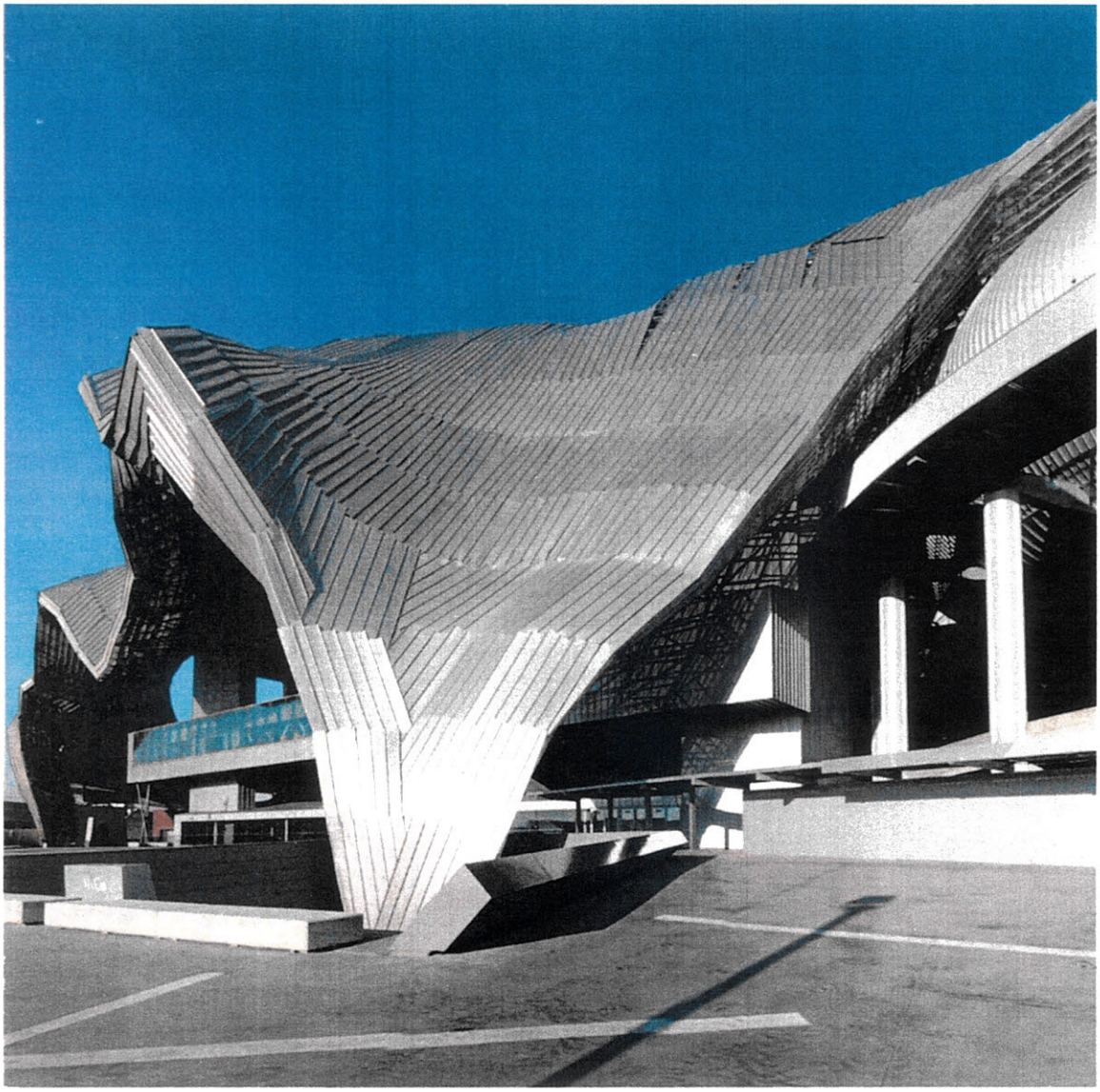

RESEARCH PAPERS FOR EUROFM'S 15TH RESEARCH SYMPOSIUM AT EFMC2016

8-9 JUNE 2016 IN MILAN, ITALY

SUSANNE BALSLEV NIELSEN AND PER ANKER JENSEN (EDITORS)

