
ISI indexed (2012): ISI indexed no
ISI indexed (2011): ISI indexed no
Original language: Danish

Bibliographical note
Source: dtu
Source-ID: u::6181
Research output: Research › Editorial – Annual report year: 2012
Simulation of indoor environment in low energy housing
The aim of this study was to assess whether low energy consumption in dwellings imposes problems by deteriorating the indoor environment. Several indoor environment parameters were correlated with the energy consumption of low energy houses. One house from a village of low energy houses in Denmark was selected and sensitivity analyses were conducted for the importance of occupancy, ventilation, window opening, and heat recovery efficiency. In particular occupancy and venting played significant roles for the indoor environment and energy consumption. It was also shown that with passive measures, but also with the installation of a chiller, a comfortable thermal indoor environment could be achieved with only a minor increase in the energy consumption.

General information
State: Published
Organisations: Department of Civil Engineering, Section for Indoor Environment, Uponor GmbH, Aalborg University
Contributors: Vagiannis, G., Knudsen, H. N., Toftum, J., Clausen, G.
Number of pages: 6
Publication date: 2012
Peer-reviewed: Yes
Keywords: Architecture and design, Building controls and automation, Energy performance, HVAC systems, Occupant/user control
Electronic versions:
9E.2.pdf

The adjuvanted effect of phthalate exposure on IgE sensitisation in early childhood
Background: Dust phthalate concentrations have previously been shown to be weakly associated with parentally reported allergic diseases, but the validity of the results has been questioned. Our aims were to investigate the association between phthalate diester exposure from two environments and IgE sensitization in children.
Method: A cross-sectional case-cohort study (n = 500) based on 2835 children, aged 3–5 years, responding to a questionnaire in the Danish Indoor Environment and Children's Health study consisted of 300 subjects randomly selected and 200 cases with at least two parentally reported doctor diagnosed allergic diseases (asthma, allergic rhinoconjunctivitis or atopic dermatitis). The same physician conducted a clinical examination of all the 500 children including a structured interview on allergic heredity, clinical and medical history Specific serum-IgE against inhalant and food allergens was determined. Samples of settled dust were collected from the children’s bedroom and daycare center for analyses of five phthalates (DEP, DnBP, DiBP, BBzp & DEHP). Phthalate intakes through three different exposure routes were calculated. The diagnosis of allergic disease was based on internationally accepted criteria.
Result: In the group of randomly selected children IgE sensitization was associated with the total phthalate exposure (P <0.05) with adjusted OR's = 3.26. There was a clear dose-response relationship between total phthalate exposure in the homes and IgE sensitization in children with asthma, allergic rhinoconjunctivitis or atopic dermatitis (P < 0.05, aOR = 2.59) and DEHP exposure (P < 0.05, aOR =3.45). IgE sensitization in children with asthma was associated with DnBP exposure (P < 0.05). IgE sensitization in the cases were associated (P < 0.05) with DnBP and BBzP exposure in the daycare centers, while analysis for the allergic diseases separately demonstrated an association with DEP, DnBP, DiBP and BBzP (P < 0.05). The association between IgE sensitization and DEP, DnBP, DiBP and BBzP was also found in the calculated phthalate intakes from the different exposure pathways, particularly in asthma (aOR > 18).
Conclusion: We found significant associations between IgE sensitization and both phthalate dust concentrations and calculated phthalate intakes. Such an association has previously been indicated in animal studies, but this is the first demonstration of such an association in human studies.

General information
State: Published
Organisations: Department of Civil Engineering, Section for Indoor Environment, Odense University Hospital, University of Southern Denmark, Karlstad University, Aarhus University
Contributors: Callesen, M., Weschler, C. J., Jensen, T., Clausen, G., Toftum, J., Bekö, G., Bomehag, C., Sigsgaard, T., Hast, A.
Pages: 654-655
Publication date: 2012
Peer-reviewed: Yes
The impact of a photocatalytic paint on indoor air pollutants: Sensory assessments

The ability of a commercial photocatalytically active cement-based paint to improve the perceived air quality was evaluated. The paint was applied to pieces of gypsum board with a total surface area of 13 m² (23% of the total wall surface). To initiate the photocatalytic activity, the paint was illuminated by bulbs emitting visible/UV light. A mixture of common indoor pollutants, including emissions from chipboard, linoleum and carpet, as well as human bioeffluents and isopropanol, were used to test the efficacy of the paint. A sensory panel of 35 subjects assessed the air quality in the test-room once before and twice after a step-change in the room condition (i.e., either a change in the sensory pollution load or the illumination of the paint). Illumination of the paint in the room polluted with building materials significantly decreased the acceptability of the air quality at both 40% (p <0.01) and 95% (p <0.05) of the final steady-state condition. Introduction of bioeffluents significantly affected the perceived air quality only shortly after the step-change (40% steady-state); with non-illuminated paint the acceptability decreased; with illuminated paint the acceptability increased. Emission of isopropanol at 1 cm³/h had no effect on the perceived air quality (both with and without illumination).

General information
State: Published
Organisations: Section for Indoor Environment, Department of Civil Engineering
Contributors: Kolarik, J., Toftum, J.
Pages: 396-402
Publication date: 2012
Peer-reviewed: Yes

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Journal: Building and Environment
Volume: 57
ISSN (Print): 0360-1323
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BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 5.22 SJR 2.169 SNIP 2.534
Web of Science (2017): Impact factor 4.539
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 4.51 SJR 1.998 SNIP 2.215
Web of Science (2016): Impact factor 4.053
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 4.37 SJR 2.067 SNIP 2.463
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 4.14 SJR 1.887 SNIP 2.742
Web of Science (2014): Impact factor 3.341
Thermal and Air Quality Acceptability in Buildings that Reduce Energy by Reducing Minimum Airflow from Overhead Diffusers

General information
State: Published
Organisations: Department of Civil Engineering, Section for Indoor Environment, University of California, Taylor Engineering, Price Industries
Associations between parental reports of doctor-diagnosed asthma and allergy among Danish children and their family habits and dwelling characteristics

General information
State: Published
Organisations: Section for Indoor Environment, Department of Civil Engineering, Odense University Hospital, Aarhus University
Contributors: Toftum, J., Clausen, G., Bekö, G., Callesen, M., Sundell, J., Bornehag, C., Sigsgaard, T., Høst, A.
Pages: Abstract No. 564
Publication date: 2011

Host publication information
Title of host publication: Proceedings of Indoor Air 2011
Keywords: Questionnaires, Epidemiology, Risk factors, Field study
URLs:
http://www.isiaq.org/events/indoor-air-2011
Source: orbit
Source-ID: 313427
Research output: Research - peer-review › Article in proceedings – Annual report year: 2011

Comparison Of Air Change Rates Obtained By Different Ventilation Measurement Techniques In Five Danish Homes.

General information
State: Published
Organisations: Section for Indoor Environment, Department of Civil Engineering, Aalborg University
Contributors: Bekö, G., Gustavsen, S., Frederiksen, M., Kolařík, B., Toftum, J., Clausen, G.
Pages: Abstract No. 602
Publication date: 2011

Host publication information
Title of host publication: Proceedings of Indoor Air 2011
Keywords: Linear regression model, Air change rate, Carbon dioxide, Homes
URLs:
http://www.isiaq.org/events/indoor-air-2011
Source: orbit
Source-ID: 313424
Research output: Research - peer-review › Article in proceedings – Annual report year: 2011

Differences Between Passive And Active Cooling Systems In Gender, Physiological Responses, Thermal Sensation And Productivity
could occur due to application of low energy/exergy cooling systems, on human thermal comfort, physiological responses, and productivity. Furthermore, focus is on the differences between gender. This paper presents preliminary results obtained from experiments with four test subjects. To examine the influence of passive and active cooling systems a climate room setup with experimental subjects is used. Twenty subjects (10 male; 10 female; age: 1830; BMI: 1825) will participate in the experiments. So far, one male subject visited the climate room on six occasions: passive cooling through (1) mixing ventilation (To=26°C), active cooling by convection through (2) mixing and (3) displacement ventilation, active cooling by radiation (4) through the ceiling and mixing ventilation (5) through the floor and mixing ventilation and (6) through the floor and displacement ventilation. Three female subjects visited the climate room on two occasions: (1) and
During the experiments both physiological responses and thermal sensation were measured. To assess the productivity and performance a 'Remote Performance Measurement' (RPM) method was used.

**Implementation of multivariate linear mixed-effects models in the analysis of indoor climate performance experiments**

The aim of the current study was to apply multivariate mixed-effects modeling to analyze experimental data on the relation between air quality and the performance of office work. The method estimates in one step the effect of the exposure on a multi-dimensional response variable, and yields important information on the correlation between the different dimensions of the response variable, which in this study was composed of both subjective perceptions and a two-dimensional performance task outcome. Such correlation is typically not included in the output from univariate analysis methods. Data...
originated from three different series of experiments investigating the effects of air quality on performance. The example analyses resulted in a significant and positive correlation between two performance tasks, indicating that the two tasks to some extent measured the same dimension of mental performance. The analysis seems superior to conventional univariate statistics and the information provided may be important for the design of performance experiments in general and for the conclusions that can be based on such studies.

**General information**

State: Published  
Organisations: DTU Data Analysis, Department of Informatics and Mathematical Modeling, Section for Indoor Environment, Department of Civil Engineering, NIRAS A/S  
Contributors: Jensen, K. L., Spliid, H., Toftum, J.  
Pages: 129-136  
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Peer-reviewed: Yes

**Publication information**

Journal: International Journal of Biometeorology  
Volume: 56  
Issue number: 1  
ISSN (Print): 0020-7128  
Ratings:  
BFI (2018): BFI-level 1  
Web of Science (2018): Indexed yes  
BFI (2017): BFI-level 1  
Scopus rating (2017): CiteScore 2.51 SJR 0.897 SNIP 1.22  
Web of Science (2017): Impact factor 2.577  
Web of Science (2017): Indexed yes  
BFI (2016): BFI-level 1  
Scopus rating (2016): CiteScore 2.25 SJR 0.799 SNIP 1.176  
Web of Science (2016): Impact factor 2.204  
BFI (2015): BFI-level 1  
Scopus rating (2015): CiteScore 1.9 SJR 0.746 SNIP 1.168  
Web of Science (2015): Impact factor 2.309  
BFI (2014): BFI-level 1  
Scopus rating (2014): CiteScore 2.66 SJR 0.838 SNIP 1.47  
Web of Science (2014): Impact factor 3.246  
Web of Science (2014): Indexed yes  
BFI (2013): BFI-level 1  
Scopus rating (2013): CiteScore 2.29 SJR 0.727 SNIP 1.332  
Web of Science (2013): Impact factor 2.104  
ISI indexed (2013): ISI indexed yes  
BFI (2012): BFI-level 1  
Scopus rating (2012): CiteScore 2.26 SJR 0.913 SNIP 1.332  
Web of Science (2012): Impact factor 2.59  
ISI indexed (2012): ISI indexed yes  
BFI (2011): BFI-level 1  
Scopus rating (2011): CiteScore 2.18 SJR 0.763 SNIP 1.347  
Web of Science (2011): Impact factor 2.254  
ISI indexed (2011): ISI indexed yes  
Web of Science (2011): Indexed yes  
BFI (2010): BFI-level 1  
Scopus rating (2010): SJR 0.933 SNIP 1.399  
Web of Science (2010): Impact factor 1.813  
BFI (2009): BFI-level 1  
Scopus rating (2009): SJR 0.919 SNIP 1.263  
BFI (2008): BFI-level 1  
Scopus rating (2008): SJR 0.965 SNIP 1.48
Indeklima i skoler – Status og konsekvenser

General information
State: Published
Organisations: Section for Indoor Environment, Department of Civil Engineering
Contributors: Toftum, J., Wargocki, P., Clausen, G.
Number of pages: 28
Publication date: 2011

Publication information
Publisher: FOA - Fag og arbejde
Original language: Danish
Electronic versions:
prod21325495269795.toftum-2.pdf
Source: orbit
Source-ID: 316350
Research output: Research - peer-review › Report – Annual report year: 2011

Indoor Environment Exposure and Absenteeism in 151 Danish Day-Care Facilities

General information
State: Published
Organisations: Section for Indoor Environment, Department of Civil Engineering, Odense University Hospital, Odense City Government and Administration, Nyborg Town Administration
Contributors: Clausen, G., Gustavsen, S., Buhl, S., Ladegaard, M. B., Callesen, M., Toftum, J.
Pages: 754
Publication date: 2011

Host publication information
Title of host publication: Proceedings of Indoor Air 2011
URLs:
http://lifelong.engr.utexas.edu/2011/
Source: orbit
Source-ID: 316157
Research output: Research - peer-review › Article in proceedings – Annual report year: 2011

Internationale visioner
Lavenergi med omtanke

Modeling of ventilation rates in bedrooms based on building characteristics and occupant behavior
Modeling ventilation rates in bedrooms based on building characteristics and occupant behavior

Air change rate (ACR) data obtained from the bedrooms of 500 Danish children and presented in an earlier paper were analyzed in more detail. Questionnaires distributed to the families, home inspections and interviews with the parents provided information about a broad range of residential characteristics and occupant behavior. These were tested in several linear regression models to identify the degree of effect each selected independent variable has on the total ACR. The measured ACRs are summarized by some of the most significant variables such as room volume (higher ACR in smaller rooms), number of people sleeping in the bedroom (higher ACR with more people), average window and door opening habits (higher ACR with more opening), sharing the bedroom with other family members (higher ACR in shared rooms), location of the measured room (higher ACR above ground floor), year of construction (lowest ACR in buildings from early 1970s), observed condensation on the bedroom window (higher ACR at less condensation), etc. The best-fitting model explained 46% of the variability in the air change rates. Variables related to occupant behavior were stronger predictors of ventilation rate (model R² ¼ 0.30) than those related to building characteristics (model R² ¼ 0.09). Although not perfectly accurate on a room-to-room basis, our best-fitting model may be useful when a rough estimate of the average air change rate for larger study populations is required in future indoor air quality models.

General information
State: Published
Organisations: Section for Indoor Environment, Department of Civil Engineering
Contributors: Bekö, G., Toftum, J., Clausen, G.
Pages: 2230-2237
Publication date: 2011
Peer-reviewed: Yes

Publication information
Journal: Building and Environment
Volume: 46
Issue number: 11
ISSN (Print): 0360-1323
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 5.22 SJR 2.169 SNIP 2.534
Web of Science (2017): Impact factor 4.539
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 4.51 SJR 1.998 SNIP 2.215
Web of Science (2016): Impact factor 4.053
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 4.37 SJR 2.067 SNIP 2.463
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 4.14 SJR 1.887 SNIP 2.742
Web of Science (2014): Impact factor 3.341
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 3.57 SJR 1.547 SNIP 2.551
Web of Science (2013): Impact factor 2.7
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 3.06 SJR 1.293 SNIP 2.857
Web of Science (2012): Impact factor 2.43
Modelling occupants' heating set-point preferences

Discrepancies between simulated and actual occupant behaviour can offset the actual energy consumption by several orders of magnitude compared to simulation results. Thus, there is a need to set up guidelines to increase the reliability of forecasts of environmental conditions and energy consumption. Simultaneous measurement of the set-point of thermostatic radiator valves (trv), and indoor and outdoor environment characteristics was carried out in 15 dwellings in Denmark in 2008. Linear regression was used to infer a model of occupants’ interactions with trvs. This model could easily be implemented in most simulation software packages to increase the validity of the simulation outcomes.

