M+P | Müller-BBM Group
The solution people

Healthy and Productive Buildings

The HPEE concept in a nutshell

The HPEE concept

The concept HPEE buildings (Healthy, Productive and Energy Efficient, pronounced as 'happy') aims to improve employee satisfaction, increase work productivity and at the same time reduce the use of energy. As a result, everyone will be happy: employees, employers and building owners.

Background

Since 2007 M+P have been engaged in the development of concepts for open plan offices. A high acoustical comfort level turned out to be an important requirement for the success of these concepts. Regarding health in general, also the overall indoor climate is being considered. Temperature, freshness, clean air and acoustics are key aspects of working healthily, comfortably and productively.

HPEE

Based on an extensive literature study and a field study, M+P have developed a method to apply scientific knowledge in a quick and intelligible way, in order to qualify and improve the indoor climate. For this purpose an accessible network of building data is used, which up to this moment is based on sensors that register air temperature, relative humidity and CO_2 level. In addition, M+P developed sensors which can be used to monitor sound reliably and cost effectively. The building data are converted to an Indoor Climate Rating (ICR) and a Potential Productivity Index (PPI) and a Mach Index (MI).

Indoor Climate Rating [ICR]

Temperature, fresh air, clean air and acoustics are the most important aspects of working comfortably. These aspects cannot always be translated directly into measurement values of sensors. For example, a temperature of 26 °C (79 °F) will be considered too warm in winter, while in summer (when outdoor temperatures are high too) it will be perceived as pleasant. This is especially true if it is possible to open a window. Measuring and assessing user comfort calls for a more sophisticated system, which combines sensor data. By monitoring, insight in the comfort level can be provided at any time.

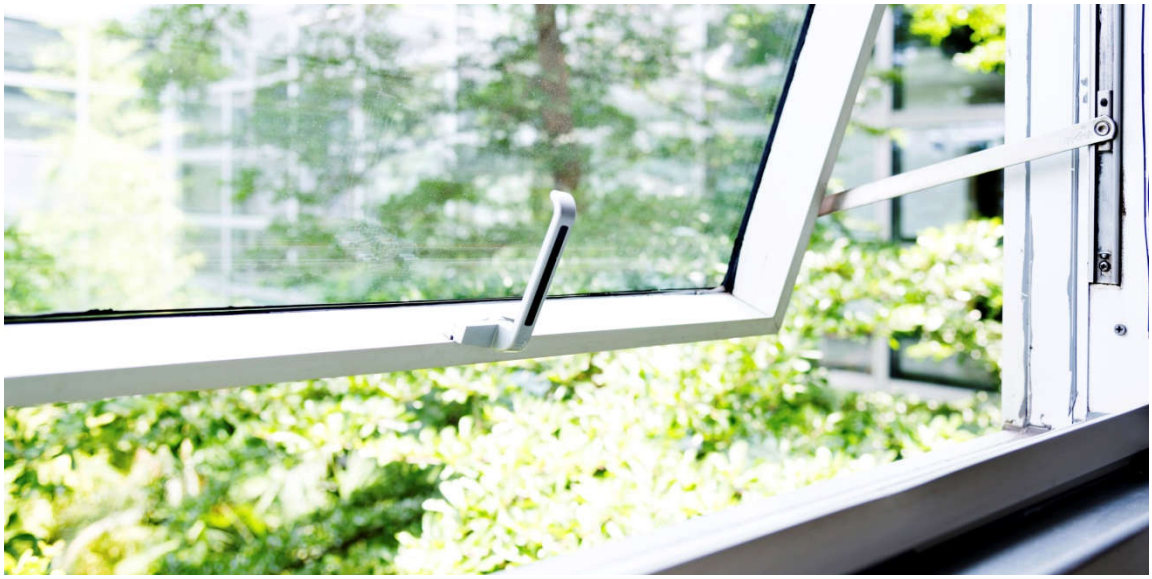
Important values to monitor are air temperature, relative humidity and CO_2 levels. Assessment of the acoustics and disturbance by sound are currently being developed.

