

Information paper – 33

Productivity in office buildings

Prepared by:
David Clark

A paper referenced in the book:

WHAT COLOUR is YOUR BUILDING?

David H. Clark



© Cundall Johnston & Partners LLP. 2013

Issue 1.0: 29 July 2013

This information paper is one of a series of papers written during the preparation of the book **What Colour is Your Building?** (www.whatcolourisyourbuilding.com). The papers do not form part of the book and have not been peer reviewed. They provide further technical detail, analysis and information to support statements made in the book. All of the papers can be downloaded from www.wholecarbonfootprint.com.

Productivity in office buildings

This information paper summarises the findings from a selection of building case studies and research papers related to productivity. The reader can make their own mind up whether the link between building design and productivity is proven, and what financial benefit, if any, might be incorporated into a business case.

1. QUALITY OF LIFE REPORT, 2010

As part of the *Quality of Life* report¹ for Development Securities, the Building Research Establishment (BRE) carried out a research survey ‘*Assessing Occupants’ Satisfaction with their Office Environment*’ of over 10,000 UK property and construction professionals. The survey indicated that the UK’s office workers are dissatisfied in a number of areas within their places of work:

- 55% said that they are working in unsatisfactory temperatures.
- 38% were not satisfied with the levels of noise.
- 33% were not satisfied with the amount of daylight.
- Nearly 45% were unhappy with the ventilation or air quality in their building.
- 53% of respondents were not happy with the amount of access to outdoor spaces.
- Over 40% did not get a satisfactory view outside.
- Nearly 60% are not satisfied with the amount of quiet space provided.

The report raised concerns that open plan working may not be suitable for all business, with negative side effects including: excessive noise; constant distraction; lack of personal ownership of space and control over conditions; concern over being overheard; and increased paranoia.

The report noted that *‘there is also a widespread reluctance among companies to invest in improvements. This makes little sense: the long-term productivity benefits would far outweigh the short-term capital costs – and from a human resources viewpoint, people represent a far greater cost to companies.’*

2. LINKING ENERGY TO HEALTH AND PRODUCTIVITY IN THE BUILT ENVIRONMENT, LOFTNESS ET AL

The Centre for Building Performance & Diagnostics at Carnegie Mellon University, led a research project² which gathered over 140 case studies between 1985 and 2000 demonstrating the link between improved building environmental quality and life cycle cost-benefits (energy, environmental, health and productivity benefits).

A summary of the findings from the analysis of these case studies are:

- **Temperature control** – the ability for individual workers to control the temperature at their workstation was shown to improve individual productivity at a range of tasks from typing and addition to creative thinking by 3.5 to 36.6%
- **Air quality** – 15 studies linked improved ventilation with 0.48 to 11% gains in individual productivity
 - 0.48 to 11% with the provision of task air (6 studies).
 - 0.62 to 7.37% with the provision of increased outside air rates (6 studies).
 - 1.1 to 3.25% with the removal of primary pollutants (3 studies).
- **Lighting quality** – 12 studies linked improved lighting design decisions with 0.7 to 23% gains in individual productivity:
 - 3 to 23% due to the introduction of indirect-direct lighting systems (4 studies).
 - 3 to 13.2% due to higher quality fixtures – high performance electronic ballasts and parabolic louvers (4 studies).
 - 0.7 to 2% due to higher lighting levels and daylight simulating fixtures (4 studies).
- **Daylight** – 7 studies linked introduction of daylight in the workplace with gains in individual and organizational productivity:
 - 3 to 18% increases in individual productivity (including student test results).
 - 40% increases in sales (an organizational productivity measure).
- **Openable windows** – 6 studies indicated that the addition of operable windows for thermal comfort, natural ventilation, or simply access to the outdoors, can impact productivity by 0.4 to 15%. The upper range of these productivity improvements, from 10 to 15% increased productivity, are achieved in mixed-mode buildings where operable windows are coordinated with mechanical air conditioning strategies.

The paper also describes the impact on energy consumption for these initiatives.

3. INDOOR CLIMATE AND PRODUCTIVITY, SEPPANEN, 2005

This paper³ aimed to show that it is possible to estimate quantitative relationships between ventilation rate and illness-caused absence, and between work performance and ventilation rate, air temperature and perceived air quality. Figure 1 shows the relative performance versus temperature. It was derived using data from 26 case studies, and correlating the percentage change in performance for each degree change in temperature.