Polyteknisk Forlag

RESEARCH PAPERS FOR EUROFM'S 15TH RESEARCH SYMPOSIUM AT EFMC 2016
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PREFACE

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Susanne Balslev Niel
Chair of the Scientifi
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PREFACE

The general conference theme for EFMC 2016 is *"FM - enhancing people and business"* and this is also the theme of the 15th EuroFM Research Symposium Research, which is organized as part of the conference. The objective of the research symposium is to present original research that contributes to the understanding of the role of FM in organisations and to encourage discussions and the development of new knowledge amongst researchers and FM professionals and educationalists on this important topic.

This year the research symposium is integrated with the business conference. The last 14 years there have been separate parallel tracks for research presentations and business presentations. Recently there have been various attempts to support a stronger cross-fertilisation between research and practice for instance with joint workshops and panel debates during the conference. However, this year the research and business tracks are fully integrated, so that most sessions include a combination of research and business presentations. The main difference between the presentations is that the research presentations are based on research papers, which have been through the same rigorous review process that was used for earlier EuroFM research symposia, and the papers are published in this scientific publication.

This publication includes all the research papers accepted for the research symposium independent on whether they are presented at a conference session or as posters. All together 40 abstracts was received and after the review process 22 papers has been accepted and are included is this publication. One half of the papers will be presented orally and the other half as posters.

A further new development is that EuroFM has agreed an open access mandate. This ensure that the full text of all published research papers and conference proceedings arising from EuroFM sponsored work should be deposited in an open access institutional repository, or if that isn't available, on the ResearchGate database after the conference.

We thank all authors and the scientific committee for great work. We wish the reader an enjoyable lecture and a lot of inspirations for further research and the application into education and practice.

May the 15th Research Symposium at EFMC 2016 in Milan become a successful event that will help FM in enhancing people and business!

Susanne Balslev Nielsen
Chair of the Scientific Committee and
EuroFM's Research Network Group

Per Anker Jensen
Member of the Scientific Committee and
Head of CFM

A warm thank you to the scientific committee

- Assoc. Prof. Susanne Balslev Nielsen, Technical University of Denmark (chair)
- Assoc. Prof. Knut Boge, Oslo and Akershus University College of Applied Sciences
- Assoc. Prof. Brenda H. Groen, Saxion University of Applied Sciences
- Prof. Per Anker Jensen, Technical University of Denmark
- Prof. Keith Jones, Anglia Ruskin University
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- Prof. Kathy Roper, Georgia Institute of Technology
- Assoc. Prof. Theo J. M. van der Voordt, Delft University of Technology
- Prof. Sergio Vega, Technical University of Madrid

CONTENTS

CONTENTS

4.1 Parameters for Comfort: Comparative study of laws and standards

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ABSTRACT

Purpose and approach: Many environmental factors are defined in laws and standards. But these regulations are mainly country specific and cannot easily be compared. In addition they have different intentions. EU-legislation and standards have led to the adaption of local regulations, but there are still differences and varying priorities in different countries. In order to give an overview of the situation, more than 100 laws, guidelines and standards from Austria, Germany, Switzerland, WHO, EU and USA were evaluated. In addition literature for the relevant areas was analysed.

Findings: The result is a database, showing key criteria, priorities and differences for health, wellbeing and comfort for different countries. To show how to use the database, this paper focuses on office environments. The room climate standards for Thermal Comfort, Indoor Air Quality, Acoustics and Lighting in office environments are compared for different countries, particularly the differences between office environments in the US and Europe and the legislative reasons behind it.

Keywords
Room climate, Indoor Environments, Health, Comfort, Legislation and Standards.