General information
State: Published
Organisations: Section for Indoor Environment, Department of Civil Engineering
Contributors: Andersen, R. V., Olesen, B. W., Toftum, J.
Pages: 1451-1456
Publication date: 2011

Host publication information
Title of host publication: Proceedings of Building Simulation 2011: 12th Conference of International Building Performance Simulation Association
Electronic versions: prod11324288510555.p.pdf
Modelling window opening behaviour in Danish dwellings

In this paper we present and analyse data from two studies of window opening behaviour in residential buildings in Denmark. Based on measurements of indoor environment, weather and window opening behaviour in 15 dwellings, we propose a model that will predict window opening behaviour. The data showed that other factors than thermal effects impact the behaviour of the occupants. Some of these factors were included in the model. We present data from repeated questionnaire surveys that show that occupants tend to adjust heating setpoints, adjust clothing and operate windows when feeling thermally uncomfortable.

General information
State: Published
Organisations: Section for Indoor Environment, Department of Civil Engineering
Contributors: Andersen, R. V., Olesen, B. W., Toftum, J.
Publication date: 2011

Host publication information
Title of host publication: Proceedings of Indoor Air 2011
Keywords: Thermal comfort, Energy, Simulation, Air quality
URLs:
http://www.isiaq.org/events/indoor-air-2011
Source: orbit
Source-ID: 315040
Research output: Research - peer-review › Article in proceedings – Annual report year: 2011

Nicotine in dust samples collected from children’s bedrooms and daycare centers in Denmark

General information
State: Published
Organisations: Section for Indoor Environment, Department of Civil Engineering, University of Gothenburg
Contributors: Weschler, C. J., Langer, S., Fischer, A., Bekö, G., Toftum, J., Clausen, G.
Pages: Abstract No. 326
Publication date: 2011

Host publication information
Title of host publication: Proceedings of Indoor Air 2011
Keywords: Smoking, Cotinine, Exposure, ETS, Changing behaviour
URLs:
http://www.isiaq.org/events/indoor-air-2011
Source: orbit
Source-ID: 313689
Research output: Research - peer-review › Article in proceedings – Annual report year: 2011

Reflections on the State of Research: Indoor Environmental Quality

More than 30 years after the First International Indoor Climate Symposium, ten researchers from the USA, Slovakia, Sweden, and Denmark gathered to review the current status of indoor environmental research. We initiated our review with discussions during the 1-day meeting and followed that with parallel research and writing efforts culminating with internal review and revision cycles. In this paper, we present our choices for the most important research findings on indoor environmental quality from the past three decades followed by a discussion of the most important research questions in our field today. We then continue with a discussion on whether there are research areas for which we can ‘close the book’ and say that we already know what is needed. Finally, we discuss whether we can maintain our identity in the future or it is time to team up with new partners.

General information
State: Published
Organisations: Section for Indoor Environment, Department of Civil Engineering
Contributors: Clausen, G., Bekö, G., Corsi, R., Gunnarsen, L., Nazaroff, W., Olesen, B. W., Sigsgaard, T., Sundell, J., Toftum, J., Weschler, C. J.
Pages: 219-230
Simulation of energy use, human thermal comfort and office work performance in buildings with moderately drifting operative temperatures

Annual primary energy use in a central module of an office building consisting of two offices separated with a corridor was estimated by means of dynamic computer simulations. The simulations were conducted for conventional all-air VAV ventilation system and thermo active building system (TABS) supplemented with CAV ventilation. Simulations comprised moderate, hot–dry and hot–humid climate. Heavy and light wall construction and two orientations of the building (east–west and north–south) were considered. Besides the energy use, also capability of examined systems to keep a certain level of thermal comfort was examined. The results showed that with the moderate climate, the TABS decreased the primary energy use by about 16% as compared with the VAV. With hot–humid climate, the portion of the primary energy saved by TABS was ca. 50% even with the supply air dehumidification taken into account. The TABS working in a moderate climate kept the predicted percentage of dissatisfied (PPD) 10%; 1.4% in comparison to 17.5% h/yr. The highest estimated loss of occupants' productivity related to their thermal sensation hasn’t exceeded 1% in whole year average.
Scopus rating (2013): CiteScore 3.79 SJR 1.852 SNIP 2.404
Web of Science (2013): Impact factor 2.465
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): CiteScore 3.36 SJR 1.745 SNIP 2.696
Web of Science (2012): Impact factor 2.679
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): CiteScore 3.23 SJR 1.476 SNIP 2.531
Web of Science (2011): Impact factor 2.386
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 1.626 SNIP 2.08
Web of Science (2010): Impact factor 2.046
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 2
Scopus rating (2009): SJR 1.533 SNIP 1.811
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 1.681 SNIP 2.055
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 1.077 SNIP 1.702
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 1.382 SNIP 1.764
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 1.292 SNIP 1.352
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 0.854 SNIP 1.674
Web of Science (2004): Indexed yes
Scopus rating (2003): SJR 1.504 SNIP 1.387
Scopus rating (2002): SJR 1.189 SNIP 1.671
Web of Science (2002): Indexed yes
Scopus rating (2001): SJR 0.972 SNIP 1.082
Scopus rating (2000): SJR 0.243 SNIP 1.235
Web of Science (2000): Indexed yes
Scopus rating (1999): SJR 0.241 SNIP 0.669
Original language: English
Keywords: Work performance, Building simulation, Drifting temperature
Electronic versions:
Simulation of Energy.pdf
DOIs:
10.1016/j.enbuild.2011.07.008
Source: orbit
Source-ID: 285082
Research output: Research - peer-review › Journal article – Annual report year: 2011

Simulering af indeklima og energiforbrug i lavenergibyggeri

General information
State: Published
Organisations: Section for Indoor Environment, Department of Civil Engineering
Contributors: Toftum, J.
Squalene and cholesterol in dust from Danish homes and daycare centers

Given the rate at which humans shed their skin (desquamation), skin flakes that contain squalene and cholesterol are anticipated to be major constituents of indoor dust. These compounds have been detected in more than 97% of the dust samples collected from 500 bedrooms and 151 daycare centers of young children living in Odense, Denmark. The mass fractions of squalene in dust were approximately log-normally distributed (homes: GM = 32 μg/g, GSD = 4.3; daycare centers: GM = 11.5 μg/g, GSD = 4.3); those of cholesterol displayed a poorer fit to such a distribution (homes: GM = 625 μg/g, GSD = 3.4; daycare centers: GM = 220 μg/g, GSD = 4.0). Correlations between squalene and cholesterol were weak (r = 0.22). Furthermore, the median squalene-to-cholesterol ratio in dust (0.05) was more than an order of magnitude smaller than that in skin oil. This implies sources in addition to desquamation (e.g., cholesterol from cooking) coupled, perhaps, with a shorter indoor lifetime for squalene. Estimated values of squalene’s vapor pressure, while uncertain, suggest meaningful redistribution from dust to other indoor compartments. We estimate that dust containing squalene at 60 μg/g would contribute about 4% to overall ozone removal by indoor surfaces. This is roughly comparable to the fraction of ozone removal that can be ascribed to reactions with indoor terpenes. Squalene containing dust is anticipated to contribute to the scavenging of ozone in all settings occupied by humans.
Squalene and cholesterol in dust samples collected from children’s bedrooms and daycare centers in Denmark

General information
State: Published
Organisations: Section for Indoor Environment, Department of Civil Engineering, University of Gothenburg
Contributors: Weschler, C. J., Langer, S., Fischer, A., Bekö, G., Toftum, J., Clausen, G.
Pages: Abstract No. 413
Publication date: 2011

Host publication information
Title of host publication: Proceedings of Indoor Air 2011
Keywords: Stratum corneum, Skin surface lipids, Cooking, Ozonolysis, Desquamation
URLs:
http://www.isiaq.org/events/indoor-air-2011
Source: orbit
Source-ID: 313705
Research output: Research - peer-review › Article in proceedings – Annual report year: 2011

Stor dansk delegation til Indoor Air 2011

General information
State: Published
Organisations: Section for Indoor Environment, Department of Civil Engineering
Contributors: Toftum, J.
Pages: 24-26
Publication date: 2011
Peer-reviewed: Unknown

Publication information
Journal: H V A C Magasinet
Issue number: 9
ISSN (Print): 1603-6913
Ratings:
ISI indexed (2013): ISI indexed no
ISI indexed (2012): ISI indexed no
ISI indexed (2011): ISI indexed no
Original language: English
Electronic versions:
Indoor Air 2011.pdf
URLs:
http://techmedia.swiflet.com/tm/hvac/59/1/
Source: orbit
Source-ID: 316393
Research output: Communication › Journal article – Annual report year: 2011

Air pollution from residential wood combustion in a Danish village: Indoor-outdoor measurements

General information
State: Published
Organisations: Section for Indoor Environment, Department of Civil Engineering
Contributors: Toftum, J.
Publication date: 2010

Publication information
Original language: English
Electronic versions:
Indoor_outdoor.pdf
Source: orbit
Central automatic control or distributed occupant control for better indoor environment quality in the future

Based on a database accumulated from several recent surveys of office buildings located in a temperate climate (Denmark), the effect on occupant perceptions and symptom prevalence was compared in buildings with natural and with mechanical ventilation in which earlier studies have shown a discrepancy in the degree of perceived control. The database was composed of 1272 responses obtained in 24 buildings of which 15 had mechanical ventilation (997 responses) and 9 had natural ventilation (275 responses). The number of occupant-reported control opportunities was higher in buildings with natural ventilation. Analysis of occupant responses, after grouping according to categories determined by the degree of satisfaction with the perceived control, showed that it was more likely the degree of control satisfaction that affected the prevalence of adverse perceptions and symptoms. Thus, the degree of control, as perceived by occupants, seemed more important for the prevalence of adverse symptoms and building-related symptoms than the ventilation mode per se. This result indicates that even though the development and application of new indoor environment sensors and HVAC control systems may allow for fully automated IEQ control, such systems should not compromise occupants’ perception of having some degree of control of their indoor environment.

General information
State: Published
Organisations: Section for Indoor Environment, Department of Civil Engineering
Contributors: Toftum, J.
Pages: 23-28
Publication date: 2010
Peer-reviewed: Yes

Publication information
Journal: Building and Environment
Volume: 45
Issue number: 1
ISSN (Print): 0360-1323
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 5.22 SJR 2.169 SNIP 2.534
Web of Science (2017): Impact factor 4.539
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 4.51 SJR 1.998 SNIP 2.215
Web of Science (2016): Impact factor 4.053
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 4.37 SJR 2.067 SNIP 2.463
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 4.14 SJR 1.887 SNIP 2.742
Web of Science (2014): Impact factor 3.341
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 3.57 SJR 1.547 SNIP 2.551
Web of Science (2013): Impact factor 2.7
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 3.06 SJR 1.293 SNIP 2.857
Web of Science (2012): Impact factor 2.43
ISI indexed (2012): ISI indexed yes
Characterization and optimized control by means of multi-parameter controllers

General information
State: Published
Organisations: Mathematical Statistics, Department of Informatics and Mathematical Modeling, Section for Indoor Environment, Department of Civil Engineering, Danish Technological Institute, Businessminds
Number of pages: 276
Publication date: 2010

Publication information
Place of publication: Danish Technological Institute
ISBN (Print): 87-7756-772-2
Original language: English
Source: orbit
Source-ID: 241034
Research output: Research - peer-review › Journal article – Annual report year: 2010

Classroom ventilation must be improved for better health and learning

General information
Differences between young adults and elderly in thermal comfort, productivity and thermal physiology in response to a moderate temperature drift

Results from naturally ventilated buildings show that allowing the indoor temperature to drift does not necessarily result in thermal discomfort and may allow for a reduction in energy use. However, for stationary conditions, several studies indicate that the thermal neutral temperature and optimum thermal condition differ between young adults and elderly. There is a lack of studies that describe the effect of aging on thermal comfort and productivity during a moderate temperature drift. In this study, the effect of a moderate temperature drift on physiological responses, thermal comfort, and productivity of eight young adults (age 22–25 year) and eight older subjects (age 67–73 year) was investigated. They were exposed to two different conditions: S1-a control condition; constant temperature of 21.5°C; duration: 8 h; and S2-a transient condition; temperature range: 17–25°C, duration: 8 h, temperature drift: first 4 h: +2 K/h, last 4 h: −2 K/h. The results indicate that thermal sensation of the elderly was, in general, 0.5 scale units lower in comparison with their younger counterparts. Furthermore, the elderly showed more distal vasoconstriction during both conditions. Nevertheless, TS of the elderly was related to air temperature only, while TS of the younger adults also was related to skin temperature. During the constant temperature session, the elderly preferred a higher temperature in comparison with the young adults.
Indeklima i danske boliger og børneinstitutioner

**General information**

State: Published
Organisations: Section for Indoor Environment, Department of Civil Engineering
Contributors: Toftum, J., Bekö, G., Clausen, G.
Pages: 32-34
Publication date: 2010
Peer-reviewed: Unknown

**Publication information**

Journal: H V A C Magasinet
Volume: 46
Influence on Occupant Responses of Behavioral Modification of Clothing Insulation in Nonsteady Thermal Environments (RP-1269)

This paper presents climate chamber experiment results in which subjects were exposed to increasing and decreasing dynamic temperature drifts while being allowed to adjust their clothing insulation as desired. The objective of the study was to substantiate the scientific basis of the recommendations on drifting temperatures as stated in ASHRAE Standard
55-2004, Thermal Environmental Conditions for Human Occupancy (ASHRAE 2004) and to extend the scope of the recommendations to cover not only thermal comfort, but also the perception of air quality, health, and performance. The experiments addressed both the summer and winter comfort ranges of temperature, and subjects were exposed to rates of temperature change of -1.2 K/h (-2.2 degrees F/h), 0 K/h (0 degrees F/h), 1.2 K/h (2.2 degrees F/h), and 2.4 K/h (4.3 degrees F/h). Exposure duration was 4 h, except for the 2.4 K/h (4.3 degrees F/h) condition when it was 2 h. Thermal sensation responses observed with adjustable clothing insulation did not differ from those observed with fixed clothing insulation, which were reported in an earlier paper. However, with fixed clothing insulation, longer exposures (>4 h) seemed to aggravate general sick-building syndrome (SBS) symptoms, an effect that was not observed with adjustable clothing insulation. In addition, the study did not detect any systematic influence on the performance of operative temperature ramps, regardless of the clothing adjustment opportunity. Although the current study focused on thermal comfort and SBS symptoms and performance, the recommendations on drifting temperatures, as stated in ASHRAE Standard 55 (ASHRAE 2004), were generally verified. But, longer exposures to increasing temperatures may increase the intensity of general SBS symptoms when no opportunity to adjust clothing insulation is available.

