



Middelfart Sparekasse, Denmark

White paper

Healthy office, healthy return

How the right acoustics can boost property value and return on investment, while adding the 'wow factor' to your office.

Sounds Beautiful

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A healthy return

For much of 2020, offices stood empty as the COVID-19 pandemic swept the world. Collective anxiety changed the world of work. So how can businesses bring workers back to the office — and with them, the productivity of in-person collaboration? It's time to invest in the future of the workplace: healthy, flexible and digital by design.

In future, the most sought-after commercial properties will protect worker wellbeing, with safety and comfort taking centre stage. In a healthy office, workers feel confident, supported and productive. Teams innovate naturally to drive business success. And everything about the environment nurtures vitality and morale. Think comfortable noise levels, hygienic and non-toxic building materials and ample natural light.

In this whitepaper, we answer key questions about healthy office design and its effects, plus how to renovate your property's acoustics to help attract and retain quality tenants.

Could creating a healthy office give your property a competitive edge?

01 Rethinking the workplace

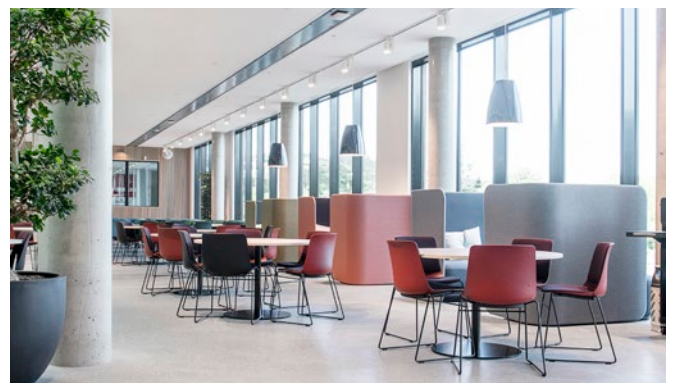
During the pandemic, the world's workers experienced a radical shift. Offices went dark as 88% of organisations asked employees to work from home¹. When the lights went back on, many workers didn't want to return to offices, whether from safety concerns or because they simply liked remote working. Now analysts are predicting that 25-30% of the workforce will work from home multiple days a week by the end of 2021².

So what does this mean for commercial property owners globally? Since the 2008 recession, many experienced rising returns as they responded to exploding demand for flexible working. They now confront another inflection point as many companies use this moment to rethink the workplace. As tenants focus on unifying dispersed workforces so they can stay competitive, they'll need offices that function as safe havens where teams can come together to meet face to face, collaborate, plan and work together.

At first, lower worker density in offices is necessary as it enables social distancing, improving worker safety. But once pandemic risks recede, demand for commercial property may soften as companies see the opportunity to shrink their footprint and reduce cost.

Right now, safe, hygienic workplaces that can accommodate fluctuating worker density have the edge. For asset owners, survival lies in smart investments to create calmly thriving properties that coax anxious and reluctant workers from their work-from-home bubbles and make them want to come to work.

1. Gartner, 2020
2. Global Workplace Analytics, 2020



02 Turning offices into comfort zones

The spaces we inhabit every day deeply influence how we feel and perform — and, by extension, what we can achieve as workers, teams and organisations. With anxiety at an all-time high, we're entering an era of neuro-architecture, where office designs actively nurture performance, concentration and productivity. Companies will aspire to the anti-anxiety office: a place that de-escalates stress, shapes positive moods and behaviours and makes people feel comfortable and safe at work.

Will building owners need to renovate?

Generally, renovation is a smart way to increase lease value and achieve a better return on investment. That's because, even when markets are flooded with choice, quality is still scarce. When workers and business owners can afford to be picky, it's important to deliver the features they expect in a modern workspace. Co-working spaces in particular will require meticulous attention to hygiene, wellbeing and acoustics. With these concerns in mind, many asset owners will want to move swiftly to upgrading their buildings with an emphasis on creating healthy offices that prioritise the mental and physical wellbeing of every occupant.