1 INTRODUCTION

This paper has two goals: First one is to describe the development of a database on room climate parameters, which are defined in international and national laws and standards. Research from the last decades has shown, how much health and performance in office environments is influenced by room climate parameters. The Definition of room climate parameters in laws and standards shows us the state of the art.

The second goal is to show the use of the database, by comparing standards in different countries in respect to office environments. Despite to globalization, there are country-specific differences in legislation. This can be interesting for companies rolling out an office-concept on a worldwide basis.

2 METHOD

This review started with an extensive research of Austrian laws and standards to identify relevant room climate parameters. As mentioned above, room parameters refer to the climate conditions inside a room. The European standard EN 15251 gave orientation for key words and helped to structure the parameters. To cover entirely the Austrian building law, the Austrian federal legal information system and the Austrian Standards Database were our search platforms. The reference list in the found standards gave hints to further sources. In the next step platforms of overarching international institutions as EU, ISO (International Organization for Standardization) and WHO (World Health Organization) were screened. To compare the German speaking countries in the DACH-region (DACH stands for D-Germany, A-Austria, CH-Switzerland) we added Swiss and German laws and standards, here to mention the VDI-Guidelines (VDI: German Engineers Association). The USA does not have official national building codes, but each state or local government adopts codes, which are developed by recognized organizations (i.e. ASHRAE). Because of this, there is little uniformity among the regulations in different states (EPA). The study refers to the most common standards. The evaluation of laws and standards took place from March 2015 to August 2015; in total more than 100 laws and standards were evaluated, resulting in about 1700 requirements.

The result of the research of laws and standards was a database to make things comparable. Two areas had to be considered:

- Common parameter definitions
- Common room types

Room parameters can be defined differently, as well as the clustering of the related rooms. In the study room parameters were selected in the following way: Room parameters have to define the conditions inside a room, not the physical characteristics of the surrounding structures and not technical values for devices (i.e. air condition). The European standard EN 15251 helps to structure the parameters: This standard defines indoor environmental parameters for design and assessment of energy performance of buildings. According to this standard the parameters are structured according to Thermal Comfort, Indoor Air Quality, Lighting and Acoustics.

As mentioned above, there is also a big variety in the clustering and naming of room types. The definition of room types is often related to area measurement standards. Room types in the database are based on ÖNORM B1800:2013. The area measurement in this Austrian Standard is according to the European standard for Facility Management (EN 15221-6).

The second goal was the comparative study in respect to office environments. Relevant room climate parameters were compared between different EU-countries and the USA.

3 RESULTS

3.1 Result 1: Database as a common model

The outcome of the extensive research of laws and standards is a rich database on room climate parameters per room type and reference to the source (law or standard), where the requirement was defined. The structure of the database allows filtering for various criteria. These are the chosen categories for indoor environment parameters:

Table 1 indoor environment parameters

• **1 Thermal Conditions**
• 1.1 temperature
• 1.2 air humidity
• 1.3 air velocity
• **2 IAQ Indoor Air Quality**
• 2.1 carbon dioxid (as indicator and benchmark for other emissions)
• 2.2 gaseous emissions (eg. formaldehyde)
• 2.3 particles and fibres
• 2.4 particle-ligated emissions (eg. dioxine/PCB)
• 2.5 tobacco smoke
• 2.6 odour
• 2.7 radiation
Mould fungus, viruses, bacteria and allergens were not part of this study.
• **3 lighting conditions**
• 3.1 **natural lighting:**
• 3.1.1 size of windows / daylight factor
• 3.1.2 intervisibility
• 3.2 **artificial lighting:**
• 3.2.1 illuminance
• 3.2.2 luminous colour
• 3.2.3 colour rendering index
• 3.2.4 Unified Glare Rate
• 3.2.5 lighting density
• 3.2.6 shadows, contrasts
• **4 acoustic conditions**
• 4.1. A- weighted sound pressure level (L Aeq and L Amax)
• 4.2. reverberation time