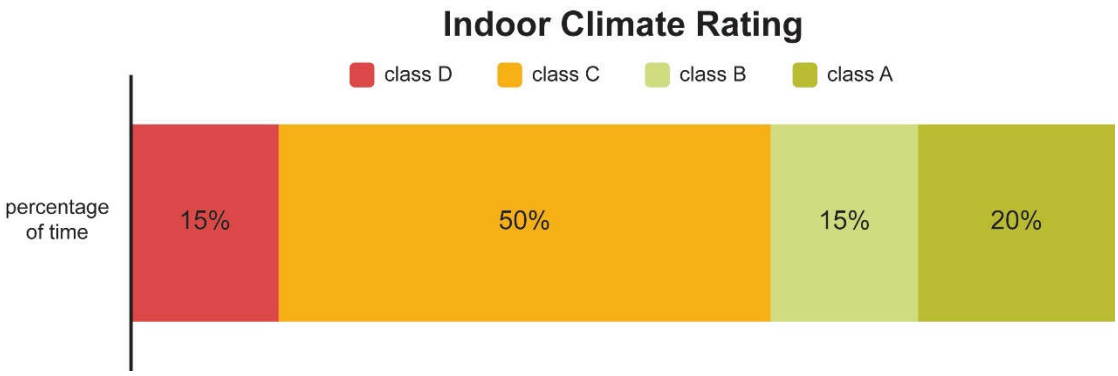
We interpret the measured values to classify them into comfort classes. In order to do that, we use relations described in international research. After choosing a time interval, for example a year, month or week, this leads to a quality evaluation.

This quality evaluation is a result of comparing and combining the evaluation values of individual components that together define the indoor climate quality. For analytical purposes, these components can also be inspected individually.

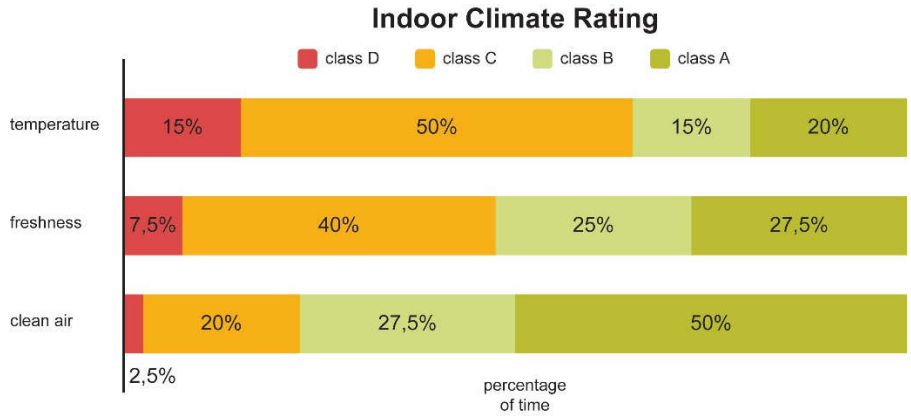
By presenting the ICR corresponding to each measured interval as a dot on a time axis, it becomes immediately clear at which moments the quality of the indoor climate is high, and at which moments it is low. This could show for example a lower rating of the temperature if the sun is shining on a façade, or a lower freshness rating when the occupancy of a room increases.

The Indoor Climate Rating should ideally be used alongside questionnaires. The two can complement each other, resulting in a better understanding of the comfort specific to the measured company, building or activities. Based on the combination of sensor and questionnaire data, targeted interventions to enhance the user comfort can be carried out. Monitoring allows for making the improvements visible and making adjustments if necessary.

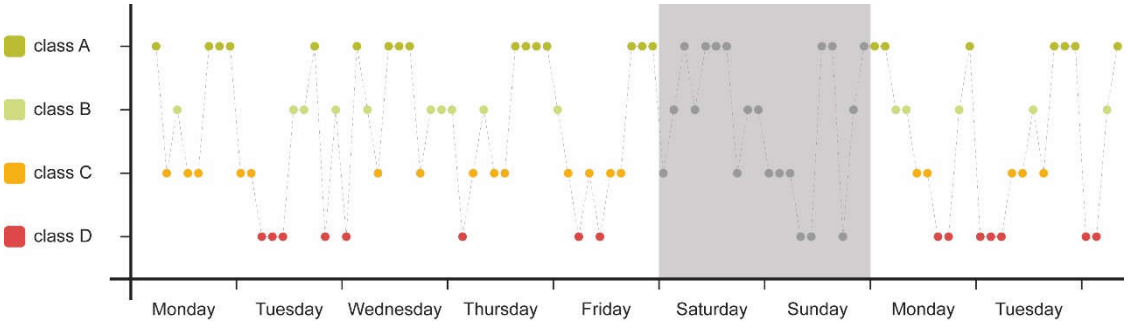




display ICR total -distribution of measurement results into comfort classes



display ICR per component -distribution of measurement results into comfort classes