Top 4 post-pandemic upgrades

- 1. Acoustics:** With workers joining meetings digitally at their desks instead of in a meeting room, noise levels can be jarring. Materials that reduce noise and distraction to create a calm environment will pay dividends in promoting the healthy cognition needed to work productively.
- 2. Daylight:** In a recent study³⁾, 47% of employees said the absence of natural light at work made them feel tired, with 43% reporting feeling gloomy. Daylight reduces stress, improves concentration and lets plants thrive. Investing in renovations that optimise light will make your building more attractive.
- 3. Flexible layouts:** The trend toward hotdesking has given way to well-spaced allocated desks needed for safe, socially distanced working. However, open plan layouts will resurge if the work-from-home trend persists as companies look to optimise floor space for reduced worker density. Tenants will value spacious meeting rooms and collaboration areas that can flex easily to accommodate desired density.
- 4. Sanitary by design:** Tenants will prefer materials that are hygienic, safe and easy to clean, with cutting-edge HVAC systems for healthy ventilation. Open air areas with stairs that allow people to avoid elevators will be appreciated in the near term. Accessible outdoor spaces will continue to be prized.

³⁾ Future Workplace, 2018



(The sound of concentration in an office where people can hear themselves think.)

03

Which renovations do today's workers value?

COVID-19 amplified the existing strong market trend to healthy offices in an unprecedented way. Already tuned in to the health and lifestyle benefits that come from working in healthy environments, post-pandemic workers will value spaces that are more comfortable and quiet than their own homes. To encourage them back to work place, employers will need to answer heightened demands for productive, calm and aesthetically designed offices. Research shows such offices pay dividends in attracting talented workers and encouraging their peak performance.

In 2014, the World Green Building Council (WBG) issued a report showing a clear link between a building's design and the wellbeing and productivity of its users. The report identified the most important factors affecting health: air quality, thermal comfort, daylight, acoustics, interior design, the views from the office, the look and feel, and locations. The impact is substantial. Poor air quality, for example, can cause employee productivity to fall by 10%. Temperatures that are too high or too low can also have a negative effect on productivity.

Personnel costs are responsible for **90% of a company's operational costs**, so it makes a huge value impact when you can help staff to work better "

Healthy office, healthy return

In 2015, the Dutch Green Building Council issued a health report, *Welfare & Productivity in Offices*, which found a strong business case for investing in healthy office environments. 'The personnel costs are responsible for 90% of the operating costs of a company, many times more than the accommodation and the energy costs. A slight improvement in the productivity of an employee can have a major impact on the profitability of the whole company.' (p. 57)

A healthy office is also appealing to employers, because they can use their work environment to showcase and differentiate their brand to potential recruits. According to WBG, building renovations rapidly pay off by:

- Increasing awareness and expectations among investors and tenants about a healthy indoor climate (p. 57)
- Prompting prospective buyers and tenants to pay more attention to health, wellbeing and productivity when evaluating buildings (p. 57)
- Introducing health, wellbeing and productivity into the assessment frameworks used in vacancy and valuations (p. 57)

Beautiful healthy offices are talent magnets

The labour market is changing fast. Baby boomers are retiring in the next ten years. Organisations are focused on attracting and retaining talented young employees. Newer generations don't necessarily attach themselves to one job for life. Instead, they desire a workplace that supports flexibility, co-operation, new technologies, sustainability, and a good work-life balance. They also prefer employers who care about their safety and wellbeing, a trend sharpened by the pandemic, which has also added hygiene into the mix. Modern office designs that emphasise all these will be in greater demand.

What do younger workers value?