The database allows filtering for different room climate parameters, for the scope of application or for the land of origin:

Table 2 structure database and example

parameter	unit	application scope	Value	labour law	source	origin/ applic ability	legaly binding?
i.e. temperature	°C	Workspaces Work with low level of physical strain (i.e. sedentary work)	between 19 and 25°	yes	Workplace Ordinance, §28	AUT	yes

To make room types comparable, the application scope of the evaluated laws and standards was assigned to room types from ÖNORM B1800:2013. See here an example:

Table 3 application scope and room assignment

ÖNORM B 1800:2013				Designation, as found in laws and standards
Nr.	usage	Nr.	Room assignment	application scope
2	Office Work	2.1 2.2	Office room Open plan office	Workspaces Work with low level of physical strain (i.e. sedentary work)

3.2 Result 2: Comparing countries

The database enables to compare laws and standards for different countries. In this paper, the focus is on office environments in Europe and the USA.

Thermal conditions in office environments

Fangers Model for thermal comfort (Fanger (1970)) is still the basis for standards on room climate worldwide. The Danish scientist Ole Fanger developed in the late 60ties the model of the predicted mean vote (PMV). The PMV describes the predicted mean thermal perception of building occupants, considering factors as sex, age, clothes, activity level or season. In warmer climates the comfort temperature for naturally ventilated buildings is much higher (van Hoof (2008)). This led to the development of an adaptive comfort model as an optional method in ASHRAE Standard 55 (2004).

European (ISO 7730) and national standards as well as ASHRAE-standards (ASHRAE Standard 55) are based on the PMV-Modell. This means, that the legal requirements for thermal comfort might be quite similar all over the world.

A glance at the laws and standards shows, that this is true in general. Differences can be found in the valuation of air humidity and air velocity as influence factors. Regulations are binding in some countries, in others they can be seen more as a recommendation. Table 4 gives a short overview: The comparison shows, that the relevance of air humidity for the satisfaction with the room temperature has a differing priority. In Austria air humidity is considered to be relevant only in rooms with air condition. Temperature is tolerable in a quite large spectrum between 19° and 25°, while there are no consequences when temperatures are higher than 25°. In German standards there exists a dependency between air humidity and

temperature, but only maximum air humidity is defined. In contrast to Austria there is a risk assessment for higher temperatures. With room temperatures higher than 35° work is not permitted by law.

In Switzerland recommendations include air humidity and air velocity. Dependent on these two factors a temperature range for thermal comfort is defined. In Switzerland there is also an action plan for high temperatures.

In ISO 7730 focus is put on the dependency of thermal comfort on air velocity; the influence of air humidity is described as insignificant for temperatures under 26°. In contrast to this, the ASHRAE Standard 55 gives recommendations on temperatures, depending on air humidity. The European ISO-Standard recommends much lower temperatures than the American ASHRAE-Standard, especially in summer. The common assumption, that in America rooms are cooled down to much lower temperatures than in Europe is not reproduced in the comparison of the standards.

Indoor Air Quality in office environments

Indoor Air Assessment: Guidelines to assess the indoor air quality can be found in different countries (in Austria: Guidelines for Indoor Air Assessment). In Europe emissions should be controlled with the EU-Construction Products Regulation and the CE-label for consumer products. The legally binding Austrian OIB-guideline requires that emissions from building materials must not be harmful to health. This requirement is deemed to be fulfilled, if approved building products are used in their designated purpose (OIB, 2011). Just one example that this control is not always working properly: In a project called 'Healthy Habitat School' the TUEV Rheinland and Sentinel Haus Institut built a classroom, added furniture, cleaned regular and made a refurbishment with new wall paint and new flooring after a period of time. They used approved randomly chosen building- and cleaning materials. The pollution of indoor air was much higher than recommended by the German Federal Environment Agency. On the other hand, they built a second classroom with a quality assessment on building materials and cleaning products. Materials were chosen, that were as sustainable and environmentally friendly as possible. This quality assessment resulted in a satisfactory indoor air quality. (Bachman, P. (2015)).