display ICR total over time

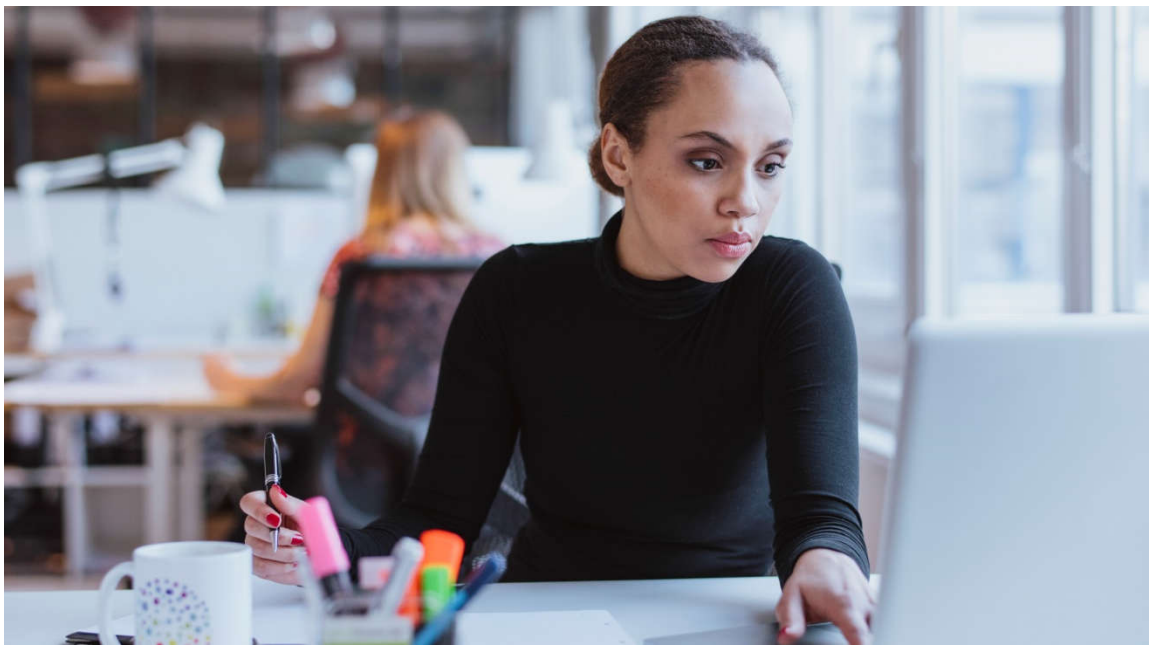
Potential Productivity Index [PPI]

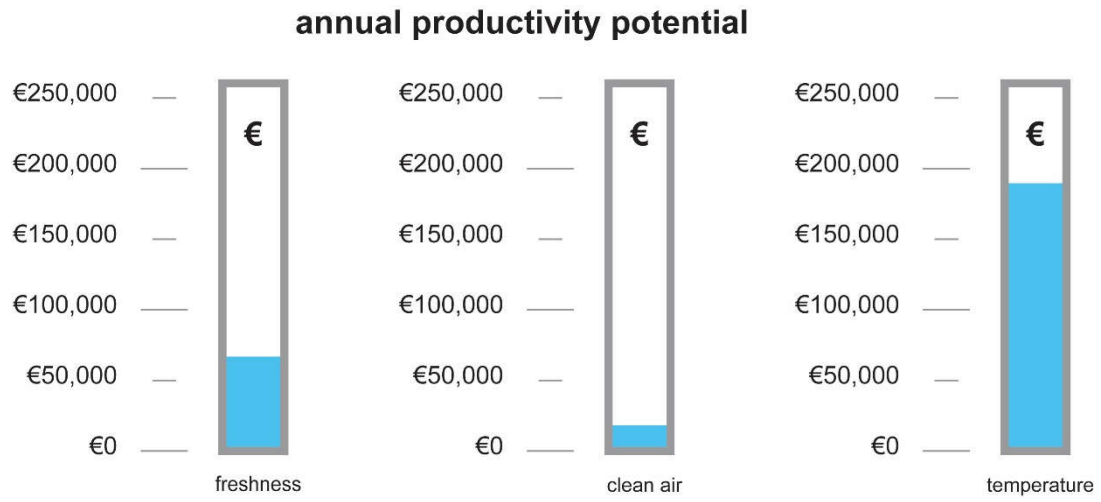
Productivity is partly linked to perceived comfort. After all, when we can work comfortably, we require less adaptation to our surroundings. Hence we can optimally focus our energy on our work.

Extensive international research has been conducted to define a relationship between productivity and the indoor climate, mostly in controlled lab environments. Based on the relations found in this research, the percentage of productivity is calculated from the same parameters used to predict user comfort: air temperature, relative humidity and CO_2 levels. This percentage shows the ratio of productively-used-time compared to the total-work- time. When the indoor climate is ideal, all time is used productively, resulting in a productivity of 100%. In that case, no further improvements can be achieved.