To attract Generation X and Millennials — and soon, Generation Z — employers need to offer a work environment that appeals to contemporary values. Spaces that are healthy, airy and bright, with beautiful furnishings, plants, design items and cutting-edge technology all hold great value to these demographics. They also expect plenty of room for flexible work and collaboration, much of it digital. High-tech multi-use spaces, huddle rooms, brainstorm areas, meeting rooms and quiet contemplation zones are vital to supporting modern work practices. Additional features such as relaxation spaces, bars and fitness rooms are also considered high status. For today's anxious post-pandemic workers, safety, comfort, health and hygiene are all important to the value equation.

The Four Cs

A successful contemporary office design carefully considers the Four Cs: Concentration, Contemplation, Communication and Collaboration. Does your office meet all of these basic needs? If you are offering a flexible open space, have you considered the acoustic measures that will be required to achieve this? For example, Communication and Collaboration will not be effective if you cannot also create the atmosphere for Concentration and Contemplation.

To support the Four Cs, it is important for a modern workplace to isolate sound and provide privacy, as well as reducing noise levels.



04

How can acoustics improve worker health and productivity?

Coming back to a noisy open plan office full of people videoconferencing and moving around will be jarring for many post-pandemic workers. Research shows noise impairs concentration and productivity. Often, trend-driven renovations with scant sound proofing make things worse. Careful acoustic design will be necessary to create the kind of safe, calm spaces workers will gravitate toward. In 2018, acoustics was added to the list.

Hearing and health

Poorly designed buildings can literally make us sick. Documented by the World Health Organization (WHO) since 1984, Sick Building Syndrome (SBS) is a series of health symptoms caused by poor air quality in a building. SBS manifests as headaches, dry eyes, sore throat, dry skin, tiredness, lack of concentration and/or feelings of dizziness.

Noise is simply stressful — and it leads to serious health problems. The WHO's 2018 report noted: 'Through direct injury to the auditory system, noise leads to effects such as hearing loss and tinnitus. In addition, noise is a nonspecific stressor that has been shown to affect human health adversely, especially following long-term exposure. Nonauditory effects include cardiovascular disease, metabolic diseases, effects on sleep, annoyance, cognitive impairment, quality of life, mental health and wellbeing, and adverse birth outcomes.' (p.1)

Acoustics are as important as air quality

Air quality has received a lot of attention in the office real estate sector. However, the industry has still not caught up when it comes to acoustics. But workers are listening. In 2019, The Leesman Index (Europe's largest independent survey of workplace effectiveness) found that bad acoustics is in the top ten most important considerations for users. Bad acoustics is also the fifth highest element of dissatisfaction, with just 30.9% of occupants satisfied with the noise levels in their offices. The World Green Building Council (2014) report supports these findings, saying, 'distraction from noise is often one of the lead causes of dissatisfaction with the office environment.' (p.32)

Impact on health

Noise and poor acoustics can lead to a series of health problems. The World Green Building Council (2014) found that 'there is no question' that excessive noise — particularly that found in an open plan office — is 'responsible for greater dissatisfaction and productivity loss than any other single environmental factor.' They also found that, not only is noise a distraction that hinders the ability to do work, 'it can also have a detrimental impact on health and levels of stress.' (p.35)

The 2018 WHO report found that 'environmental noise may induce acute cardiovascular and metabolic effects both directly, through subcortical connections, and indirectly, by projections via the auditory cortex. The main effects include secretion of stress hormones and blood pressure elevations caused by vasoconstriction.' (p.1)



Negative effects on productivity

As well as the negative health effects, noise leads to losses in productivity. The World Green Building Council (2014) uncovered a 1998 study, which found that 'there was up to a 66% drop in performance for a working memory task (the ability to recall elements after a short length of time) when participants were exposed to different types of background noise.'

A follow-up study by the same authors in 2005 found that 99% of people surveyed reported that 'their concentration was impaired by office noise, such as unanswered phones and background speech.' (p. 32)

The Dutch Green Building Council (2015) adds to this point: 'Research shows that people in a silent space perform 16% better in memory tests and almost 40% better in calculation tests, compared to in an open office with 65 dB (A) background noise.'