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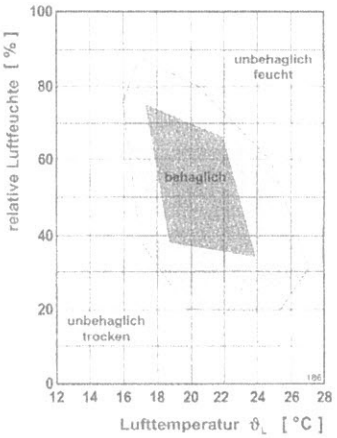
Table 4 comparison of thermal conditions for office workplace

land	air humidity and air velocity:	Temperature:	law or standard
Austria	Humidity between 40 and 70%. Only regulated for rooms with air condition. Air velocity Max. 0,10 m/s	Between 19 and 25°C 25° if possible not to exceed.	Workplace Ordinance VO§28
Germany	max. 80% humidity	20°C	ASR A3.5: Room Temperature
	max. 70% humidity	22 °C	
	max. 62% humidity	24°C	
	max. 55% humidity	26°C	
		26°C not to exceed If outside temperature >26°C and Indoor air temperature >26° additional measures and Risk assessment for special groups: pregnancy, older people.. If indoor air temperature >30°C action plan for all employees If indoor air temperature >35°C:Work not permitted	
	Air velocity: < 0,15 m/s	If indoor air temperature >20°C	ASR A3.6 Ventilation
Switzerland	recommendation of EN ISO 7730, additional: Recommendation of indoor air temperature, depending on Air Humidity and Air Velocity. Risk assessment and action plan for temperatures >26°C Diagram on the influence of temperature and relative air humidity on thermal comfort is part of the guideline:  Terhaag (1986) Figure taken from: SECO (2015)	Instructions to Ordinances 3 and 4 , Swiss Labour Law
Europe, ISO	Summer: (Cat.A) 0,12 m/s	23.5-25,5°C acceptable	ISO 7730:2005
	Winter: (Cat. A) 0,16 m/s	21-23°C acceptable	
USA Canada	Summer: (light clothing) if 30%, then:	24.5-28°C acceptable	ASHRAE Standard 55-2010 The same values are recommended by the Canadian Centre for Occupational Health and Safety. (ccohs.ca)
	Summer: (light clothing) if 60%, then:	23-25.5°C acceptable	
	Winter: (warm clothing) if 30%, then	20.5-28°C acceptable	
	Winter: (warm clothing) if 60% then	20-24°C acceptable	

CO_2: CO_2 (carbon dioxide) is an indicator for indoor air quality. The recommended values for good air quality do not vary much. The Austrian Guidelines for Indoor Air Assessment recommend a concentration of 600-1000 ppm as a standard mean value. EN 13779: 2007 defines the same value as a recommendation for moderate air quality. Besides to the MAK-Value (Maximale Arbeitsplatz Konzentration – maximum workplace concentration) of 5000ppm there are no binding regulations for CO_2. The MAK-value limits the effects of chemicals workers may encounter in the course of their job; higher values are supposed to be harmful to health. The concentration of CO_2 influences performance and wellbeing with much lower values, as you can see from the general recommendations for air quality. CO_2-Values in the concentration of 600-1000ppm indicate that the values for human emanations, odours and some other volatile organic substances are also in a good spectrum.

Chemical agents: With respect to legal regulations on occupational health, in all countries there is a kind of ordinance on the exposure to chemical agents (Austria: Grenzwerteverordnung). It sets out exposure limit values and preventive measures to protect workers from the effects of chemicals they may encounter in the course of their job, so to say: Materials they use for their work, i.e. detergents for the cleaning stuff. The emissions from materials and devices in the office environment are not regulated in these ordinances, but in product regulations and guidelines for Indoor Air Assessment. The Austrian Guidelines for Indoor Air Assessment recommend the same value of 0.5 ppm for formaldehyde as the exposure limit value in the Austrian Grenzwerteverordnung. In other cases values from these two sources can vary in a large spectrum. The Grenzwerteverordnung- exposure limit value for i.e. styrol is 2000 times higher (85mg/ m^3) than the recommended value from the guidelines for indoor air quality (40 $\mu g/m^3$).