A productivity of 90% leaves room for an improvement of 10%, expressed in the Potential Productivity Index. Combining this PPI with the hourly profit of an employer, or with their costs, can be used to indicate the potential profit of improving the indoor climate.

The influence of temperature, fresh air and clean air on productivity are assessed separately. The total effect is determined by the decisive aspect, which is the worst performing. This indicates the potential profit of improving the indoor climate on that aspect. Consequently, a plan can be made to determine by how much productivity will increase, how much investments are needed for this and how much profit this will generate.



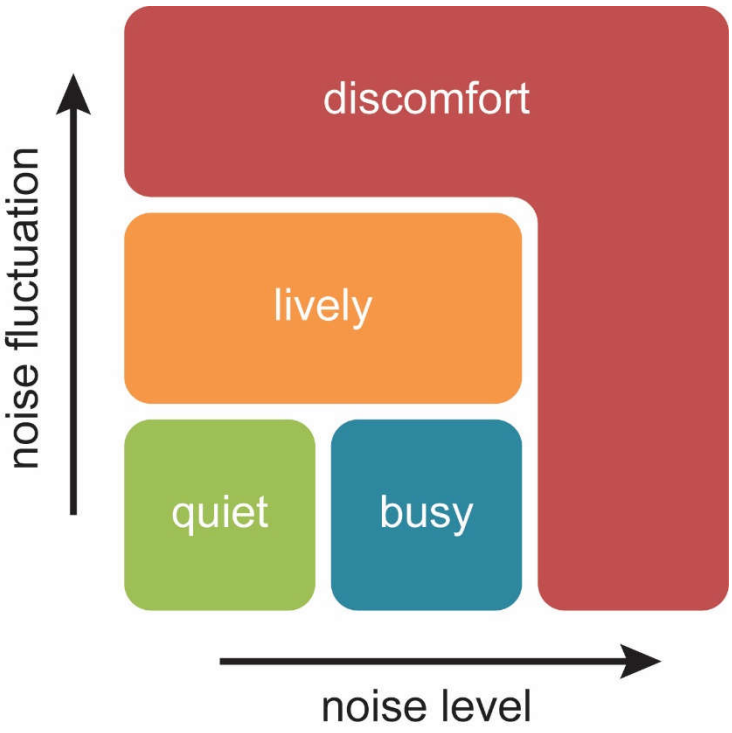


productivity = 90.5 % / PPI = 9.5%
financial potential: € 190,000
(example of business services company, turnover of €2M)

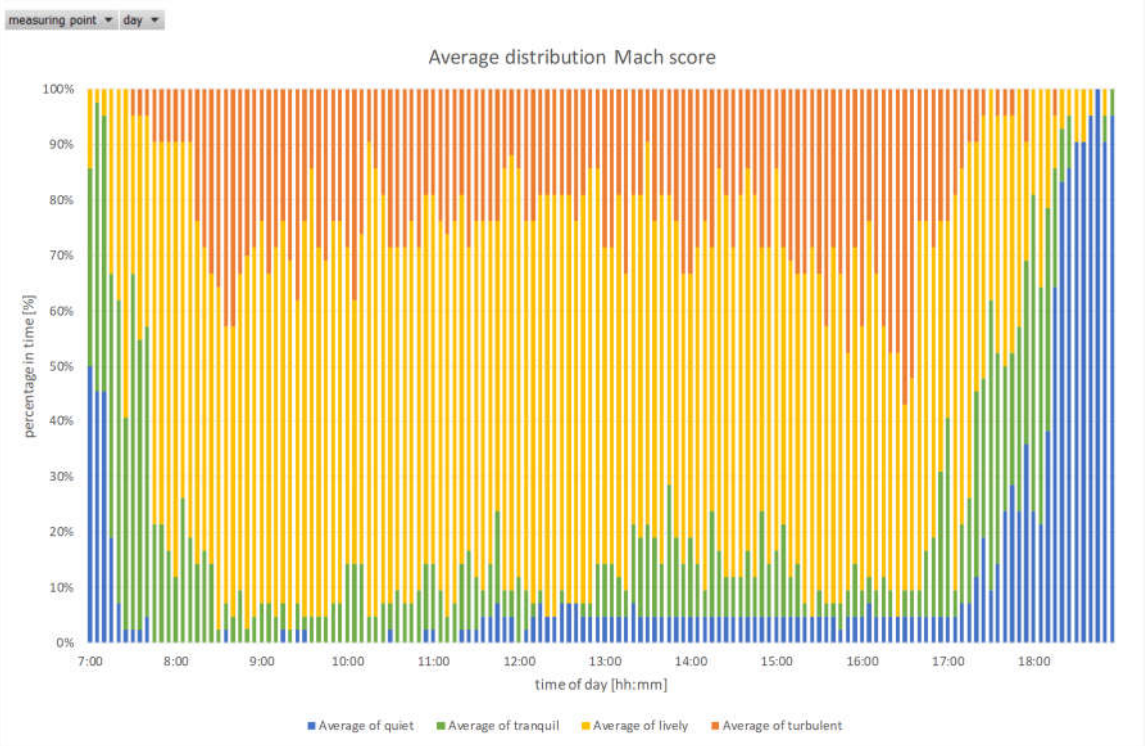
Mach index (sound)