They also found that after a disruption, it takes an average of 25 minutes to restart a complex task and at least eight minutes to get back to the same concentration and speed level. 'Switching between tasks is a big and underestimated source of errors and it wastes a lot of intellectual productivity,' says the DGBC, estimating 'a loss of 24 work days, per employee, per year.' (p. 28)

How did offices get so noisy?

There are many reasons for poor acoustics — the largest of which is the popularisation of the open plan office in the 1980s. Cubicles and modular furniture made way for open spaces, which were felt to be less depressing and better for employee social inclusion.

Over time, these open offices physically changed the way we work. Microsoft's 2005 framework *The New World of Work*, in which employees had the freedom to determine where and when they worked, gradually lost ground to the idea of multifunctional flex spaces, where any kind of work could be undertaken at any time.

Employees have literally lost ground. The Bureau Stedelijke Planning found that in the 1990s, the average office worker had 30m² of space per person. Pre-pandemic, this shrank to just 20m² per person, and was expected to decrease by another 30% to around 13m². We're now seeing a dramatic reversal of this trend with COVID-19 forcing greater distance between workers. While unlikely to persist long term, this expansion is a good thing for worker comfort. Smaller spaces with mixed usages have led to increased noise problems, along with a decline in concentration, health, wellbeing and productivity.

Sound cabinets

'Traditionally, suspended ceilings with sound-absorbing stone wool panels were used to achieve acoustic comfort,' says Pascal van Dort, Global Acoustics Ambassador at Rockfon. 'In areas where privacy is important, you would use highly insulating ceiling panels together with wall panels. A solution like that would eliminate any modern problems regarding acoustics in offices.'

Unfortunately, says van Dort, the traditional suspended ceiling is disappearing from modern offices. In new renovations it has become fashionable to expose concrete floors, pipes and ventilation ducts, either for aesthetic reasons or for thermal core activation. To make matters worse, new renovations often incorporate hard materials like glass, metal and marble.

'This is how "sound cabinets" are created,' says van Dort. 'With these materials, there is often no absorption value. The design may look trendy and modern, but it only exacerbates noise problems.'

This problem is made worse by the fact that most countries have no acoustic standards for offices, notes Theodoor Höngens, Director and Senior Advisor of M + P, an acoustic consultancy firm. 'There are guidelines, but they are very generic. To get really good acoustics you must know the specific needs of the user, for example, what degree of concentration is required.'

“After a disruption, it takes an average of 25 minutes to restart a complex task and at least eight minutes to get back to the same concentration and speed level.”

05

How can the latest acoustic solutions create office space that's as beautiful as it's healthy?

Determining the acoustic comfort of an office space involves calculating sound pressure level, reverberation time, speech intelligibility and sound insulation. Thankfully, it is easy to consider these parameters as they also align with the Four Cs of good office design: Contemplation, Collaboration, Communication and Contemplation.

Contemplation requires good Sound Pressure

Sound pressure level is crucial in rooms where employees need to withdraw to think. The sound pressure level is a measure of how noisy it is in a given space. Strong peaks in sound pressure, as well as sustained high average sound pressure levels over a period of time, can cause severe hearing problems. The sound pressure level in a room depends on the strength of the sound source, the shape of the space, and the absorption of the sound-absorbing surfaces.

Collaboration requires a good Reverberation Time

Reverberation is an essential factor in spaces where people work together. Reverberation time is the time (in seconds) that it takes for the sound pressure level to decrease by 60 dB after a sound source is switched off. Reverberation time depends on the volume and shape of the room, as well as the quality and positioning of the sound-absorbing materials in the space. The more sound-absorbing materials that are in the room, the shorter the reverberation time.





(The sound of concentration in an office where people can hear themselves think.)

Communication requires good Speech Intelligibility

Speech intelligibility measures the ability to hear and understand speech in a room. Being able to understand another person easily and comfortably is the basis of good communication. Speech intelligibility is influenced by the speech signal itself, the direction of the incoming sound, the sound level of the background noise, the reverberation time in the room and the shape of the space.