Tobacco smoke: Legally binding regulations, concerning indoor air quality, can be found in the laws concerning tobacco smoke. Protection of non-smokers is regulated in Austria in the Occupational Health and Safety Act (Arbeitsstättenverordnung). Non-smokers are widely protected, but if the company management has no own directives, in Austria smokers are still allowed to smoke at their workplace: If the employee has a single office or in the room are only other smokers and if the workplace is not open to customers, smoking is allowed. In the USA smoking is not regulated by the federal Occupational Safety and Health Administration. Each state has its own regulations. Surprisingly there are still some states, where smoking in workplaces is allowed. In North Carolina for example smoking is prohibited only in the enclosed areas of restaurants and bars (nolo.com).

Lighting in office environments

Natural lighting and views: The lighting topic affects workplace design very much. In Austria the view outside from each stationary workplace is mandatory. For this reason, the typical American cubicle workplaces could not be realized in an Austrian office. European EN 12464-1 gives not so many restrictions, but underlines the importance of natural light.

Glare effects: To avoid glare effects on computer screens, the EU-Council Directive on the minimum safety and health requirements for work with display screen equipment regulates, that workplaces always have to be parallel to windows. If office furniture manufacturer show pictures of workbenches with windows in the back, this might be a project outside the EU.

Acoustics: Concerning acoustics, there are two main topics: Noise prevention and speech intelligibility. Most regulations on acoustics refer to characteristics of the surrounding building and outfitting elements. The recommendations on adequate maximum noise levels

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do not differ very much: The Austrian VOLV (ordinance noise and vibrations) defines noise levels over 65dB(A) as disturbing for basic office work; for intellectual activity the critical value is 50dB(A). Worldwide, noise-induced hearing impairment is the most prevalent irreversible hazard (WHO, 1999). The critical value for noise induced hearing impairment depends from noise level and duration. The action value for long-term exposure – 8hours/day- is limited with 80dB(A), peak exposure is limited with 135dB(A) (VOLV). The critical values for noise induced hearing impairment are more relevant for other workplaces than offices. Office-related noise topics are:

- Noise as an environmental stressor with physiological and mental impact on health, concentration and performance
- Interference of noise with speech communication

Table 5 Natural lighting and views

land	Natural lighting	view	law or standard
Austria	1. size of translucent openings min. 10% of floor surface 2. windows have to lead directly into open air.	View outside mandatory from each stationary workplace. Window size at least 5% of floor surface of the room. Light domes or glass-roofs do not count for intervisibility.	Workplace Ordinance §28
Germany	Min. relation of translucent openings to floor surface of 1:10		ASR A3.4.: Lighting
Switzerland	Reference to EN12464-1		
Europe	Underlines the importance of natural light. Requirements for natural light are the same as for artificial lighting.		EN12464-1

3 CONCLUSION

By comparing office environments in the US and Europe despite to the globalization trend many differences can be found. Reshaping the own office environment, one might get inspired by trendsetting workplace concepts, seen for example at the new Facebook or Google headquarters. These concepts cannot be transferred one by one to European countries. Workplace design is regulated in labour law, which has its basic structure in EU regulations, but is in detail still country-specific. Therefore, when rolling out a workplace concept internationally the design and roll out team has to take into consideration the local regulations. This can even be the case when expats are working for a longer time in other countries.

The next step of the research is to set up statistical models, to link office environment parameters to the performance of the employees. With the help of the models it will then be possible to provide guidelines for "productive" workplace infrastructure.