General information
State: Published
Organisations: Section for Indoor Environment, Department of Civil Engineering
Contributors: Toftum, J., Kolarik, J., Belkowska, D., Olesen, B. W.
Pages: 59-74
Publication date: 2010
Peer-reviewed: Yes

Publication information
Journal: HVAC & R Research
Volume: 16
Issue number: 1
ISSN (Print): 2374-4731
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 1.05
Web of Science (2017): Impact factor 1.183
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 1.01
Web of Science (2016): Impact factor 0.88
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Web of Science (2015): Impact factor
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 0.514 SNIP 0.731
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 0.561 SNIP 0.891
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 0.544 SNIP 1.104
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 0.498 SNIP 0.742
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 0.93 SNIP 0.956
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Komfort, symptomer og præstation med varierende temperaturer

General information
State: Published
Organisations: Section for Indoor Environment, Department of Civil Engineering
Contributors: Toftum, J., Kolarik, J., Olesen, B. W.
Pages: 36-37
Publication date: 2010
Peer-reviewed: Unknown

Publication information
Journal: H V A C Magasinet
Issue number: 6
ISSN (Print): 1603-6913
Ratings:
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ISI indexed (2011): ISI indexed no
Original language: English
Source: orbit
Source-ID: 262952
Research output: Research - peer-review › Journal article – Annual report year: 2010

Ny REHVA anvisning om skolers indeklima og energieffektivitet

General information
State: Published
Organisations: Section for Indoor Environment, Department of Civil Engineering
Contributors: Toftum, J.
Pages: 10-11
Publication date: 2010
Peer-reviewed: Unknown

Publication information
Journal: H V A C Magasinet
Phthalate and PAH concentrations in dust collected from Danish homes and daycare centers

As part of the Danish Indoor Environment and Children's Health (IECH) study, dust samples were collected from 500 bedrooms and 151 daycare centers of children (ages 3 to 5) living on the island of Fyn. The present paper reports results from the analyses of these samples for five phthalate esters (diethyl phthalate (DEP), di(n-butyl) phthalate (DnBP), di(isobutyl) phthalate (DiBP), butyl benzyl phthalate (BBzP), di(2-ethylhexyl) phthalate (DEHP)) and three PAHs (pyrene, benz[a]anthracene (B[a]A) and benzo[a]pyrene (B[a]P)). The three PAHs and DEHP were detected in dust samples from all sites, while DEP, DnBP, DiBP and BBzP were detected in more than 75% of the bedrooms and more than 90% of the daycare centers. The dust mass-fractions of both phthalates and PAHs were log-normally distributed. With the exception of DEP, the mass-fractions of phthalates in dust were higher in daycare centers than homes: PAH mass-fractions in dust were similar in the two locations. There was no correlation among the different phthalates in either homes or daycare centers. In contrast, the PAH were correlated with one another more strongly so in homes (R² = 0.80-0.90) than in daycare centers (R² = 0.28-0.45). The dust levels of several phthalates (BBzP, DnBP and DEHP) were substantially lower than those measured in a comparable study conducted 6-7 years earlier in Sweden. Although usage patterns in Denmark differ from those in Sweden, the current results may also reflect a change in the plasticizers that are used in common products including toys. PAH levels were roughly an order of magnitude lower than those measured in Berlin and Cape Cod residences, suggesting that the Danish sites are less impacted by motor vehicle emissions.
Ventilation rates in the bedrooms of 500 Danish children

The ongoing "Indoor Environment and Children's Health" (IECH) study investigates the environmental risk factors in homes and their association with asthma and allergy among children aged 1-5 years. As part of the study, the homes of 500 children between 3 and 5 years of age were inspected. The selected children included 200 symptomatic children (cases) and 300 randomly selected children (bases). As part of the inspection, the concentration of carbon dioxide in the bedrooms of the children was continuously measured over an average of 2.5 days. The ventilation rates in the rooms...
during the nights when the children were sleeping in the room were calculated using a single-zone mass balance for the occupant-generated CO2. The calculated air change rates were log-normally distributed (R-2 > 0.98). The geometric mean of the air change rates in both the case and the base group was 0.46 air changes per hour (h\(^{-1}\); geom. SD = 2.08 and 2.13, respectively). Approximately 57% of both cases and bases slept at a lower ventilation rate than the minimum required ventilation rate of 0.5 h\(^{-1}\) in new Danish dwellings. Only 32% of the bedrooms had an average CO2 concentration below 1000 ppm during the measured nights. Twenty-three percent of the rooms experienced at least a 20-minute period during the night when the CO2 concentration was above 2000 ppm and 6% of the rooms experienced concentrations above 3000 ppm. The average air change rate was higher with more people sleeping in the room. The air change rate did not change with the increasing outdoor temperature over the 10-week experimental period. The calculation method provides an estimate of the total airflow into the bedroom, including airflows both from outdoors and from adjacent spaces. To study the accuracy of the calculated air change rates and their deviation from the true outside air change rates, we calculated CO2 concentrations at different given air change rates using an indoor air quality and ventilation model (Contam). Subsequently we applied our calculation procedure to the obtained data. The air change rate calculated from the generated CO2 concentrations was found to be between 0% and 51% lower than the total air change rate defined in the input variables for the model. It was, however, higher than the true outside air change rate. The relative error depended on the position of the room in relation to the adjacent rooms, occupancy in the adjacent room, the nominal air change rate and room-to-room airflows.

**General information**

State: Published
Organisations: Section for Indoor Environment, Department of Civil Engineering, Manufacturing Engineering, Department of Mechanical Engineering
Contributors: Bekö, G., Lund, T., Nors, F., Toftum, J., Clausen, G.
Pages: 2289-2295
Publication date: 2010
Peer-reviewed: Yes

**Publication information**
Journal: Building and Environment
Volume: 45
Issue number: 10
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Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 5.22 SJR 2.169 SNIP 2.534
Web of Science (2017): Impact factor 4.539
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 4.51 SJR 1.998 SNIP 2.215
Web of Science (2016): Impact factor 4.053
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 4.37 SJR 2.067 SNIP 2.463
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 4.14 SJR 1.887 SNIP 2.742
Web of Science (2014): Impact factor 3.341
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 3.57 SJR 1.547 SNIP 2.551
Web of Science (2013): Impact factor 2.7
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 3.06 SJR 1.293 SNIP 2.857
Web of Science (2012): Impact factor 2.43
ISI indexed (2012): ISI indexed yes
A large proportion of the world’s energy consumption is spent in an effort to maintain a comfortable and healthy indoor environment. As a consequence reductions in the energy consumed to climatise buildings are instrumental to the efforts of reducing energy related CO2 emissions and alleviating the European energy import dependencies. Whole building simulations of indoor environment and energy consumption are becoming more and more used in the design phase of buildings. Previously the simulation of physical factors such as transmission and ventilation heat losses has received a lot of attention. As a consequence, most programs are capable of accurate simulations of the physical properties of a building. However, even though the occupants’ control of the various systems in the building has a significant impact on the energy consumption and the indoor environment, only few studies have focused on the behaviour of their occupants. As a consequence, there is a need to investigate occupants’ interactions with building controls, such as opening of windows, adjustments of heating set-points, use of solar shading, etc. Some models of occupants’ interactions with operable windows do exist, but these are based on measurements in offices, and they only take thermal comfort into account. The work described in this thesis mainly focused on the window opening and heating behaviour of occupants in Danish dwellings. Also the use of solar shading and artificial lighting has received some attention. The control related behaviour of occupants was found to have a substantial impact on the energy performance of a building. This becomes increasingly important in buildings designed using the adaptive model of thermal comfort, where occupants are encouraged to interact with building controls. It was found that determination of acceptable thermal conditions with the adaptive model may result in significant energy savings and at the same time will not have large consequences for the mental performance of the occupants. Large differences in the behaviour patterns of occupants were found between dwellings. The time of day had a great effect on the behaviour patterns in the investigated dwellings. This effect was significant at similar environmental conditions, suggesting that environmental variables alone can not explain all the variance in the observed behaviour. The results showed that the behaviour of the occupants was driven by a variety of
variables, including thermal comfort, perception of air quality and other IEQ variables, weather and physical aspects of the dwelling. Based on observation of real behaviour, a definition of occupant behaviour patterns in building simulation programs was proposed. The proposed model was implemented into the simulation environment IDA ICE and compared to a reference simulation, which emulated a simulation as it could have been performed by a designer. There were large differences in the simulated indoor environment between the two simulations, which resulted in considerably lower energy consumption in the reference simulation. Since the definition is based on observation of real behaviour, it will significantly increase the validity of the simulation result and ensure that the results are closer to reality, when implemented into simulation programs. Furthermore, it will enable designers to better assess the effects of the occupant’s behaviour and thereby the effects of different designs.

**General information**
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Organisations: Section for Indoor Environment, Department of Civil Engineering
Contributors: Andersen, R. V., Olesen, B. W., Toftum, J.
Number of pages: 104
Publication date: Sep 2009

**Publication information**
Place of publication: Kgs. Lyngby, Denmark
Publisher: Technical University of Denmark (DTU)
Original language: English
Electronic versions:
Thesis with papers - RVA.pdf
Source: orbit
Source-ID: 255801
Research output: Research › Ph.D. thesis – Annual report year: 2009

**A Bayesian Network approach to the evaluation of building design and its consequences for employee performance and operational costs**

A Bayesian Network approach has been developed that can compare different building designs by estimating the effects of the thermal indoor environment on the mental performance of office workers. A part of this network is based on the compilation of subjective thermal sensation data and the associated objective thermal measurements from 12,000 office occupants from different parts of the world. A Performance Index (P) is introduced that can be used to compare directly the different building designs and furthermore to assess the total economic consequences of the indoor climate with a specific building design. In this paper, focus will be on the effects of temperature on mental performance and not on other indoor climate factors. A total economic comparison of six different building designs, four located in northern Europe and two in Los Angeles, USA, was performed. The results indicate that investments in improved indoor thermal conditions can be justified economically in most cases. The Bayesian Network provides a reliable platform using probabilities for modelling the complexity while estimating the effect of indoor climate factors on human beings, due to the different ways in which humans are affected by the indoor climate.

**General information**
State: Published
Organisations: Section for Indoor Environment, Department of Civil Engineering, Coastal, Maritime and Structural Engineering, Department of Mechanical Engineering
Contributors: Jensen, K. L., Toftum, J., Friis-Hansen, P.
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Peer-reviewed: Yes

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Journal: Building and Environment
Volume: 44
Issue number: 3
ISSN (Print): 0360-1323
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BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 5.22 SJR 2.169 SNIP 2.534
Web of Science (2017): Impact factor 4.539
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
A case-base study of residential IEQ related risk factors and parental reports of asthma and allergy among 500 Danish children – IECH

General information
State: Published
Organisations: Section for Indoor Environment, Department of Civil Engineering, Center for Microbial Biotechnology, Department of Systems Biology, BioChemical Engineering
Contributors: Toftum, J., Clausen, G., Callesen, M., Bekö, G., Weschler, C. J., Langer, S., Andersen, B., Høst, A.
Pages: 617
Publication date: 2009

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Title of host publication: Proceedings of Healthy Buildings
Source: orbit
Source-ID: 256083
Research output: Research - peer-review › Article in proceedings – Annual report year: 2009

A questionnaire survey on dwelling characteristics and the prevalence of asthma and allergy among Danish children – IECH

General information
State: Published
Organisations: Section for Indoor Environment, Department of Civil Engineering
Contributors: Toftum, J., Clausen, G., Bekö, G., Callesen, M., Sundell, J., Bornehag, C., Høst, A.
Pages: 613
Publication date: 2009

Host publication information
Title of host publication: Proc. of Healthy Buildings 2009
Source: orbit
Source-ID: 256084
Research output: Research - peer-review › Article in proceedings – Annual report year: 2009

Carbon dioxide concentrations and ventilation rates in 500 Danish homes: Indoor Environment and Children's Health (IECH) study

General information
State: Published
Organisations: Section for Indoor Environment, Department of Civil Engineering, Technical University of Denmark
Contributors: Bekö, G., Nors, F., Toftum, J., Clausen, G.
Publication date: 2009

Host publication information
Title of host publication: Proceedings of Healthy Buildings 2009
Volume: CD, paper No.: 383
Source: orbit
Source-ID: 253851
Research output: Research - peer-review › Article in proceedings – Annual report year: 2009

Glem aldrig brugeren

General information
State: Published
Organisations: Section for Indoor Environment, Department of Civil Engineering
Contributors: Toftum, J.
Pages: 6
Publication date: 2009
Peer-reviewed: Unknown
Healthy Buildings 2009

General information
State: Published
Organisations: Section for Indoor Environment, Department of Civil Engineering
Contributors: Toftum, J.
Pages: 8
Publication date: 2009
Peer-reviewed: Unknown

Indoor Environment and Children's Health (IECH) – An ongoing epidemiological investigation on the association between indoor environmental factors in homes and kindergartens and children's health and wellbeing

General information
State: Published
Organisations: Section for Indoor Environment, Department of Civil Engineering, Center for Microbial Biotechnology, Department of Systems Biology
Pages: 603
Publication date: 2009

Host publication information
Title of host publication: Proceedings of Healthy Buildings 2009
Place of publication: Syracuse
Source: orbit
Source-ID: 256075
Research output: Research - peer-review » Article in proceedings – Annual report year: 2009

Indoor environment and children's health in 151 Danish kindergartens

General information
State: Published
Organisations: Section for Indoor Environment, Department of Civil Engineering
Contributors: Clausen, G., Nors, F., Nielsen, T., Buhl, S., Ladegaard, M. B., Callesen, M., Toftum, J.
Pages: 619
Publication date: 2009
Influence on occupant responses of behavioral modification of clothing insulation in non-steady thermal environments

**General information**

**State:** Published

**Organisations:** Section for Indoor Environment, Department of Civil Engineering

**Contributors:** Toftum, J., Kolarik, J., Belkowska, D., Olesen, B. W.

**Pages:** 164

**Publication date:** 2009

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Long term monitoring of window opening behaviour in Danish dwellings

**ABSTRACT:** During the first eight months of 2008, measurements of occupant behaviour and eight environmental variables was carried out in 15 dwellings. Logistical regression was applied to infer the probability of open window as a function of the outdoor temperature. The results were compared with the findings in the literature. The measured variables just prior to an opening/closing event were compared to variables where no events occurred. Indoor air quality and solar radiation where found to be the main drivers in the occupants’ determination of when to open a window. The indoor air quality and outdoor temperature affected when the window was closed and finally the time of day had an impact on the window opening behaviour of the occupants.