Concentration requires good Sound Insulation

In spaces designed for confidential conversations, sound insulation is crucial. Sound insulation indicates how well a particular construction (such as partitions, ceilings or floors) can prevent speech, music or other noise penetrating into adjacent spaces, either via air ducts or other building elements. The mass, airtightness and sound absorption of the construction are the primary properties to be considered.

Where could you implement acoustic solutions in your office?

When you're looking to improve the acoustics of your office space, the first place to consider is your ceiling. It is likely to be your largest usable surface by a long way, and it also catches the greatest proportion of 'annoying' effects.

The second most important area is the walls. An important consideration is avoiding 'flutter echo' — a sound that falls between two walls, or between walls and ceiling. There are panels that can be installed to specifically combat this problem.

Where should you begin with your acoustic renovation design?

The specific properties and parameters of acoustics can be confusing and data heavy. What's more, every single building is different, so there's no standard approach for ensuring comfortable acoustics. The best starting point is often to engage an acoustic consultancy firm, such as M + P, or an acoustic manufacturer, such as Rockfon. They can work with you to measure your acoustic levels and recommend bespoke solutions.

To help with these conversations, it can be useful to consider the general guidelines from the International WELL Building Standard (2017):

Ceiling requirements:

- Open workspaces should have a minimum NRC⁴⁾ of 0.9 for the entire surface area of the ceiling (excluding lights, skylights, diffusers and grilles).
- Conference and teleconference rooms should have a minimum NRC of 0.8 on at least 50% of the surface area of the ceiling (excluding lights, skylights, diffusers and grilles). (p.130)
- Large open workplaces must be equipped with a ceiling finish with a high sound absorption ($w \geq 0.85$) to avoid reflections on the ceiling.

Wall requirements:

- Enclosed offices, conference and teleconference rooms should have a minimum NRC of 0.8 on at least 25% of the surface area of interior surrounding walls.
- Open workspaces should have a minimum NRC of 0.8 on at least 25% of the surface area of the surrounding walls.
- Partitioned office spaces should have partitions that reach at least 1.2 m [48 inches] and have a minimum NRC of 0.8. (p. 130)
- Sound-producing activities and equipment must be accommodated with sound-absorbing walls or panels, to ensure work areas are shielded from disturbance.
- Walking routes should preferably be protected from work areas, through walls with a height of approximately 1.4 m.
- Grouped desks in an open plan workspace can be shielded from each other through sound-absorbing panels. These need to be at least 400 mm above the desktop, but not too much higher, so that visual contact between employees is maintained (p. 68).

⁴⁾ NRC: A measure for rating the overall sound absorption of a material when used in an enclosed architectural space where sound is reflected at many angles of incidence. A ceiling system with an NRC < 0.50 is low performance, an NRC > 0.70 is high performance.

06 Which materials offer the best acoustic performance?

When it comes to assuring worker comfort and wellbeing, there is an endless, perhaps overwhelming list of manufacturers with a huge range of different acoustic materials on offer. It is difficult to say whether one product is materially better than another, because different acoustic problems will require different acoustic solutions. What's more, acoustic calculations are challenging, even for experts.

However, one element that certainly will affect your office acoustics is the ceiling, as it is the largest free surface in any room. For worker health and productivity, a quality office space will require a ceiling with high-quality sound absorption materials. Common materials used for this purpose include: Stone wool, mineral wool, modern stucco, metal, perforated metal, concrete, unperforated drywall, perforated plasterboard and wood wool cement. The best way to understand which material would be right for your office space is to engage a manufacturer or consultancy firm. Some manufacturers offer free assessment services.

There is a common understanding that furnishing elements, such as carpets, furniture, plants and curtains, can have sound-absorbing qualities. This is true to a minimal extent. However, it is far more effective to create a true healthy building that will stand the test of time by using high-quality acoustics in your core building design, rather than trying to compensate afterwards with furnishings.