REFERENCES

Bachmann, P. (2015): *Bau und Betrieb von Bildungseinrichtungen. Sentinel Haus Institut und TÜV Rheinland.* In: Tagungsunterlagen Management Forum Starnberg, December 2015, Germany.

Fanger, P.O. (1970): *Thermal comfort: analysis and applications in environmental engineering*. Danish Technical Press ,Copenhagen, Denmark.

SECO – Direktion für Arbeit - Arbeitsbedingungen (Hrsg.) (2015): *Wegleitung zu den Verordnungen 3 und 4 zum Arbeitsgesetz*. Bern, Switzerland

Terhaag, L.(1986).: *Thermische Behaglichkeit - Grundlagen*. In: Beckert, J.; Mechel, F.P.; Lamprecht, H.-O.: Gesundes Wohnen: Wechselbeziehungen zwischen Mensch und gebauter Umwelt; ein Kompendium. S. 49 ff., Beton-Verlag, Düsseldorf, Germany.

Van Hoof, J.(2008): *Forty years of Fangers model of thermal comfort: comfort for all?*. Indoor Air 2008; 18: 182–201, Singapore.

Laws and standards:

Arbeitsstättenverordnung (AStV): *Verordnung des Bundesministeriums für Arbeit, Gesundheit und Soziales, mit der Anforderungen an Arbeitsstätten und an Gebäuden auf Baustellen festgelegt und die Bauarbeiterschutzverordnung geändert wird.* Austria

ASHRAE Standard 55-2013: *Thermal Environmental Conditions for Human Occupancy,* USA

EN 13779: 2007 *Ventilation for non-residential buildings – Performance requirements for ventilation and room-conditioning systems,* CEN, European Comittee for Standardization, Brussels, Belgium.

EN 15251:2007 *Indoor environmental input parameters for design and assessment of energy performance of buildings addressing indoor air quality, thermal environment, lighting and acoustics*, CEN, European Comittee for Standardization, Brussels, Belgium.

EN 15221-6:2011 *Facility Management - Part 6: Area and Space Measurement in Facility Management,* CEN, European Comittee for Standardization, Brussels, Belgium.

EN ISO 7730:2005: *Ergonomics of the thermal environment -- Analytical determination and interpretation of thermal comfort using calculation of the PMV and PPD indices and local thermal comfort criteria*, CEN, European Comittee for Standardization, Brussels, Belgium.

EN 12464-1:2011*: Light and lighting. Lighting of work places. Indoor work places*, CEN, European Comittee for Standardization, Brussels, Belgium.

EU-Council Directive 90/270/EEC: *minimum safety and health requirements for work with display screen equipment,* Brussels, Belgium.

ÖNORM B-1800:2013 *Determination of areas and volumes of buildings and related outdoor areas,* Austrian Standards Institute, Vienna, Austria.

OIB-Richtlinie 3 (2011): *Hygiene, Gesundheit und Umweltschutz,* Österreichisches Institut für Bautechnik, Austria.

Regulation (EU) No 305/2011: *Construction Products Regulation,* Brussels, Belgium.

Richtlinie zur Bewertung der Luftqualität von Innenräumen: Hrsg. Österreichische Akademie der Wissenschaften – Kommission für Reinhaltung der Luft im Auftrag des BMLFUW, Austria.

Technische Regeln für Arbeitsstätten *ASR A3.4.: Beleuchtung*. (2011) Hrsg. Bundesministerium für Arbeit und Soziales, Ausschuss für Arbeitsstätten, Germany.

Technische Regeln für Arbeitsstätten *ASR A3.5 Raumtemperatur*. (2010) Hrsg. Bundesministerium für Arbeit und Soziales, Ausschuss für Arbeitsstätten, Germany.

Technische Regeln für Arbeitsstätten *ASR A3.6 Lüftung*. (2012) Hrsg. Bundesministerium für Arbeit und Soziales, Ausschuss für Arbeitsstätten, Germany.