**General information**

**State:** Published

**Organisations:** Section for Indoor Environment, Department of Civil Engineering

**Contributors:** Andersen, R. V., Toftum, J., Olesen, B. W.

**Pages:** 490-494

**Publication date:** 2009

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Occupant performance and building energy consumption with different philosophies of determining acceptable thermal conditions

Based on building energy and indoor environment simulations, this study uses a recently developed method relying on Bayesian Network theory to estimate and compare the consequences for occupant performance and energy consumption of applying temperature criteria set according to the adaptive model of thermal comfort and the more conventional PMV model. Simulations were carried out for an example building with two configurations (with and without mechanical cooling) located in tropical, subtropical, and temperate climate regions. Even though indoor temperatures differed significantly between building configurations, especially in the tropical climate, the estimated performance differed only modestly between configurations. However, energy consumption was always lower in buildings without mechanical cooling, particularly so in the tropical climate. The findings indicate that determining acceptable indoor thermal environments with the adaptive comfort model may result in significant energy savings and at the same time will not have large consequences for the mental performance of occupants.

**General information**

**State:** Published
Occupant Responses and Office Work Performance in Environments with Moderately Drifting Operative Temperatures (RP-1269)

Fifty-two experimental subjects (50% female) were seated in a climate chamber and exposed to operative temperature ramps with different slopes, directions, and durations during two related experiments. The first experiment covered a temperature range of 22°C–26.8°C (71.6°F–80.2°F) and subjects wore light clothing (0.5 clo). The operative temperature was increased in rates of 0.6 K/h (1.1°F/h) (for 8 h), 1.2 K/h (2.2°F/h) (for 4 h), 2.4 K/h (4.3°F/h) (for 2 h), and 4.8 K/h (8.6°F/h) (for 1 h), respectively. In one session, subjects were exposed to a constant temperature of 24.4°C (75.9°F) (for 4 h). The second experiment covered a temperature range of 17.8°C–25°C (64°F–77°F), and subjects wore heavier clothing (0.7 clo). Temperature ramps of 0.6 K/h (1.1°F/h) (for 8 h), 1.2 K/h (2.2°F/h) (for 6 h), 0.6 K/h (−1.1°F/h) (for 8 h), and −1.2 K/h (−2.2°F/h) (for 6 h) were examined. Subjects assessed their thermal sensation, acceptability of the thermal environment, perceived air quality, and intensity of sick building syndrome (SBS) symptoms. Subjects’ performance was measured by simulated office work, including tasks such as addition, proofreading, reading and comprehension, and text typing. Results of the experiments showed that even moderately changing operative temperature ramps were sensed by sedentary subjects when exposure times exceeded 4 h. No significant effects on SBS symptoms related to local irritation of mucous membranes were found, while intensity of headache, concentration ability, and general well-being were significantly affected in most of the ramps. Linear dependence of perceived air quality on operative temperature was noted. No significantly consistent effects of individual temperature ramps on office work performance were found.

General information
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Organisations: Section for Indoor Environment, Department of Civil Engineering, Technion-Israel Institute of Technology
Contributors: Kolarik, J., Toftum, J., Olesen, B. W., Shitzer, A.
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Peer-reviewed: Yes

Publication information
Journal: HVAC & R Research
Volume: 15
Issue number: 5
ISSN (Print): 2374-4731
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 1.05
Web of Science (2017): Impact factor 1.183
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Simulated performance of the Thermo Active Building System (TABS) with respect to the provided thermal comfort and primary energy use

The central module of an office building conditioned by a Thermo Active Building System (TABS) coupled with constant volume ventilation was evaluated by means of dynamic computer simulations. Additionally, the same building model was simulated with a conventional all air VAV ventilation system for comparison. The results showed that with the moderate climate, the TABS decreased the primary energy use by about 16% as compared with the VAV. With hot-humid climate, the portion of the primary energy saved by TABS was ca. 50% even with the supply air dehumidification taken into
account. The TABS working in a moderate climate kept the Predicted Percentage of Dissatisfied (PPD) 10%; 1.4% in comparison to 17.5% hours/year.

**General information**
State: Published
Organisations: Section for Indoor Environment, Department of Civil Engineering
Contributors: Kolarik, J., Olesen, B. W., Toftum, J.
Publication date: 2009

**Host publication information**
Title of host publication: Proceedings of Healthy Buildings 2009
Volume: CD, paper No.: 309
Keywords: Thermo Active Building System, Energy Consumption, Thermal Comfort
Source: orbit
Source-ID: 255535
Research output: Research - peer-review › Article in proceedings – Annual report year: 2009

**Simulation of the effects of window opening and heating set-point behaviour on indoor climate and building energy performance**
Simultaneous measurement of occupant behaviour, indoor and outdoor environment was carried out in 15 dwellings in Denmark during the period from January to August 2008. Based on the measurements occupant behavioural patterns were defined and implemented in the building simulation program IDA ICE. A case and a reference simulation were carried out. In the case, the behaviour patterns derived from the measurements were used while the reference used simulated behaviour patterns defined like they might have been by a consultant engineer. The simulated behaviour patterns resulted in large differences in indoor environmental variables between the two simulations. The heat consumption was more than three times as high in the case as in the reference simulation. This underlines the importance of considering the behaviour of the occupants in the design process of buildings.

**General information**
State: Published
Organisations: Section for Indoor Environment, Department of Civil Engineering
Contributors: Andersen, R. V., Toftum, J., Olesen, B. W.
Pages: 610
Publication date: 2009

**Host publication information**
Title of host publication: Proceedings of the 9th international conference - Healthy Buildings 2009
Keywords: Occupant behaviour, Energy, Simulation, Window opening, heating set-point
Electronic versions:
HB2009_Full_Paper 2.pdf
Source: orbit
Source-ID: 255797
Research output: Research - peer-review › Article in proceedings – Annual report year: 2009

**Skolerne igen, igen**

**General information**
State: Published
Organisations: Section for Indoor Environment, Department of Civil Engineering
Contributors: Toftum, J.
Pages: 6
Publication date: 2009
Peer-reviewed: Unknown

**Publication information**
Journal: H V A C Magasinet
Volume: 12
ISSN (Print): 1603-6913
Ratings:
ISI indexed (2013): ISI indexed no
ISI indexed (2012): ISI indexed no
ISI indexed (2011): ISI indexed no
Original language: Danish
Source: orbit
Survey of occupant behaviour and control of indoor environment in Danish dwellings

Repeated surveys of occupant control of the indoor environment were carried out in Danish dwellings from September to October 2006 and again from February to March 2007. The summer survey comprised 933 respondents and the winter survey 636 respondents. The surveys were carried out by sending out invitations to addresses obtained from a Danish register along with information on dwelling characteristics. Meteorological data was obtained from the Danish Meteorological Institute. Four control mechanisms (window open/closed, heating on/off, lighting on/off and solar shading in/ not in use) were analysed separately by means of multiple logistic regression in order to quantify factors influencing occupants’ behaviour. The window opening behaviour was strongly related to the outdoor temperature. The perception of the environment and factors concerning the dwelling also impacted the window opening behaviour. The proportion of dwellings with the heating turned on was strongly related to the outdoor temperature and the presence of a wood burning stove. The solar radiation, dwelling ownership conditions and the perception of the indoor environment also affected the use of heating. The results of the statistical analyses form a basis for a definition of standard behaviour patterns which can be used to make calculation of energy consumption of buildings more accurate.

General information
State: Published
Organisations: Section for Indoor Environment, Department of Civil Engineering, Mathematical Statistics, Department of Informatics and Mathematical Modeling
Contributors: Andersen, R. V., Toftum, J., Andersen, K. K., Olesen, B. W.
Pages: 11-16
Publication date: 2009
Peer-reviewed: Yes

Publication information
Journal: Energy and Buildings
Volume: 41
Issue number: 1
ISSN (Print): 0378-7788
Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 4.96 SJR 2.061 SNIP 2.12
Web of Science (2017): Impact factor 4.457
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 4.64 SJR 2.055 SNIP 1.968
Web of Science (2016): Impact factor 4.067
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 4.07 SJR 2.04 SNIP 2.146
Web of Science (2015): Impact factor 2.973
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 4.21 SJR 2.079 SNIP 2.875
Web of Science (2014): Impact factor 2.884
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): CiteScore 3.79 SJR 1.852 SNIP 2.404
Web of Science (2013): Impact factor 2.465
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): CiteScore 3.36 SJR 1.745 SNIP 2.696
Web of Science (2012): Impact factor 2.679
ISI indexed (2012): ISI indexed yes
Thermal comfort, physiological responses and performance of elderly during exposure to a moderate temperature drift

General information
State: Published
Organisations: Section for Indoor Environment, Department of Civil Engineering, Eindhoven University of Technology
Contributors: Schellen, L., Toftum, J.
Pages: 249
Publication date: 2009

Host publication information
Title of host publication: Proc. of Healthy Buildings 2009
Source: orbit
Source-ID: 232072
Research output: Research - peer-review › Journal article – Annual report year: 2009

Central automatic control or distributed occupant control for better indoor environment quality in the future
Based on a database accumulated from several recent surveys of office buildings located in a temperate climate (Denmark), the effect on occupant perceptions and symptom prevalence was compared in buildings with natural and
mechanical ventilation in which earlier studies have shown a discrepancy in the degree of perceived control. The database was composed of 1353 responses obtained in 25 buildings of which 15 had mechanical ventilation (997 responses) and 9 had natural ventilation (275 responses). Analysis of occupant responses, after grouping according to categories determined by the degree of satisfaction with the perceived control, showed that the degree of control satisfaction, but rarely building category (natural vs. mechanical ventilation), affected the prevalence of adverse perceptions and symptoms. Thus, the degree of control, as perceived by occupants, was more important for the prevalence of adverse symptoms and building related symptoms than the ventilation mode per se. This result indicates that even though the development and application of new indoor environment sensors and HVAC control systems may allow for fully automated IEQ control, such systems should not compromise occupants’ perception of having some degree of control of their indoor environment.

**General information**
State: Published
Organisations: Department of Civil Engineering, Section for Indoor Environment
Contributors: Toftum, J.
Number of pages: 216
Pages: 72-88
Publication date: 2008

**Host publication information**
Title of host publication: Proc. of International Symposium on the Interaction between human and Building Environment
Place of publication: Yonsei University, Seoul, Korea
Publisher: Human and Building Environment Laboratory, Yonsei University
Source: orbit
Source-ID: 232867
Research output: Research - peer-review › Article in proceedings – Annual report year: 2008

Human subjects’ perception of indoor environment and their office work performance during exposures to moderate operative temperature ramps

The objective of the presented research work was to study the effects of moderate operative temperature drifts on human thermal comfort, perceived air quality, intensity of SBS symptoms and office work performance. Experimental subjects (52, 50% female) were seated in a climatic chamber and exposed to operative temperature ramps (±0.6 K/h, ±1.2 K/h, +2.4 K/h, +4.8 K/h) of different direction and duration. The studied temperature ranges were 22-26.8°C (light clothing - 0.5 clo) and 17.8-25°C (heavier clothing - 0.7 clo). Exposure to steady temperatures (24.4, 21.4°C) corresponding to a neutral thermal sensation was also included. Subjects filled out questionnaires regarding perception of the environment and intensity of SBS symptoms. Subjects performed simulated office tasks (addition, text typing, proof reading, comprehension and reasoning). Results showed that all tested ramps were recognized by sedentary subjects when the exposure time exceeded four hours. No significant effect on SBS symptoms related to local irritation of mucous membranes was found, while intensity of headache, well feeling and concentration ability was significantly higher at the end of the exposure to the temperature ramps. A linear relation between perceived air quality and temperature (enthalpy) was found. No significant consistent effect of individual temperature ramps on office work performance was found. Increasing operative temperature...
appeared to slightly decrease speed of addition and text typing regardless the slope of the ramp, when compared to constant temperature condition. With respect to mentioned results it can be recommended to avoid ramp with slopes equal or above 1.1ºC/0.25h. Spaces where temperature ramps occur should be properly ventilated to avoid further increase of SBS symptoms caused by aggravation of perceived air quality. Increasing temperature may negatively influence speed of simple, repetitive tasks of mental work. The significant effect on complex tasks that require concentration, vigilance and logical thinking was not found.