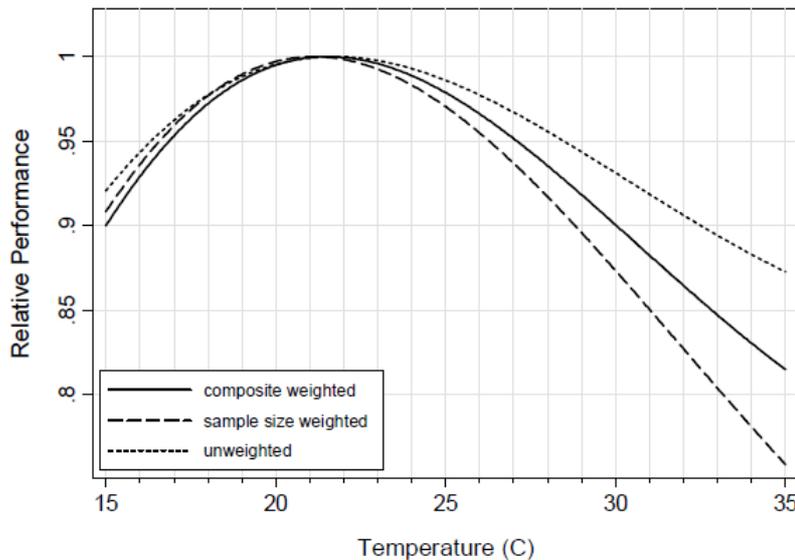


Fig 1 Relative performance versus internal temperature (source: Seppanen, 2005)

4. CALL CENTRE & SCHOOL RESEARCH, HESCHONG MAHONE GROUP

A study⁴ by the Hershong Mahone Group (HMG) in the US in 2001 found that workers with the best possible view versus those with no view in Call Centres processed calls 6 to 12% faster, and office workers were found to perform 10 to 25% better on tests of mental function and memory recall. Reports of increased fatigue were most strongly associated with a lack of view. Providing views and daylight needs to avoid the negative impact of glare. Glare from primary view windows decreased office worker performance by 15 to 21%. The characteristics of the physical environment were found to represent about 1/8th to 1/3rd of the entire ability to predict variation in individual worker performance.

A variety of studies of daylight in schools in the US by HMG identified a central tendency of a 21% improvement in student learning rates in classrooms with good daylighting.

5. DO GREEN BUILDINGS MAKE DOLLARS AND SENSE?

First published in 2009, this on-going research project by CBRE, University of San Diego and McGraw-Hill Construction is based on annual surveys of 150 offices managed by CBRE in the US.⁵ Key findings from the first three years of the project related to productivity in green buildings included:

- 19% of building occupants reported increased productivity.
- 94% of tenant managers registered higher employee satisfaction.

Other findings include:

- Most tenants will not admit to being willing to pay more for a green building, yet empirical evidence suggests they will and do.
- Green buildings, even if only Energy Star labelled tend to be occupied by higher than average wage tenants who generally feel more productive and take fewer sick days.
- Public image and recruitment of and retention of employees are enhanced in green buildings.

6. SICK BUILDING SYNDROME STUDY, UNITED STATES, 1996

Section H4.11 in Appendix H provides a summary of an American study into sick building syndrome which showed a clear correlation between dirty supply air systems and increased risk of reported respiratory symptoms.⁶ The increase or decrease in sick days can be translated into a financial cost or saving.

7. RETROFIT OF 500 COLLINS STREET, MELBOURNE, 2005-06

This study⁷ by Sustainability Victoria and the Kador Group followed the upgrade of an existing and occupied multi-tenanted 28-level office building with 25,500m² NLA in the Melbourne CBD. Two existing tenants were studied to evaluate productivity before and after the refurbishment.

At Oakley Thompson, a small law firm, organisational performance was examined through sick leave records, while individual performance was analysed through a typing test for secretaries and through the lawyers' billable hours. Lonsec, a stockbroking and research firm, agreed to participate in a staff survey after their move because an executive of the company had observed that *'productivity has gone through the roof'* and wanted to document this. For Lonsec, the survey was only conducted after the move, with staff directly contrasting the new office with their recollections of their previous office.

The key findings of the measured performance at Oakley Thompson were:

- 39% reduction in average sick leave days per employee per month: from 0.46 days before the move to 0.28 after the move.
- 44% reduction in the monthly average cost of sick leave (senior staff's sick leave fell more than that of support staff).
- 9% improvement in the average typing speed of secretaries, and a significant improvement in overall accuracy.
- 7% increase in lawyers' billings ratio, despite a 12% decline in the average monthly hours worked by the lawyers. This would indicate that despite working less hours after the move, more of the lawyers' time was spent on billable work.

The findings from the staff surveys of both firms were:

- 12% increase in self-reported productivity at Lonsec compared to 0% at Oakley Thompson (contradicting the measured improvements).
- Staff perception of temperature comfort increased by 5% at the Oakley Thompson office, and by 65% at Lonsec.
- At Lonsec, 64% found the old office ambience tiring compared to only 9% in the new office; 40% of staff found the new office 'invigorating' compared to zero in the old office.
- Reductions of between 5 and 26% in staff perceptions of their health – headache, sore eyes, cold & flu, fatigue and poor concentration.