07 Which factors determine the success of an acoustic ceiling solution?

Dominique Goven, Channel Marketing Manager at Rockfon, comments that 'Suspended ceilings have multiple purposes, they can hide or integrate lighting, heating, cooling and airconditioning and they can protect against fire. Recently there is a greater focus on the design of a space and creating different types of areas that improve occupant wellbeing and productivity. Rockfon acoustic solutions let architects, designers and contractors respond to these needs and create visually appealing offices that promote wellbeing. Our solutions aren't just highly sound absorptive; some can help increase the reach of daylight throughout a building, reducing the need for artificial light by up to 11%. And with the post-pandemic emphasis on hygiene, Rockfon ceilings are sanitary by design, they are made from natural stone and are resistant to bacteria and mould. Plus, every product we make has clear information on how it meets acoustic and WELL, LEED, BREEAM and DGNB sustainable building standards'. says Goven.

'Whatever the specific site challenges, Rockfon provides many high-quality design solutions in terms of colour, dimensions and free-hanging islands and baffles. We offer various wall solutions, as well as a completely seamless ceiling that looks smooth as a plasterboard ceiling and has the acoustic properties people expect from Rockfon ceilings. We also deliver technical solutions that provide sound insulation and sound absorption combined in a single panel, plus consultancy to help your customers get the technical details right.'

08 Conclusion

The COVID-19 pandemic threw the modern workplace into disarray, and with it the office rental market. It forced many businesses to downsize or close. It also unleashed a work-from-home megatrend. In this climate of profound stress and anxiety about public spaces, the healthy office is key to bringing workers back to their workplaces to meet face to face, collaborate, plan, innovate and work together.

Post-pandemic employers will seek calm offices that don't just look and feel great but that actively promote mental and physical wellbeing. They'll choose buildings that feature quality acoustics, natural light and spacious, well-ventilated layouts. Buildings that are sanitary by design and built with non-toxic, hygienic materials, will have the edge. Businesses that use this moment to create healthier workplaces will win the hearts and minds of the next generation of talent. They'll also reap productivity and performance benefits.

To create healthy offices, many property owners will need to renovate. Those who get it right and meet the standards of modern work will lock in quality tenants, value and returns. In any renovation, quality acoustics are important to success. Yet many property owners do not consider acoustics at all — or worse, try to remedy bad acoustics as an afterthought. There is a clear need for acoustics to be considered during the early stages of a renovation design. The most effective framework is the 4Cs (Concentration, Contemplation, Communication, Cooperation) which translate to the four most important acoustic parameters (Sound Pressure, Reverberation Time, Speech Intelligibility and Sound Insulation). Consulting an expert is the best way forward. Generally, however, it is likely that the ceiling and the walls will be fundamental to the acoustic solution, because they represent the largest free space in a property. There is some concern that ceiling and wall acoustic solutions will look unappealing to younger workers, however, ceiling manufacturers like Rockfon have developed highly aesthetic ceiling solutions that can improve indoor climate and daylight distribution to match the needs of designers, contractors and workers.