General information
State: Published
Organisations: Section for Indoor Environment, Department of Civil Engineering, Technion-Israel Institute of Technology
Contributors: Kolarik, J., Toftum, J., Olesen, B. W., Shitzer, A.
Pages: 429
Publication date: 2008

Host publication information
Title of host publication: Proceedings of Indoor Air 2008
ISBN (Print): 97-88-77877270-1
Keywords: Office work performance, Thermal comfort, Temperature ramp
URLs:
http://www.indoorair2008.org
Source: orbit
Source-ID: 232895
Research output: Research - peer-review › Conference abstract in proceedings – Annual report year: 2008

Indeklima i danske skoler

General information
State: Published
Organisations: Section for Indoor Environment, Department of Civil Engineering, Technical University of Denmark
Contributors: Gustafsen, S., Toftum, J.
Pages: 10-12
Publication date: 2008
Peer-reviewed: Unknown

Publication information
Journal: H V A C Magasinet
Volume: 44
Issue number: 12
ISSN (Print): 1603-6913
Ratings:
ISI indexed (2013): ISI indexed no
ISI indexed (2012): ISI indexed no
ISI indexed (2011): ISI indexed no
Original language: Danish
Source: orbit
Source-ID: 232890
Research output: Communication › Journal article – Annual report year: 2008

Indeklima i klare tal

General information
State: Published
Organisations: Section for Indoor Environment, Department of Civil Engineering
Contributors: Toftum, J.
Pages: 52-52
Publication date: 2008
Peer-reviewed: Unknown

Publication information
Journal: H V A C Magasinet
Volume: 44
Issue number: 8
ISSN (Print): 1603-6913
Ratings:
Indoor Air 2008

General information
State: Published
Organisations: Section for Indoor Environment, Department of Civil Engineering
Contributors: Toftum, J.
Pages: 6
Publication date: 2008
Peer-reviewed: Unknown

Publication information
Journal: H V A C Magasinet
Volume: 44
Issue number: 7
ISSN (Print): 1603-6913
Ratings:
ISI indexed (2013): ISI indexed no
ISI indexed (2012): ISI indexed no
ISI indexed (2011): ISI indexed no
Original language: Danish
Source: orbit
Source-ID: 232875
Research output: Communication › Journal article – Annual report year: 2008

Komfort og energiforbrug

General information
State: Published
Organisations: Section for Indoor Environment, Department of Civil Engineering
Contributors: Toftum, J., Kolarik, J.
Pages: 12-14
Publication date: 2008
Peer-reviewed: Unknown

Publication information
Journal: H V A C Magasinet
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Ratings:
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ISI indexed (2012): ISI indexed no
ISI indexed (2011): ISI indexed no
Original language: Danish
Source: orbit
Source-ID: 232886
Research output: Communication › Journal article – Annual report year: 2008

Occupant behaviour and control of indoor environment surveyed in Danish dwellings

General information
State: Published
Organisations: Section for Indoor Environment, Department of Civil Engineering, Mathematical Statistics, Department of Informatics and Mathematical Modeling
Occupant responses and energy use in buildings with moderately drifting temperatures

Earlier studies conducted in climate chambers have examined a large range of temperature ramps from 0.5 K/h to 5 K/h (0.9°F/h to 9°F/h), but their focus was mostly on establishing temperature limits for acceptable thermal comfort with non-steady-state temperatures. Thus, when this ASHRAE funded research was initiated in 2005 knowledge was lacking on how the intensity of building related symptoms, the perception of air quality and the performance of office work were affected by exposure to non-steady-state temperatures. ASHRAE Standard 55 (2004) provides recommendations for maximum rates of temperature change to avoid discomfort, but these recommendations are based mostly on engineering judgment and to some extent on results of earlier thermal comfort research. New approaches to reducing the consumption of energy for climate conditioning in buildings are often associated with indoor temperatures that drift somewhat during the day, and there was a need to extend the scope of the recommendations to cover not only thermal comfort, but also health and productivity. The aim of the proposed research was to carry out human subject experiments and field observations to validate the scientific basis of the recommendations on non-steady-state temperatures as stated in Standard 55 and to evaluate how Sick Building Syndrome symptoms, perceived air quality and performance are affected by such changing temperatures. In addition, the feasibility of non-steady-state temperatures as a means of energy savings and reduction of installed HVAC system capacity was evaluated by dynamic simulation of building energy consumption and indoor environment, taking into account potential effects on occupants of such non-steady thermal environments. Several building HVAC configurations and locations with different outdoor climate conditions were simulated. Two different approaches were used in the human subject experiments; a) exposure of human subjects to temperature ramps with fixed clothing insulation and b) with subjects being allowed to adjust their clothing insulation as desired. In the former experiments, subjects’ thermal sensation was expected to vary along with the drifting temperature, as a basis for the most conservative limits to design temperatures and their maximum permitted rate of change, while in the latter experiments, thermal sensations were expected to remain more stable, justifying wider temperature limits. Experiments covered short-term exposures (1 and 2 hrs) at high rates of temperature change as well as moderate to long-term exposures (4 and 8 hrs) at modest and low rates of temperature change. Temperature ramps spanned the summer and winter comfort ranges of temperature. The experiments were designed to address not only thermal comfort but also to determine whether a range of human symptoms would be affected by increasing and decreasing temperature ramps, and to quantify their effects on the performance of typical office tasks.

General information
State: Published
Organisations: Section for Indoor Environment, Department of Civil Engineering
Contributors: Toftum, J., Olesen, B. W., Kolarik, J., Mattarolo, L., Beikowska, D.
Number of pages: 145
Publication date: 2008
This study examined the formation and growth of secondary organic aerosols (SOA) generated when ozone was added to a 1 m\(^3\) glass chamber that contained either pine shelving, oriented strand board (OSB), beech boards, or beach boards painted with an "eco" paint. The experiments were conducted at close to real-world conditions; the chamber was ventilated at 0.5 air changes/h; the loadings (exposed surface of building materials to chamber volume) were in the range of 1–2.5 m\(^2\)m\(^{-3}\); and the initial O\(_3\) concentrations were between 15 and 40 ppb. Throughout each experiment particles were measured with both a condensation nuclei counter and an optical counter, while terpenes were measured before and after the ozone exposure period using sorbent tubes. The pine boards emitted primarily a-pinene and 3-carene and lesser amounts of 5 other terpenes; when O\(_3\) was introduced, the particle counts increased dramatically; the mass concentration reached w15 mgm\(^{-3}\) at w20 ppb O\(_3\), and w95 mgm\(^{-3}\) at w40 ppb O\(_3\). The OSB emitted primarily limonene and a-pinene. Although the particle counts increased when O\(_3\) was introduced, the increase was not as large as anticipated based on the terpene concentrations. The beech boards emitted negligible quantities of terpenes, and the introduction of O\(_3\) resulted in almost no increase in the particle concentration. Beech boards painted with an "eco" paint emitted large amounts of limonene and lesser amounts of carvone; upon introduction of O\(_3\) the particle counts increased sharply with the mass concentration reaching w20 mgm\(^{-3}\) at w15 ppb O\(_3\) and w160 mgm\(^{-3}\) at w35 ppb O\(_3\). These experiments demonstrate that the emission of terpenes and potential generation of SOA varies greatly among different types of wood and pressed wood materials. In the case of the pine boards and painted beech boards, the SOA concentrations generated at modest O\(_3\) concentrations approach or exceed current guideline levels for PM2.5 established by the US EPA and the World Health Organization.
Thermal comfort, physiological responses and performance during exposure to a moderate temperature drift

The objective of this research was to study the effects of a moderate temperature drift on human thermal comfort, physiological responses, productivity and performance. A dynamic thermophysiological model was used to examine the possibility of simulating human thermal responses and thermal comfort under moderate transient conditions. To examine the influence of a moderate temperature ramp, a climate room set-up with experimental subjects was used. Eight subjects visited the climate room on two occasions: 1) exposure to a transient condition (a moderate temperature ramp) and 2) a steady temperature corresponding with a neutral thermal sensation (control situation). During the experiments both physiological responses and thermal sensation were measured. Productivity and performance were assessed with a ‘Remote Performance Measurement’ (RPM) method. Physiological and thermal sensation data indicate significant
differences between the transient condition and the control situation. Productivity and performance tests show no significant changes between the two situations. Simulations obtained with the thermophysiological model were in good agreement with the measurements. Possible improvements of the performance and productivity tests and the thermophysiological model will be discussed.

Total building economic consequences of the effect of temperature on mental performance of office workers
A building simulation program called iDbuild has been developed that calculates the consequences for the indoor environment and energy consumption of selected building design parameter variations. The program thus supports the decision process by facilitating the comparison of different building designs. This paper describes the development of a new module to iDbuild, which calculates the overall economic consequences of parameter variations of the air quality and thermal conditions in an office environment, when accounting for the effect on employee performance of the indoor environment.

Trends i indeklimaforskningen

Human Thermal Comfort in Environments with Moderately Drifting Operative Temperatures - State of the Art and Current Research

General information
State: Published
Organisations: Indoor Environment, Department of Mechanical Engineering
Contributors: Olesen, B. W., Toftum, J., Kolarik, J.
Publication date: 2007

Host publication information
Title of host publication: Clima 2007 WellBeing Indoors Proceedings CD ROM
Place of publication: Helsinki, Finland
Source: orbit
Source-ID: 207435
Research output: Research - peer-review › Article in proceedings – Annual report year: 2007

Indoor air quality and occupant satisfaction in five mechanically and four naturally ventilated open-plan office buildings
Occipant responses and indoor environment characteristics were recorded and compared in five mechanically and four naturally ventilated open-plan office buildings by using a simple approach that enabled us to survey many buildings simultaneously. All occupant responses were obtained during one afternoon. In a pre-experiment, temperature and the concentration of CO2 were monitored in 2-10 locations/office to evaluate the variation throughout the offices. A representative measurement point was subsequently selected and measurements of the same parameters were made during one week. All offices were monitored during the same week and occupant responses to the indoor environment were collected via the internet on the same day within that week. The temperature and the CO2 concentration varied more and were in some cases higher in the naturally ventilated buildings, but occupant responses in terms of symptoms and adverse perceptions differed only modestly between the two building types. Although rarely supported by statistical significance, the results indicated a somewhat higher degree of satisfaction with the indoor environment and a lower prevalence/intensity of symptoms among the occupants in the naturally ventilated buildings.

General information
State: Published
Organisations: Indoor Environment, Department of Mechanical Engineering
Contributors: Hummelgaard, J., Juhl, P., Saebjornsson, K., Clausen, G., Toftum, J., Langkilde, G.
Pages: 4051-4058
Publication date: 2007
Peer-reviewed: Yes

Publication information
Journal: Building and Environment
Volume: 42
Issue number: 12
ISSN (Print): 0360-1323
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 5.22 SJR 2.169 SNIP 2.534
Web of Science (2017): Impact factor 4.539
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 4.51 SJR 1.998 SNIP 2.215
Web of Science (2016): Impact factor 4.053
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Keywords: occupant satisfaction, SBS symptoms, offices, mechanical ventilation, natural ventilation

Original language: English

10.1016/j.buildenv.2006.07.042

Source: orbit

Source-ID: 214897

Research output: Research - peer-review › Journal article – Annual report year: 2007
Occupant behaviour and control of indoor environment in Danish dwellings
Repeated surveys on occupant behaviour and indoor climate were carried out in Danish dwellings from September to October 2006 and again from February to March 2007. The summer survey comprised 933 respondents and the winter survey 636 respondents. The surveys were carried out by sending 5000 invitations to a sample of the Danish housing stock. The addresses were obtained from a Danish register along with information on physical properties of each dwelling. Meteorological data was obtained from the Danish Meteorological Institute. The outdoor temperature, solar radiation and type of supplementary heating had the largest effect on the proportion of dwellings with the heating on. The outdoor solar radiation and the perceived illumination had the largest effect on the proportion of dwellings with lights on. The most frequent reason listed for opening the windows in summer and winter was to obtain more air movement.

Simulation of the Effects of Occupant Behaviour on Indoor Climate and Energy Consumption
In this study the influence of occupant behaviour on energy consumption were investigated in simulations of a single room occupied by one person. The simulated occupant could manipulate six controls, such as turning on or off the heat and adjusting clothing. All control actions were carried out with the aim of keeping the PMV value within predefined limits in accordance with CR1752 [1]. An energy consuming and an energy efficient behavioural mode were simulated. A reference simulation was made during which the occupant had no control over the environment. The occupant was able to keep the thermal indoor environment close to neutral when he/she had the possibility to manipulate the controls. The energy consumption was similar within each behavioural mode regardless of the PMV limits. However, the energy consumption in the energy consuming behavioural mode was up to 330% higher than in the energy efficient behavioural mode.

Survey of Occupant behaviour and control of the indoor environment in Danish Dwellings
Repeated surveys on occupant behaviour and indoor climate were carried out in Danish dwellings in September to October 2006 and again in February to March 2007. The summer survey comprised 933 respondents and the winter survey 636 respondents. The surveys were internet based and were carried out by sending out invitations to 5000 addresses in Denmark. The addresses were obtained from a Danish register along with information on physical properties of each dwelling. Meteorological data from the closest weather station was obtained from the Danish Meteorological Institute. Out of the three parameters: Outdoor temperature, wind speed and solar radiation, the outdoor temperature had the largest effect on the proportion of dwellings with windows open and heating on. The solar radiation had a small effect on the proportion of dwellings with lights on, while none of the parameters seemed to affect the proportion of dwellings with solar shading in use. The most significant reason listed for opening the windows in summer and winter was to obtain more air movement. Danish dwellings and European offices were affected in the same way by the outdoor temperature, when it comes to the proportion of dwellings/offices with windows open or heating on. The outdoor temperature did not seem to affect the proportion of dwellings with solar shading in use.
Thermal Comfort, Perceived Air Quality and Intensity of SBS symptoms during Exposure to Moderate Operative Temperature Ramps

General information
State: Published
Organisations: Indoor Environment, Department of Mechanical Engineering
Contributors: Kolarik, J., Olesen, B. W., Toftum, J., Mattarolo, L.
Number of pages: 237
Publication date: 2007

Ozone initiated reactions and human comfort in indoor environments

Chemical reactions between ozone and pollutants commonly found indoors have been suggested to cause adverse health and comfort effects among building occupants. Of special interest are reactions with terpenes and other pollutants containing unsaturated carbon-carbon bonds that are fast enough to occur under normal conditions in various indoor settings. These reactions are known to occur both in the gas phase (homogeneous reactions) and on the surfaces of building materials (heterogeneous reactions), producing a number of compounds that can be orders of magnitude more odorous and irritating than their precursors. The present thesis investigates the effects of ozone-initiated reactions with limonene and with various interior surfaces, including those associated with people, on short-term sensory responses. The evaluations were conducted using a perceived air quality (PAQ) method introduced by Fanger (1988). The experiments, involving hundreds of human subjects and subsequent physical and chemical measurements, were conducted under realistic indoor conditions in unfurnished office-like environments, in stainless-steel chambers and inside a full-scale model of a section of an airplane cabin. These experiments have shown that the common occurrence of ozone and limonene at typical concentrations and ventilation rates encountered indoors can significantly reduce the perceived air quality even under conditions when these pollutants cannot be sensed if present by themselves. Many of the reaction products that are typical for ozone-limonene chemistry have been concomitantly identified with real time measurement using proton-transfer-reaction mass spectrometry (PTR-MS), at concentrations high enough to be responsible for the sensory effects reported. The stabilized reaction products of ozone-limonene chemistry including aldehydes, ketones and carboxylic acids are known to partition between the gas phase and condensed phase according to the vapour pressure specific to each compound. The concentrations of condensed phase products, which can be easily detected by ordinary particle counters, were shown to be proportional to the magnitude of the sensory responses. However, the particles themselves did not appear to be the primary causative agent, but instead are co-varying surrogates for sensory offending gas-phase species. The experiments involving heterogeneous reactions of ozone with various indoor materials also showed that these reactions can significantly alter the nature of emitted pollutants from indoor surfaces. One set of experiments with various carpet samples showed that although ozone initiated reactions reduced to some extent the initial strong odor of a new carpet, ozone exposure of old carpets significantly enhanced the emissions of odor offending compounds that can persist for hours and days after ozone exposure has ended. The PTR-MS measurements conducted in the simulated aircraft cabin demonstrated that the presence of ozone had significantly increased the concentrations of numerous oxidized compounds in the air of the cabin environment. The most abundant oxidation products were saturated and unsaturated aldehydes and tentatively identified low-molecular-weight carboxylic acids. Some of these compounds were detected at concentrations high enough to trigger the human olfactory sense. When the cabin contained soiled T-shirts, as well as ozone, the concentration of products derived from oxidized skin oil was significantly higher than when the cabin contained ozone alone. Detailed measurements of ozone removal in the aircraft cabin, under systematically varied conditions have shown how different surfaces, including seats, recirculation filters and people themselves contribute to overall ozone removal. People are the largest ozone sink, removing almost 60% of ozone in the cabin and its recirculation system. The aircraft seats, that are contaminated with human bioeffluents and represent a large surface area in the cabin, were the second largest ozone sink, removing about 25% of the ozone. To a smaller extent ventilation filters (~7%) and other surfaces (~10%) also contributed to the removal of ozone.
Den attraktive erhvervsPh.D-ordning