Verordnung Lärm und Vibrationen (2006): *Verordnung über den Schutz der Arbeitnehmer/innen vor der Gefährdung durch Lärm und Vibrationen*, Austria

WHO World Health Organisation (1999): *Guidelines for Community Noise,* Geneva, Switzerland

Search platforms / weblinks: status January 21th 2016

Austrian Standards: *https://www.austrian-standards.at/home/*

EPA United States Environmental Protection Agency *http://www3.epa.gov/region9/greenbuilding/codes/standards.html*

Federal Occupational Safety and Health Administration, USA: *https://www.osha.gov/law-regs.html*

North Carolina Laws on Smoking: *http://www.nolo.com/legal-encyclopedia/workplace-smoking-laws-north-carolina-46919.html*

RIS Rechtsinformationssystem des Bundes, Österreich (Austrian federal legal information system): *https://www.ris.bka.gv.at/*

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ABSTRACT

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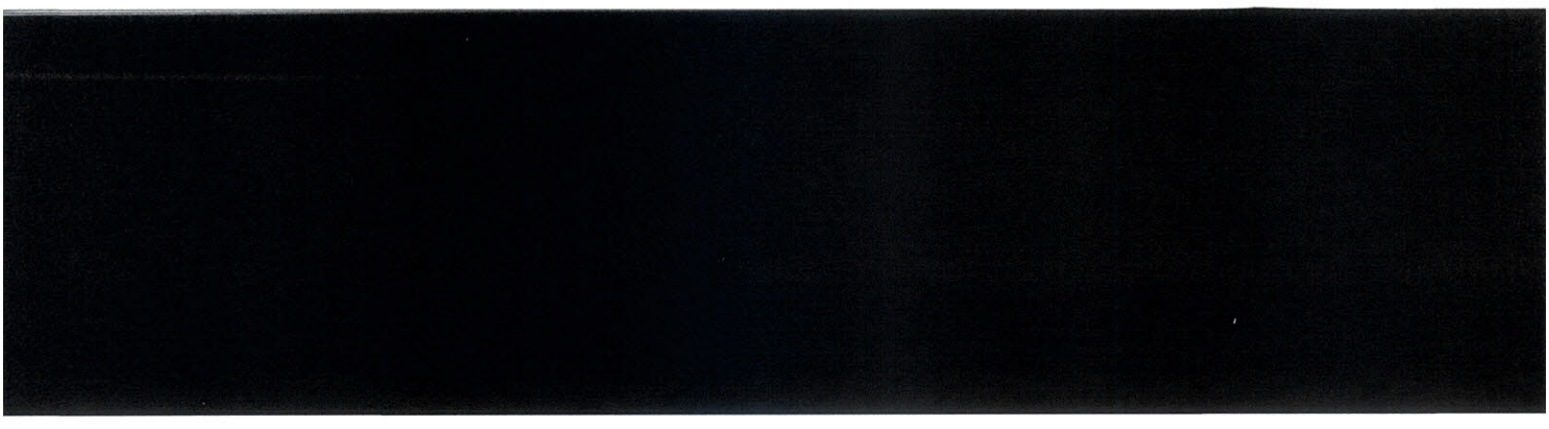

The 15th EuroFM Research Symposium was organized as part of the European Facilities Management conference EFMC 2016 in Milan Italy, 8-9 June 2016.

The objective of the research symposium is to present original research that contributes to the understanding of the role of FM in organisations and to encourage discussions and the development of new knowledge amongst researchers and FM professionals and educationalists on this important topic.

This year the research symposium was fully integrated with the business conference to support a strong cross-fertilisation between research and practice. Most sessions included a combination of research and business presentations. The main difference between the presentations was that the research presentations are based on research papers, which have been through a rigorous review process as used for earlier EuroFM research symposia, and the papers are published in this scientific publication.

All together 40 abstracts was received and after the review process 22 papers was accepted and are included is this publication.

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