In the available literature, sound is less well described when it comes to productivity and perceived comfort. Extensive surveys have proven sound to be an important factor influencing discomfort. Generally speaking, people experience less comfort at high sound levels. Research shows that this is mainly due to the level of distraction caused by sound. Whether or not sound is distracting depends on the type of sound in relation to the type of activity someone is doing. In addition, our personality is an important factor.

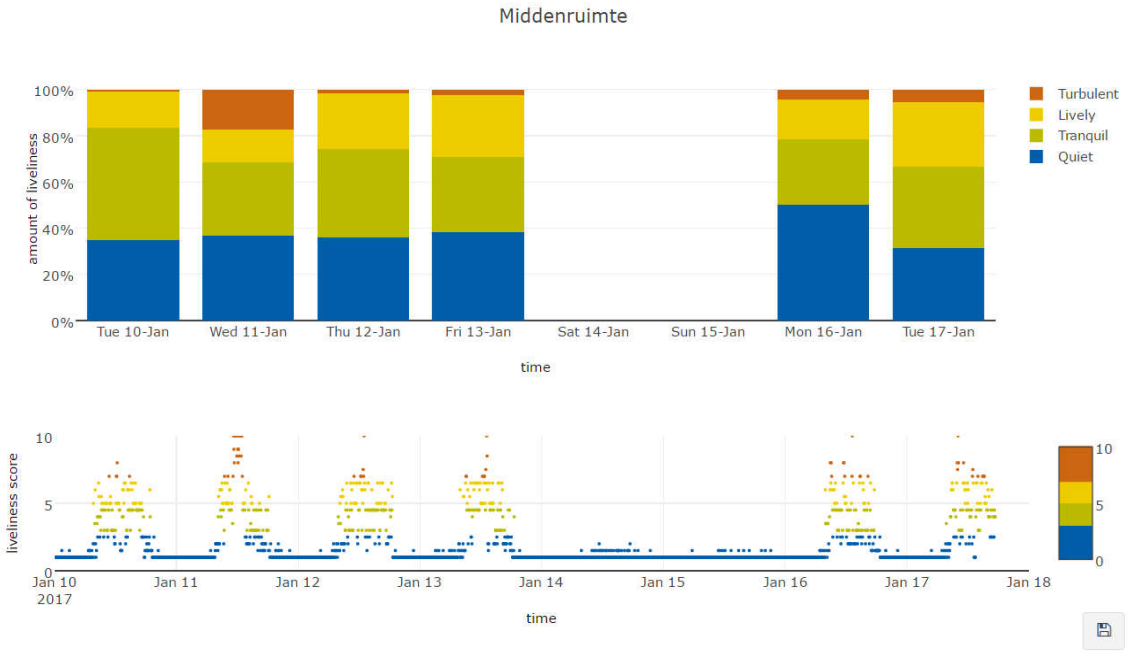
Hence, differences between individuals, as well as the type of sound and work activities, are important for the perceived level of distraction. Therefore it is virtually impossible to quantify the loss of performance in a certain sound environment, without using additional information. We do know however that certain personalities and types of work activities are better suited for quiet environments, while others do not experience discomfort or even thrive in a lively sound environment.
The assessment method that M+P developed, which is based on a field study carried out in different office environments, offers the opportunity to qualify the sound environment using intelligible descriptions. To do so, both the sound level and the amount of fluctuation are assessed. Subsequently one can easily estimate the expected productivity in a certain sound environment, using knowledge of the intended work activities or a personal preference.



framework for determining the Mach index (for more information, please refer to "Proposed method for measuring 'liveliness' in open plan offices", Vellenga, S., Höngens, T. and Bouwhuis, T., 2017)



example of measurement data liveliness



example online portal

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