General information
State: Published
Organisations: Indoor Environment, Department of Mechanical Engineering, Birch & Krogboe A/S
Contributors: Lars, C., Toftum, J.
Pages: 6
Publication date: 2006
Peer-reviewed: Unknown

Publication information
Journal: H V A C Magasinet
Issue number: 9
ISSN (Print): 1603-6913
Ratings:
ISI indexed (2013): ISI indexed no
ISI indexed (2012): ISI indexed no
ISI indexed (2011): ISI indexed no
Original language: Danish

Bibliographical note
Editorial
Source: orbit
Source-ID: 194157
Research output: Communication › Journal article – Annual report year: 2006

Human thermal comfort and office work performance in an environment with moderately increasing operative temperature

General information
State: Published
Organisations: Indoor Environment, Department of Mechanical Engineering, Technical University of Denmark
Contributors: Kolarik, J., Olesen, B. W., Toftum, J.
Number of pages: 207
Publication date: 2006

Host publication information
Title of host publication: Proceedings of Healthy Buildings
Source: orbit
Source-ID: 194153
Research output: Research - peer-review › Article in proceedings – Annual report year: 2006

Indeklima i spillesteder - et forsømt barn

General information
State: Published
Organisations: Indoor Environment, Department of Mechanical Engineering
Contributors: Hillbrecht, T., Toftum, J.
Pages: 52-56
Indeklimaproblemer kan afhjælpe

General information
State: Published
Organisations: Indoor Environment, Department of Mechanical Engineering
Contributors: Toftum, J.
Pages: 6
Publication date: 2006
Peer-reviewed: Unknown

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Journal: H V A C Magasinet
Issue number: 8
ISSN (Print): 1603-6913
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ISI indexed (2013): ISI indexed no
ISI indexed (2012): ISI indexed no
ISI indexed (2011): ISI indexed no
Original language: Danish
Source: orbit
Source-ID: 194156
Research output: Communication › Journal article – Annual report year: 2006

Influence of ozone-limonene reactions on perceived air quality,

General information
State: Published
Organisations: Indoor Environment, Department of Mechanical Engineering
Contributors: Tamás, G., Weschler, C. J., Toftum, J., Fanger, P. O.
Pages: 168-178
Publication date: 2006
Peer-reviewed: Yes

Publication information
Journal: Indoor Air
Volume: 16
Issue number: 3
ISSN (Print): 0905-6947
Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 3.9
Thermal sensation and thermophysiological responses with metabolic step-changes

This study investigated the effect on thermal perception and thermophysiological variables of controlled metabolic excursions of various intensities and durations. Twenty-four subjects alternately were seated on a chair or exercised by walking on a treadmill at a temperature predicted to be neutral at sedentary activity. In a second experimental series, subjects alternated between rest and exercise as well as between exercise at different intensities at two temperature levels. Measurements comprised skin and oesophageal temperatures, heart rate and subjective responses. Thermal sensation started to rise or decline immediately (within one minute) after a change of activity, which means that even moderate activity changes of short duration affect thermal perceptions of humans. After approximately 15-20 min under constant activity subjective thermal responses approximated the steady-state response. The sensitivity of thermal sensation to changes in core temperature was higher for activity down-steps than for up-steps. A model was proposed that estimates transient thermal sensation after metabolic step-changes. Based on predictions by the model, weighting factors were suggested to estimate a representative average metabolic rate with varying activity levels, e.g. for the prediction of thermal sensation by steady-state comfort models. The activity during the most recent 5 min should be weighted 65%, during the prior 10-5 min 25% and during the prior 20-10 min 10%.
Human thermal comfort in environments with moderately drifting operative temperatures – state of the art and current research

General information
State: Published
Organisations: Department of Mechanical Engineering, Indoor Environment
Contributors: Jakub, K., Olesen, B. W., Toftum, J.
Publication date: 2005

Host publication information
Title of host publication: Proc. of Energy Efficient Technologies in Indoor Environment
Source: orbit
Source-ID: 184906
Research output: Research › Article in proceedings – Annual report year: 2005

Indoor air quality and occupant satisfaction in five mechanically and four naturally ventilated open-plan office buildings

General information
State: Published
Organisations: Department of Mechanical Engineering, Indoor Environment
Contributors: Hummelgarrd, J., Juhl, P., Sæbjömsson, K., Clausen, G., Toftum, J., Langkilde, G.
Pages: 675-680
Publication date: 2005

Host publication information
Title of host publication: INDOOR AIR 2005 : PROCEEDINGS OF THE 10TH INTERNATIONAL CONFERENCE ON INDOOR AIR QUALITY AND CLIMATE
Volume: 1-5
Publisher: Tsinghua University Press
ISBN (Print): 978-7-89494-830-4
Source: orbit
Source-ID: 184907
Research output: Research › Article in proceedings – Annual report year: 2005

Influence of ozone-limonene reactions on perceived air quality

General information
Host publication information
Title of host publication: Proc. of Indoor Air 2005 : 10th International Conference on Indoor Air Quality and Climate, 2-9 September, Beijing, China
Volume: 1
Source: orbit
Source-ID: 184905
Research output: Research - peer-review › Article in proceedings – Annual report year: 2005

Intervention studies with remote measurement of occupant comfort, health and performance

General information
State: Published
Organisations: Indoor Environment, Department of Mechanical Engineering
Contributors: Toftum, J., Lantner, A., Svanekjær, H.
Pages: 178-181
Publication date: 2005

Host publication information
Title of host publication: Proc. of International Conference on Environmental Ergonomics
Editor: Holmér, I.
Source: orbit
Source-ID: 184904
Research output: Research › Article in proceedings – Annual report year: 2005

Remote Performance Measurement (RPM) – A new, internet-based method for the measurement of occupant performance in office buildings

General information
State: Published
Organisations: Indoor Environment, Department of Mechanical Engineering
Contributors: Toftum, J., Wyon, D., Svanekjær, H., Lantner, A.
Pages: 357-361
Publication date: 2005

Host publication information
Title of host publication: Proc. of Indoor Air 2005
Volume: 1
Place of publication: China
URLs:
http://www.indoorair2005.org.cn
Source: orbit
Source-ID: 184903
Research output: Research - peer-review › Article in proceedings – Annual report year: 2005

Air movement - good or bad?

General information
State: Published
Organisations: Indoor Environment, Department of Mechanical Engineering
Contributors: Toftum, J.
Pages: 40-45
Publication date: 2004
Peer-reviewed: Yes

Publication information
Journal: Indoor Air
Volume: 14
Issue number: supplement 7
Human projected area factors for detailed direct and diffuse solar radiation analysis

General information
State: Published
Organisations: Indoor Environment, Department of Mechanical Engineering
Contributors: Kubaha, K., Fiala, D., Toftum, J., Taki, A.
Pages: 113-129
Publication date: 2004
Peer-reviewed: Yes

Publication information
Journal: International Journal of Biometeorology
Volume: 49
ISSN (Print): 0020-7128
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 2.51 SJR 0.897 SNIP 1.22
Web of Science (2017): Impact factor 2.577
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 2.25 SJR 0.799 SNIP 1.176
Web of Science (2016): Impact factor 2.204
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 1.9 SJR 0.746 SNIP 1.168
Web of Science (2015): Impact factor 2.309
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 2.66 SJR 0.838 SNIP 1.47
Web of Science (2014): Impact factor 3.246
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 2.29 SJR 0.727 SNIP 1.332
Web of Science (2013): Impact factor 2.104
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 2.26 SJR 0.913 SNIP 1.332
Web of Science (2012): Impact factor 2.59
ISI indexed (2012): ISI indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): CiteScore 2.18 SJR 0.763 SNIP 1.347
Web of Science (2011): Impact factor 2.254
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 0.933 SNIP 1.399
Web of Science (2010): Impact factor 1.813
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 0.919 SNIP 1.263
BFI (2008): BFI-level 1
New indoor environment chambers and field experiment offices for research on human comfort, health and productivity

General information
State: Published
Organisations: Indoor Environment, Department of Mechanical Engineering
Contributors: Toftum, J., Langkilde, G., Fanger, P. O.
Pages: 899-903
Publication date: 2004
Peer-reviewed: Yes

Publication information
Journal: Energy and Buildings
Volume: 36
Issue number: 9

Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes

BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 4.96 SJR 2.061 SNIP 2.12
Web of Science (2017): Impact factor 4.457
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 4.64 SJR 2.055 SNIP 1.968
Web of Science (2016): Impact factor 4.067
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 4.07 SJR 2.04 SNIP 2.146
Web of Science (2015): Impact factor 2.973
Web of Science (2015): Indexed yes

BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 4.21 SJR 2.079 SNIP 2.875
Web of Science (2014): Impact factor 2.884
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): CiteScore 3.79 SJR 1.852 SNIP 2.404
Web of Science (2013): Impact factor 2.465
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
Thermal comfort indices

General information
State: Published
Organisations: Indoor Environment, Department of Mechanical Engineering
Contributors: Toftum, J.
Publication date: 2004

Host publication information
Title of host publication: Handbook of Human Factors and Ergonomics Methods
Place of publication: Boca Raton, Fl.
Publisher: CRC Press
Editors: Stanton, N., Hedge, A., Brookhuis, K., Salas, E., Hendrick, H.
Source: orbit
Source-ID: 155625
Research output: Research - peer-review > Book chapter – Annual report year: 2004
Transient thermal sensation and comfort resulting from adjustment of clothing insulation

General information
State: Published
Organisations: Department of Mechanical Engineering, Indoor Environment
Contributors: Goto, T., Toftum, J., Fanger, P. O., Yoshino, H.
Publication date: 2004

Publication information
Original language: English
Source: orbit
Source-ID: 155721
Research output: Research - peer-review » Book – Annual report year: 2004

Fra forskning til erhvervsliv (From research to business)

General information
State: Published
Organisations: Indoor Environment, Department of Mechanical Engineering
Contributors: Toftum, J.
Pages: 38
Publication date: 2003
Peer-reviewed: Unknown

Publication information
Journal: DANVAK Magasinet
ISSN (Print): 1601-1767
Original language: Danish
Source: orbit
Source-ID: 25767
Research output: Communication » Journal article – Annual report year: 2003

Human Response to Air Movement - Evaluation of ASHRAE’s Draft Criteria

The aim of this study was to evaluate the present ASHRAE Standard 55-92 draft criteria and to describe how air movement is perceived at thermal sensations slightly cooler and slightly warmer than neutral. At temperatures 18oC, 20oC, 23oC, 26oC, and 28oC (64.4oF, 68oF, 73.4oF, 78.8oF, and 82.4oF), 40 subjects at slightly cool, neutral and slightly warm overall thermal sensation were exposed to air velocities that were increased step-by-step from less than 0.1 m/s to 0.8 m/s (19.7 fpm to 157.5 fpm). Subjects who felt cool or slightly cool perceived air movement as being uncomfortable at lower air velocities than did subjects feeling neutral or warmer. No difference in draft sensitivity between subjects feeling neutral, slightly warm or warm was observed. A smaller percentage of subjects were dissatisfied due to draft than prescribed by ASHRAE Standard 55 guidelines on air movement. The discrepancy could be explained by the effect of thermal sensation and activity level on draft sensitivity. Permissible mean air velocities as recommended by the standard thus provide a conservative upper limit for air velocity that protects occupants who are sensitive to air movement, occupants who feel cooler than neutral or occupants who are occupied mostly with sedentary work. To accommodate all occupants in a given indoor environment, it is therefore recommended that air movement generated by the HVAC system be designed according to the criteria in the current Standard 55 to minimize complaints of draft. To provide comfort for occupants who prefer more air movement, local air movement under individual control is easy to generate, e.g. by a desk fan.

General information
State: Published
Organisations: Department of Mechanical Engineering
Contributors: Toftum, J., Melikov, A. K., Tynel, A., Bruzda, M., Fanger, P. O.
Pages: 187-202
Publication date: 2003
Peer-reviewed: Yes

Publication information
Volume: 9
Issue number: 2
ISSN (Print): 2374-4731
Ratings:
Initial studies of oxidation processes on filter surfaces and their impact on perceived air quality

Ozone concentrations were monitored up- and downstream of used filter samples at airflow rates of 1.0 and 0.2 L s⁻¹. The ozone concentration in the air upstream of the filters was ~75 ppb, while the concentration downstream of the filter was initially ~35% lower at 1 L s⁻¹ and ~55% lower at 0.2 L s⁻¹. Within an hour the removal efficiency had decreased to roughly 5% at 1 L s⁻¹ and 10% at 0.2 L s⁻¹. These filter samples were then placed in either nitrogen or ambient air for 48 hours. Afterwards it was found that there was partial regeneration of the filter's ozone removal capabilities. In companion studies, human subjects assessed air passing through various filter samples. This occurred when samples were first placed in the test rig (each of 3 filters equivalent); immediately after the samples had sat for 48 hours in ozone, nitrogen or air (ozone-treated worse than air-treated worse than nitrogen-treated); and after ambient air had passed through the treated filters for 2 hours. In the last case all filters were more acceptable than they had been right after the 48-hour treatments. However, the ozonized filter was still the most polluting of the three.

General information
State: Published
Organisations: Section for Indoor Environment, Department of Civil Engineering, Technical University of Denmark
Contributors: Bekö, G., Halás, O., Clausen, G., Weschler, C. J., Toftum, J.
Pages: 156-162
Publication date: 2003

Host publication information
Title of host publication: Proceedings of Healthy Buildings 2003
Place of publication: National University of Singapore
Publisher: Department of Building
Source: orbit
Source-ID: 25627
Research output: Research - peer-review › Article in proceedings – Annual report year: 2003

Sensory pollution load from a used ventilation filter at different airflow rates

General information
State: Published
Organisations: Department of Mechanical Engineering
Contributors: Tejsen, P. S., Clausen, G., Toftum, J.
Pages: 257-261
Publication date: 2003

Host publication information
Title of host publication: Proceedings of Healthy Buildings 2003, vol. 3
Volume: Vol. 3
Place of publication: National University of Singapore
Publisher: Department of Building
Source: orbit
Source-ID: 25701
Research output: Research - peer-review › Article in proceedings – Annual report year: 2003

Simulering af menneskers termiske komfort og fysiologi (Simulation of human thermal comfort and physiology)

General information
State: Published
Organisations: Indoor Environment, Department of Mechanical Engineering
Contributors: Toftum, J.
Pages: 16-18
Publication date: 2003
Peer-reviewed: Unknown

Publication information
Journal: DANVAK Magasinet
ISSN (Print): 1601-1767
Original language: Danish
Source: orbit
Source-ID: 25771
Research output: Communication › Journal article – Annual report year: 2003
**Transient thermal sensation and comfort resulting from adjustment of clothing insulation**

This study investigated the transient effects on human thermal responses of clothing adjustments. Two different levels of activity were tested, and the temperature was set to result in a warm or cool thermal sensation at each activity level. The subjects (12 females and 12 males) wore identical uniforms and were asked to take off or don a part of the uniform after they had adapted to the experimental conditions for more than 20 minutes. The results showed that the thermal sensation votes responded immediately to the adjustment of clothing insulation and reached a new steady-state level within 5 minutes after both an increase and a decrease of clothing insulation, independent of the activity level.