References

1. Gartner, 2020
1. Global Workplace Analytics, 2020
- Stijnenbosch, M. H. (2015). ONTWIKKELINGEN OP DE KANTORENMARKT IN NEDERLAND. Retrieved from <https://www.hanze.nl/assets/kc-noorderruimte/Documents/Public/Publicaties%2520Lectoren%252001-10-2015/STIJNENBOSCH%252C%2520M%2520-%2520kantorenmarkt%2520planologische%2520kengetallen.pdf+&cd=1&hl=nl&ct=clnk&gl=nl>
- Dynamis. (2017). Sprekende Cijfers Kantorenmarkten 2017. Retrieved from https://dynamis.nl/uploads/media/sprekendecijfers_kantorenmarkt_2017-definitief.pdf
- Facility Management Nederland en CoreNet Global. (2013). Wat wil de Eindgebruiker | Op naar een vraaggestuurde kantorenmarkt. Retrieved from http://www.cbre.eu/emea_en/IMGS_STYLES/docs/CBRE101211%20Wellness%20in%20the%20Workplace_FINAL.PDF
- CBRE Europe, Middle East and Africa. (2016). Wellness in the workplace – Unlocking future performance. Retrieved from http://www.cbre.eu/emea_en/IMGS_STYLES/docs/CBRE101211%20Wellness%20in%20the%20Workplace_FINAL.PDF
- Future Workplace study, 'The Employee Experience', 2018. Retrieved from <https://hbr.org/2018/09/the-1-office-perk-natural-light>
- World Green Building Council. (2014). Health, Wellbeing & Productivity in Offices | The next chapter for green building. Retrieved from http://www.worldgbc.org/sites/default/files/compressed_WorldGBC_Health_Wellbeing_Productivity_Full_Report_Dbl_Med_Res_Feb_2015.pdf
- Dutch Green Building Council. (2015). Gezondheid, Welzijn & Productiviteit in Kantoren. Retrieved from <https://www.dgbc.nl/sites/dgbc.nl/files/bijlagen/DGBC-Gezondheid,-Welzijn-&-Productiviteit-in-Kantoren.pdf>
- Workplace Unlimited. (2015). Planning for Psychoacoustics: A Psychological Approach to Resolving Office Noise Distraction. Retrieved from <http://workplaceunlimited.com/Ecophon%20Psychoacoustics%20v4.5.pdf>
- Bureau Stedelijke Planning. (z.j.) [Vakkennis]. Retrieved from <http://www.stedplan.nl/vakkennis/het-nieuwe-werken/>
- Beuker, T. C., & Boer, E. (2017). Well voor Bouwfysici. Bouwfysica, 2017(1), 21. Retrieved from https://dgmr.nl/uploads/files/18_21_Beuker_01_2017.pdf
- Dutch Flemish Building Physics Association. (2017). Handboek Bouwfysische Kwaliteit Gebouwen. Retrieved from <http://nvbv.org/wp-content/uploads/2017/01/NVBV-Handboek-BKG-v2.22-print.pdf?>
- WELL Building Institute. (z.j.). [Feature 80. Sound reducing surfaces]. Retrieved from <https://standard.wellcertified.com/v8/comfort/sound-reducing-surfaces>
- WELL Building Institute. (z.j.). [Feature 81. Sound barriers]. Retrieved from <https://standard.wellcertified.com/v8/comfort/sound-barriers>
- WHO (2018) 'Environmental guidelines for the European Region.' Retrieved from http://www.euro.who.int/__data/assets/pdf_file/0006/378078/noise-guidelines-methodology-eng.pdf?ua=1
- WHO (2018) 'Biological mechanisms related to cardiovascular and metabolic effects by environmental noise.' Retrieved from http://www.euro.who.int/__data/assets/pdf_file/0004/378076/review-noise-bio-effects-eng.pdf?ua=1
- Microsoft (2005) 'Digital Workstyles: The New World of Work' Retrieved from <https://www.immagic.com/eLibrary/ARCHIVES/GENERAL/MICROSFT/M050500M.pdf>
- Acoustic guidelines:**
Architectural Acoustics, Ana M. Jaramillo en Chris Steel, ISBN 9780415732147
- Handboek Bouwfysische Kwaliteit Gebouwen, Nederlands Vlaamse Bouwfysica Vereniging, <https://nvbv.org/wp-content/uploads/2017/01/NVBV-Handboek-BKG-v2.23-update-20180323.pdf>
- Interviews:**
Pascal van Dort, Global Acoustics Ambassador Rockfon (Rockwool International A/S)
- Theodoor Höngens, directeur/senior adviseur M + P Raadgevende ingenieurs BV

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