**General information**

State: Published  
Organisations: Department of Mechanical Engineering, Indoor Environment  
Contributors: Goto, T., Toftum, J., Fanger, P. O., Yoshino, H.  
Pages: 835-840  
Publication date: 2003

**Host publication information**

Title of host publication: Proceedings of Healthy Buildings 2003  
Place of publication: Singapore  
Publisher: NUS Press  
Source-ID: 155847  
Research output: Research - peer-review › Article in proceedings – Annual report year: 2004

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**Ultrafine and fine particle formation in a naturally ventilated office as a result of reactions between ozone and scented products**

Ultrafine and fine particle formation as a result of chemical reactions between ozone and four different air fresheners and a typical lemon-scented domestic cleaner was studied in a fully furnished, naturally ventilated office. The study showed that under conditions representative of those occurring in such offices, air fresheners or scented cleaners may react with ozone to form secondary organic aerosols (SOA). The tested air fresheners were relatively small sources of SOA with detectable increases occurring only in the ultrafine particle number concentration. With the cleaner, also an increase in particle mass was observed.

**General information**

State: Published  
Organisations: Department of Mechanical Engineering  
Contributors: Toftum, J., Dijken, F. V.  
Pages: 134-139  
Publication date: 2003

**Host publication information**

Title of host publication: Proceedings of Healthy Buildings 2003  
Place of publication: National University of Singapore  
Publisher: Department of Building  
Source-ID: 25697  
Research output: Research - peer-review › Article in proceedings – Annual report year: 2003

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**Extension of the PMV model to non-air-conditioned building in warm climates**

The PMV model agrees well with high-quality field studies in buildings with HVAC systems, situated in cold, temperate and warm climates, studied during both summer and winter. In non-air-conditioned buildings in warm climates, occupants may sense the warmth as being less severe than the PMV predicts. The main reason is low expectations, but a metabolic rate that is estimated too high can also contribute to explaining the difference. An extension of the PMV model that includes an expectancy factor is introduced for use in non-air-conditioned buildings in warm climates. The extended PMV model agrees well with quality field studies in non-air-conditioned buildings of three continents.

**General information**

State: Published  
Organisations: Indoor Environment, Department of Mechanical Engineering  
Contributors: Fanger, P. O., Toftum, J.  
Pages: pp. 533-536  
Publication date: 2002  
Peer-reviewed: Yes
Human preference for air movement

Human preference for air movement was studied at slightly cool, neutral, and slightly warm overall thermal sensations and at temperatures ranging from 18 deg.C to 28 deg.C. Air movement preference depended on both thermal sensation and temperature, but large inter-individual differences existed between subjects. Preference for less air movement was linearly correlated with draught discomfort, but the percentage of subjects who felt draught was lower than the percentage who preferred less air movement.

General information
State: Published
Organisations: Indoor Environment, Department of Mechanical Engineering
Contributors: Toftum, J., Melikov, A. K., Tynel, A., Bruzda, M., Fanger, P. O.
Publication date: 2002

Host publication information
Title of host publication: Proceedings of Roomvent 2002
Publisher: Technical University of Denmark and Danvak
Source: orbit
Source-ID: 62542
Research output: Research - peer-review › Article in proceedings – Annual report year: 2002

Human response to combined indoor environment exposures

Most thermal comfort standards and guidelines presume sedentary, light activity and a neutral overall thermal sensation when predicting local thermal discomfort. In addition, current standards specify criteria for separate aspects of the indoor environment, e.g., thermal climate, air quality or noise, with only little consideration of possible interactions between the different types of exposure. The studies summarized in this article found a clear impact of activity and overall thermal sensation on human sensitivity to air movement, whereas no interaction effects of exposure to several local thermal discomfort factors were observed. Limited evidence was found of significant interactions between different aspects of the indoor environment. Only for the effect of air temperature and air humidity on sensory air quality were well-established relationships available.

General information
State: Published
Organisations: Indoor Environment, Department of Mechanical Engineering
Contributors: Toftum, J.
Pages: 601-606
Publication date: 2002
Peer-reviewed: Yes

Publication information
Journal: Energy and Buildings
Volume: 34
Issue number: 6
ISSN (Print): 0378-7788
Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 4.96 SJR 2.061 SNIP 2.12
Web of Science (2017): Impact factor 4.457
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 4.64 SJR 2.055 SNIP 1.968
Web of Science (2016): Impact factor 4.067
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 4.07 SJR 2.04 SNIP 2.146
Web of Science (2015): Impact factor 2.973
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 4.21 SJR 2.079 SNIP 2.875
Web of Science (2014): Impact factor 2.884
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): CiteScore 3.79 SJR 1.852 SNIP 2.404
Web of Science (2013): Impact factor 2.465
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): CiteScore 3.36 SJR 1.745 SNIP 2.696
Web of Science (2012): Impact factor 2.679
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): CiteScore 3.23 SJR 1.476 SNIP 2.531
Web of Science (2011): Impact factor 2.386
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 1.626 SNIP 2.08
Web of Science (2010): Impact factor 2.046
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 2
Scopus rating (2009): SJR 1.533 SNIP 1.811
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 1.681 SNIP 2.055
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 1.077 SNIP 1.702
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 1.382 SNIP 1.764
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 1.292 SNIP 1.352
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 0.854 SNIP 1.674
Web of Science (2004): Indexed yes
Scopus rating (2003): SJR 1.504 SNIP 1.387
Scopus rating (2002): SJR 1.189 SNIP 1.671
Web of Science (2002): Indexed yes
Scopus rating (2001): SJR 0.972 SNIP 1.082
Scopus rating (2000): SJR 0.243 SNIP 1.235
Web of Science (2000): Indexed yes
Perceived air quality, thermal comfort, and SBS symptoms at low air temperature and increased radiant temperature

This study investigated if low air temperature, which is known to improve the perception of air quality, also can reduce the intensity of some SBS symptoms. In a low-polluting office, human subjects were exposed to air at two temperatures 23 deg.C and 18 deg.C both with and without a pollution source present at the low temperature. To maintain overall thermal neutrality, the low air temperature was partly compensated for by individually controlled radiant heating, and partly by allowing subjects to modify clothing insulation. A reduction of the air temperature from 23 deg.C to 18 deg.C suggested an improvement of the perceived air quality, while no systematic effect on symptom intensity was observed. The overall indoor environment was evaluated equally acceptable at both temperatures due to local thermal discomfort at the low air temperature.

General information
State: Published
Organisations: Indoor Environment, Department of Mechanical Engineering, Technical University of Denmark
Contributors: Toftum, J., Reimann, G. P., Foldbjerg, P., Clausen, G., Fanger, P. O.
Publication date: 2002

Host publication information
Title of host publication: Proceedings of Indoor Air 2002
Source: orbit
Source-ID: 62559
Research output: Research - peer-review › Article in proceedings – Annual report year: 2002

Prediction of thermal sensation in non-air-conditioned buildings in warm climates

The PMV model agrees well with high-quality field studies in buildings with HVAC systems, situated in cold, temperate and warm climates, studied during both summer and winter. In non-air-conditioned buildings in warm climates, occupants may sense the warmth as being less severe than the PMV predicts. The main reason is low expectations, but a metabolic rate that is estimated too high can also contribute to explaining the difference. An extension of the PMV model that includes an expectancy factor is introduced for use in non-air-conditioned buildings in warm climates. The extended PMV model agrees well with quality field studies in non-air-conditioned buildings of three continents.

General information
State: Published
Organisations: Indoor Environment, Department of Mechanical Engineering
Contributors: Fanger, P. O., Toftum, J.
Publication date: 2002

Host publication information
Title of host publication: Proceedings of Indoor Air 2002
Source: orbit
Source-ID: 62562
Research output: Research - peer-review › Article in proceedings – Annual report year: 2002

Thermal sensation and comfort with transient metabolic rates

This study investigated the effect on thermal perceptions and preferences of controlled metabolic excursions of various intensities (20%, 40%, 60% relative work load) and durations (3-30 min) imposed on subjects that alternated between sedentary activity and exercise on a treadmill. The thermal environment was held constant at a temperature corresponding to PMV=0 at sedentary activity. Even low activity changes of short duration (1 min at 20% relative work load) affected thermal perceptions. However, after circa 15 min of constant activity, subjective thermal responses approximated the steady-state response, after both up-steps and down-steps of activity.

General information
State: Published
Organisations: Department of Mechanical Engineering, Indoor Environment
Contributors: Goto, T., Toftum, J., Dear, R. D., Fanger, P. O.
Publication date: 2002
Human response to combined indoor environment exposures

General information
State: Published
Organisations: Indoor Environment, Department of Mechanical Engineering
Contributors: Toftum, J.
Publication date: 2001

Host publication information
Title of host publication: Proceedings of Moving Thermal Comfort Standards into the 21st Century
Place of publication: Oxford
Publisher: Oxford Brookes University
Source: orbit
Source-ID: 64197
Research output: Research - peer-review › Article in proceedings – Annual report year: 2001

Thermal comfort in the future - excellence and expectation

General information
State: Published
Organisations: Indoor Environment, Department of Mechanical Engineering
Contributors: Fanger, P. O., Toftum, J.
Publication date: 2001

Host publication information
Title of host publication: Proceedings of Moving Thermal Comfort Standards into the 21st Century
Place of publication: Oxford
Publisher: Oxford Brookes University
Source: orbit
Source-ID: 64182
Research output: Research - peer-review › Article in proceedings – Annual report year: 2001

Discomfort due to skin humidity with different fabric textures and materials

General information
State: Published
Organisations: Department of Energy Engineering, Novenco
Contributors: Toftum, J., Rasmussen, L. W., Mackeprang, J., Fanger, P. O.
Publication date: 2000
Peer-reviewed: Yes

Publication information
Journal: A S H R A E Transactions
Volume: 106
Issue number: 2
ISSN (Print): 0001-2505
Ratings:
BFI (2018): BFI-level 1
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 0.53 SJR 0.512 SNIP 0.498
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 0.42 SJR 0.329 SNIP 0.566
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 0.36 SJR 0.431 SNIP 0.572
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 0.32 SJR 0.392 SNIP 0.436
Air humidity requirements for human comfort

Upper humidity limits for the comfort zone determined from two recently presented models for predicting discomfort due to skin humidity and insufficient respiratory cooling are proposed. The proposed limits are compared with the maximum permissible humidity level prescribed in existing standards for the thermal indoor environment. The skin humidity model predicts discomfort as a function of the relative humidity of the skin, which is determined by existing models for human heat and moisture transfer based on environmental parameters, clothing characteristics and activity level. The respiratory model predicts discomfort as a function of the driving forces for heat loss from the respiratory tract, namely the air temperature and humidity of the surrounding air. An upper humidity limit based on a relative skin humidity of 0.54, corresponding to 20% dissatisfied, results in a maximum permissible humidity level near 100% rh. For respiratory comfort the requirements much more stringent and results in lower permissible indoor air humidities. Compared with the upper humidity limit specified in existing thermal comfort standards, e.g. ASHRAE Addendum 55a, the humidity limit based on skin humidity was less restrictive and the humidity limit based on respiratory comfort was far more restrictive.
Effect of fabric texture and material on perceived discomfort at high humidity

General information
State: Published
Organisations: Department of Energy Engineering
Contributors: Toftum, J., Rasmussen, L. W., Mackeprang, J., Fanger, P. O.
Pages: 608-613
Publication date: 1999

Host publication information
Title of host publication: Proc. Indoor Air '99
Place of publication: London
Publisher: Construction Research Communications, Ltd.
Source: orbit
Source-ID: 172324
Research output: Research - peer-review › Article in proceedings – Annual report year: 1999

Effekt af tekstilmateriale og -struktur på menneskers komfort ved høj fugtighed: (Effect of fabric texture and material on perceived discomfort at high humidity)

General information
State: Published
Mennerk oplevelse af træk

General information
State: Published
Organisations: Department of Energy Engineering
Contributors: Toftum, J., Melikov, A., Zhou, G.
Pages: 27-32
Publication date: 1999
Peer-reviewed: No

Publication information
Journal: Danvak VVS Bladet
Volume: 35
Issue number: 8
Original language: Danish
Source: orbit
Source-ID: 172325
Research output: Research › Journal article – Annual report year: 1999

The impact of human perception of simultaneous exposure to thermal load, low-frequency ventilation noise and indoor air pollution

General information
State: Published
Organisations: Department of Energy Engineering
Contributors: Alm, O., Witterseh, T., Clausen, G., Toftum, J., Fanger, P. O.
Pages: 270-275
Publication date: 1999

Host publication information
Title of host publication: Proc. of 8th International Conference on Indoor Air Quality and Climate
Place of publication: London
Publisher: Construction Research Communications, Ltd.
Source: orbit
Source-ID: 172429
Research output: Research › peer-review › Article in proceedings – Annual report year: 1999

Nye øvre grænser for luftfugtighed

General information
State: Published
Organisations: Department of Energy Engineering
Contributors: Toftum, J., Jørgensen, A.
Pages: 22-24
Publication date: 1998
Peer-reviewed: No

Publication information
Journal: DANVAK
Volume: 6
Original language: Danish
Source: orbit
Source-ID: 169817
Research output: Research › Journal article – Annual report year: 1998
Upper limits for air humidity based on human comfort

General information
State: Published
Organisations: Department of Energy Engineering
Contributors: Toftum, J., Fanger, P. O., Jørgensen, A. S.
Pages: 331-334
Publication date: 1998

Host publication information
Title of host publication: Proc. of International Conference on Human-Environment System
Place of publication: Yokohama
Publisher: Society of Human-Environment System, Japan
Source: orbit
Source-ID: 170964
Research output: Research - peer-review > Article in proceedings – Annual report year: 1998

Upper limits for air humidity to prevent warm respiratory discomfort

General information
State: Published
Organisations: Department of Energy Engineering
Contributors: Toftum, J., Jørgensen, A., Fanger, P. O.
Pages: 15-23
Publication date: 1998
Peer-reviewed: Yes

Publication information
Journal: Energy and Buildings
Volume: 28
Issue number: (3)
Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 4.96 SJR 2.061 SNIP 2.12
Web of Science (2017): Impact factor 4.57
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 4.64 SJR 2.055 SNIP 1.968
Web of Science (2016): Impact factor 4.067
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 4.07 SJR 2.04 SNIP 2.146
Web of Science (2015): Impact factor 2.973
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 4.21 SJR 2.079 SNIP 2.875
Web of Science (2014): Impact factor 2.884
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): CiteScore 3.79 SJR 1.852 SNIP 2.404
Web of Science (2013): Impact factor 2.465
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): CiteScore 3.36 SJR 1.745 SNIP 2.696
Upper limits for indoor air humidity to avoid uncomfortably humid skin

General information
State: Published
Organisations: Department of Energy Engineering
Contributors: Toftum, J., Jørgensen, A., Fanger, P. O.
Pages: 1-13
Publication date: 1998
Peer-reviewed: Yes

Publication information
Journal: Energy and Buildings
Volume: 28
Issue number: (3)
Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Airflow direction and discomfort due to draught

General information
State: Published
Organisations: Department of Energy Engineering
Publication date: 1997

Host publication information
Title of host publication: Clima 2000
Source: orbit
Source-ID: 169024
Research output: Research - peer-review › Book chapter – Annual report year: 1997

Draught sensitivity is influenced by general thermal sensations

General information
State: Published
Organisations: Department of Energy Engineering
Contributors: Toftum, J., Nielsen, R.
Pages: 295-305
Publication date: 1996
Peer-reviewed: Yes

Publication information
Journal: International Journal of Industrial Ergonomics
Volume: 18
ISSN (Print): 0169-8141
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 1.85 SJR 0.795 SNIP 1.487
Web of Science (2017): Impact factor 1.429
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 1.66 SJR 0.601 SNIP 1.538
Web of Science (2016): Impact factor 1.415
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 1.4 SJR 0.603 SNIP 1.265
Web of Science (2015): Impact factor 1
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 1.71 SJR 0.715 SNIP 1.99
Web of Science (2014): Impact factor 1.07
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 2.05 SJR 0.862 SNIP 1.914
Web of Science (2013): Impact factor 1.214
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 1.8 SJR 1.021 SNIP 1.728
Web of Science (2012): Impact factor 1.208
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): CiteScore 1.76 SJR 0.642 SNIP 1.725
Web of Science (2011): Impact factor 1.26
ISI indexed (2011): ISI indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 0.713 SNIP 1.357
Web of Science (2010): Impact factor 1.322
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 2
Scopus rating (2009): SJR 0.958 SNIP 1.331
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 0.726 SNIP 1.25
Scopus rating (2007): SJR 0.524 SNIP 1.253
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 0.315 SNIP 0.846
Scopus rating (2005): SJR 0.628 SNIP 1.119
Scopus rating (2004): SJR 0.594 SNIP 1.234
Web of Science (2004): Indexed yes
Scopus rating (2003): SJR 0.593 SNIP 0.846
Scopus rating (2002): SJR 0.485 SNIP 0.915
Web of Science (2002): Indexed yes
Scopus rating (2001): SJR 0.372 SNIP 0.668
Scopus rating (2000): SJR 0.284 SNIP 0.847
Scopus rating (1999): SJR 0.315 SNIP 0.481
Original language: English
Source: orbit
Source-ID: 167481
Research output: Research - peer-review › Journal article – Annual report year: 1996

**Effekt af luftstrømnings retning på menneskers opfattelse af træk**

**General information**
State: Published
Organisations: Department of Energy Engineering
Contributors: Toftum, J., Melikov, A. K., Zhou, G.
Number of pages: 51
Publication date: 1996

**Publication information**
Original language: Danish
Source: orbit
Source-ID: 167483
Research output: Research - peer-review › Report – Annual report year: 1996

**Impact of activity level and thermal sensation on human response to air movements**

**General information**
State: Published
Organisations: Department of Energy Engineering
Contributors: Toftum, J.
Publication date: 1996

**Host publication information**
Title of host publication: Proceedings
Place of publication: Jerusalem
Publisher: 7th International Conference on Environmental Ergonomics
Impact of metabolic rate on human response to air movements during work in cool environments

General information
State: Published
Organisations: Department of Energy Engineering
Contributors: Toftum, J., Nielsen, R.
Pages: 307-316
Publication date: 1996
Peer-reviewed: Yes

Publication information
Journal: International Journal of Industrial Ergonomics
Volume: 18
ISSN (Print): 0169-8141
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 1.85 SJR 0.795 SNIP 1.487
Web of Science (2017): Impact factor 1.429
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 1.66 SJR 0.601 SNIP 1.538
Web of Science (2016): Impact factor 1.415
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 1.4 SJR 0.603 SNIP 1.265
Web of Science (2015): Impact factor 1
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 1.71 SJR 0.715 SNIP 1.99
Web of Science (2014): Impact factor 1.07
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 2.05 SJR 0.862 SNIP 1.914
Web of Science (2013): Impact factor 1.214
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 1.8 SJR 1.021 SNIP 1.728
Web of Science (2012): Impact factor 1.208
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): CiteScore 1.76 SJR 0.642 SNIP 1.725
Web of Science (2011): Impact factor 1.26
ISI indexed (2011): ISI indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 0.713 SNIP 1.357
Web of Science (2010): Impact factor 1.322
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 2
Scopus rating (2009): SJR 0.958 SNIP 1.331
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 0.726 SNIP 1.25
Scopus rating (2007): SJR 0.524 SNIP 1.253
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 0.315 SNIP 0.846
Scopus rating (2005): SJR 0.628 SNIP 1.119
Scopus rating (2004): SJR 0.594 SNIP 1.234
Web of Science (2004): Indexed yes
Scopus rating (2003): SJR 0.593 SNIP 0.846
Scopus rating (2002): SJR 0.485 SNIP 0.915
Web of Science (2002): Indexed yes
Scopus rating (2001): SJR 0.372 SNIP 0.668
Scopus rating (2000): SJR 0.284 SNIP 0.847
Scopus rating (1999): SJR 0.315 SNIP 0.481
Original language: English
Source: orbit
Source-ID: 167480
Research output: Research - peer-review » Journal article – Annual report year: 1996

Projects:

**Udvikling af model til beregning af de økonomiske konsekvenser af indeklimaforbedringer**
Jensen, K. L., PhD Student, Department of Civil Engineering
Toftum, J., Main Supervisor, Department of Civil Engineering
Christoffersen, L. D., Supervisor
Wargocki, P., Examiner, Department of Civil Engineering
Boerstra, A. C., Examiner
Seppänen, O., Examiner
ErhvervsPhD-ordningen VTU
01/09/2005 → 22/04/2009
Award relations: Udvikling af model til beregning af de økonomiske konsekvenser af indeklimaforbedringer
Project: PhD

**Trækgener i det industrielle arbejdsmiljø**
Toftum, J., PhD Student, Department of Mechanical Engineering
Langkilde, G., Main Supervisor, Department of Mechanical Engineering
DTU-stipendium
01/08/1992 → 16/01/1994
Award relations: Trækgener i det industrielle arbejdsmiljø
Project: PhD

**Impact of human convective boundary layer on inhaled air quality and its protective role under different ventilation strategies**
Licina, D., PhD Student, Department of Civil Engineering
Melikov, A. K., Main Supervisor, Department of Civil Engineering
Sekhar, C., Supervisor
Tham, K. W., Supervisor
Toftum, J., Examiner, Department of Civil Engineering
Novoselac, A., Examiner
Poh, H. J., Examiner
Joint degree
01/09/2013 → 30/09/2015
Award relations: Impact of human convective boundary layer on inhaled air quality and its protective role under different ventilation strategies
Project: PhD

**Mechanical Ventilation Solutions for Optimisation of Energy Efficiency an Indoor Environments in Danish Homes**
Johnston, C. J., PhD Student, Department of Civil Engineering
Nielsen, T. R., Main Supervisor, Department of Civil Engineering
Noyé, P. A., Supervisor, Department of Civil Engineering
Toftum, J., Supervisor, Department of Civil Engineering
Wargocki, P., Examiner, Department of Civil Engineering
Model for Multidimensional Heat, Air and Moisture Conditions in Building Envelope Components
Steskens, P. W. M. H., PhD Student, Department of Civil Engineering
Rode, C., Main Supervisor, Department of Civil Engineering
Hjorslev Hansen, M., Supervisor, Department of Civil Engineering
Janssen, H., Supervisor, Department of Civil Engineering
Dela, B. F., Supervisor
Toftum, J., Examiner, Department of Civil Engineering
Christoffersen, L. D., Examiner
Janssens, A., Examiner
Forskningsrådsfinansiering
01/08/2006 → 06/01/2010
Award relations: Model for Multidimensional Heat, Air and Moisture Conditions in Building Envelope Components
Project: PhD

Personalized ventilation
Kaczmarczyk, J., PhD Student, Department of Mechanical Engineering
Melikov, A. K., Main Supervisor, Department of Mechanical Engineering
Fanger, P. O., Supervisor, Department of Mechanical Engineering
Holmér, I., Examiner
Toftum, J., Examiner, Department of Mechanical Engineering
DTU-lønnet stipendie
01/08/2000 → 21/10/2003
Award relations: Personalized ventilation
Project: PhD

Sensation of "Dryness" humidity of air, comfort and health
Lagercrantz, L. P., PhD Student, Department of Mechanical Engineering
Sundell, J., Main Supervisor, Department of Mechanical Engineering
Kjærgaard, S. K., Examiner
Knudsen, H. N., Examiner
Toftum, J., Examiner, Department of Mechanical Engineering
DTU-lønnet stipendie
01/07/2002 → 02/02/2006
Award relations: Sensation of "Dryness" humidity of air, comfort and health
Project: PhD

Indoor Particles
Tamás, G., PhD Student, Department of Mechanical Engineering
Fanger, P. O., Main Supervisor, Department of Mechanical Engineering
Toftum, J., Supervisor, Department of Mechanical Engineering
Weschler, C. J., Supervisor, Department of Mechanical Engineering
D'Angelo, G., Examiner, Department of Mechanical Engineering
Olesen, B. W., Examiner, Department of Mechanical Engineering
DTU-lønnet stipendie
01/01/2003 → 30/06/2006
Award relations: Indoor Particles
Project: PhD

Building certification schemes and the quality of indoor environment
Da Silva, N. A. F., PhD Student, Department of Civil Engineering
Wargocki, P., Main Supervisor, Department of Civil Engineering
Tham, K. W., Supervisor
Toftum, J., Examiner, Department of Civil Engineering
Cheong Kok Wai, D., Examiner
Newsham, G., Examiner
Institut stipendie (DTU) Samf.
01/01/2012 → 30/11/2015
Award relations: Building certification schemes and the quality of indoor environment
Project: PhD

People's Behaviour Regarding Control of the Indoor Environment
Andersen, R. K., PhD Student, Department of Civil Engineering
Olesen, B. W., Main Supervisor, Department of Civil Engineering
Toftum, J., Supervisor, Department of Civil Engineering
Nicol, J. F., Examiner
Brohus, H., Examiner
Wargocki, P., Examiner, Department of Civil Engineering
DTU, Samfinansiering
01/08/2005 → 02/09/2009
Award relations: People's Behaviour Regarding Control of the Indoor Environment
Project: PhD

Human comfort and self-estimated performance in relation to indoor environmental parameters and building features
Frontczak, M. J., PhD Student, Department of Civil Engineering
Wargocki, P., Main Supervisor, Department of Civil Engineering
Toftum, J., Examiner, Department of Civil Engineering
Boerstra, A. C., Examiner
Corgnati, S. P., Examiner
Institut stipendie (DTU) Samf.
01/09/2008 → 25/01/2012
Award relations: Human comfort and self-estimated performance in relation to indoor environmental parameters and building features
Project: PhD

Warm or Cold, Lights influence on thermal comfort
Various indicators point out that a connection exists between the ambient temperature and the correlated color temperature that users prefer for the lit environment. In warm climate the use of cooler lighting is much more common than in a colder climate where people use much warmer light sources. Presumably the use of different colored light sources is due to the experience of cooler climate at cooler light sources and the impression of warmth follows a warmer looking light source. With new LED technology the correlated color temperature (warm white to cool white) is easily controllable. The goal of the project is to demonstrate how controllable LED lighting can be used to expand the temperature interval that users find comfortable. The project is founded on previous research on colored light. It will lead to a decrease in the energy consumption of buildings.
Logadóttir, Á., Project Manager, Aalborg Universitet, Statens Byggeforskningsinstitut
Markvat, J., Project Participant, Aalborg Universitet, Statens Byggeforskningsinstitut
Thorseth, A., Project Participant, Department of Photonics Engineering, Diode Lasers and LED Systems
Dam-Hansen, C., Project Participant, Department of Photonics Engineering, Diode Lasers and LED Systems
Toftum, J., Project Participant, Department of Civil Engineering, Section for Indoor Climate and Building Physics
Project ID: 70963
External Project ID: PSO 348-030
ELFORSK
01/03/2016 → 31/12/2018
Collaborators: Aalborg Universitet, Statens Byggeforskningsinstitut
Award relations: Warm or Cold, Lights influence on thermal comfort
Project: Research

Human response to air movements - preference and draft discomfort
The influence of overall thermal sensation, activity level, chair insulation, questionnaire design and physical measurement conditions on human perception on air movements will be tested with human subjects in the climate chamber. By direct comparison, environments with low air velocity and at a moderate temperature and environments with elevated air velocity and temperature will be evaluated with respect to comfort and preference.
Toftum, J., Project Manager, Department of Energy Engineering
Fanger, P. O., Project Participant, Department of Energy Engineering
Melikov, A. K., Project Participant, Department of Energy Engineering
01/04/1998 → 31/03/1999
Project: Research
**Effect of fabric texture and material on perceived discomfort at high humidity**
The project investigates the effect of material (cotton/polyester) and texture (woven/knitted) of the inner layer of a clothing ensemble on human discomfort at high skin humidity.
Toftum, J., Project Manager, Department of Energy Engineering
Rasmussen, L. W., Project Participant, Department of Energy Engineering
01/04/1998 → 31/03/1999
Project: Research

**Impact of airflow direction on human sensation of draught**
Toftum, J., Project Manager, Department of Energy Engineering
Ukendt: DKK726,000.00
01/03/1995 → 31/08/1996
Award relations: Impact of airflow direction on human sensation of draught
Project: Research

**Effect of air humidity on human comfort**
Toftum, J., Project Manager, Department of Energy Engineering
Ukendt: DKK726,000.00, Ukendt: DKK380,000.00
01/10/1995 → 31/12/1996
Award relations: Effect of air humidity on human comfort, Effect of air humidity on human comfort
Project: Research