The report notes that: *'Impacts such as the Hawthorne Effect or arguments that any office upgrade, whether sustainable or not, leads to a positive boost in productivity, cannot be fully discounted. However, the length of time between the Oakley Thompson pre- and post-measurements, and the consistency of the results across many indicators, make the sustainable refurbishment a more likely explanation.'*

8. CH2 HOUSE, MELBOURNE – USING PRODUCTIVITY TO JUSTIFY GREEN INVESTMENT

One high profile example of using productivity gains in a business case is the City of Melbourne's A\$51 million office building, CH2 House, which opened in August 2006. To justify to taxpayers the 22% cost premium for the green features of the building, the business case assumed a 4.9% improvement in productivity. A study in 2008 after one year's operation showed that staff productivity had improved by 10.9%, giving an annual cost saving of over A\$2million.⁸

Interestingly this productivity survey hasn't been repeated since (or the results haven't been published) so it is unclear whether this productivity boost was due to the wow factor of moving into a state of the art new building. The on-going occupant experience may not have been as positive as the initial productivity survey suggested.⁹

‘Feedback from the occupants has not been entirely positive. They complained about lack of sound privacy caused by low-velocity floor air conditioning system, hard sound-reflecting surfaces and open plan offices. In addition, satisfaction with lighting levels has not been very high. The fittings installed during construction provided insufficient task lighting. This was exacerbated by the use of dark furniture, carpeting and partitioning. There is also little penetration of natural daylight into offices on the west elevation due to the timber shuttering.

Many of these issues have been remedied retrospectively, but at an additional cost and a loss of faith amongst workers, who see the building as overcomplicated and overly demanding in terms of operation, management and maintenance. Building experts blame the over-complex specification and question how much of the design is green bling and how much really contributes to performance.’

As of July 2013, almost seven years after it opened, no data on the actual energy performance of the building had been published to back up its claim of being one of the world’s greenest buildings.¹⁰ This building, while undoubtedly a good example of what is possible in green design and initiatives, does not provide sufficiently robust evidence to justify productivity benefits in the commercial office sector.

Notes

All websites were accessed on 21 July 2013 unless noted otherwise.

1. *Building Quality of Life*, a report on the property industry's key role in delivering a better life in Britain, by Development Securities PLC, 2010.
www.developmentsecurities.com/devsecplc/dlibrary/documents/QualityofLife_March2010.pdf
2. Linking Energy to Health and Productivity in the Built Environment: Evaluating the Cost-Benefits of High Performance Building and Community Design for Sustainability, Health and Productivity, Loftness et al, Greenbuild 2003. http://www.usgbc.org/Docs/Archive/MediaArchive/207_Loftness_PA876.pdf
3. *Indoor Climate and Productivity*; Olli Seppanen, Helsinki University of Technology, Finland, 2005
http://web1.swegon.com/upload/AirAcademy/Articles/Swegon_IAQ_and_productivity_prot.pdf
4. www.h-m-g.com/projects/daylighting/summaries%20on%20daylighting.htm
5. *Building Performance and Occupier Satisfaction Produce Improved Return on Green Building Investments*, CBRE website, October 6, 2011. www.cbre.com/EN/aboutus/MediaCentre/2011/Pages/10062011.aspx. Also refer to Do Green Buildings Make Dollars and Sense? USD-BMC Working Paper 09-11, Draft: November 6, 2009.
www.sandiego.edu/business/documents/real_estate/Do_Green_Buildings_Make_Dollars_and_Sense_draft_Nov_6_2009.pdf.
6. Refer to clause 8.4.7, CIBSE Guide A.
7. *Employee Productivity in a Sustainable Building: Pre- and Post-Occupancy Studies in 500 Collins Street*, a study commissioned by Sustainability Victoria and the Kador Group, 2005
www.sustainability.vic.gov.au/resources/documents/500_collins_productivity_study.pdf
8. Data taken from City Of Melbourne's CH2 website:
www.melbourne.vic.gov.au/Sustainability/CH2/Pages/CH2Ourgreenbuilding.aspx
9. *Low Down Under*; Robert Burns, BSRIA Delta t. (2008). Quotes taken from Building Quality of Life (refer to note 1)
10. The building was predicted to have 60% lower CO₂ emissions than a top rated 5 star NABERS rated building.
www.melbourne.vic.gov.au/Sustainability/CH2/DesignDelivery/Documents/CH2_Snapshot5.pdf
Several requests have been made by the author for metered energy data of the building so that this could be included in the book. No NABERS rating or measured energy data had been published on the council's CH2 website by July 2013.

The inevitable legal bit

While reasonable efforts have been made to provide accurate information, Cundall Johnston & Partners LLP do not make any representation, express or implied, with regard to the accuracy of information contained in this paper, nor do they accept any legal responsibility or liability for any errors or omissions that may be made. This paper is provided for information purposes only. Readers are encouraged to go to the source material to explore the issues further. Please feel free to use any material (except photos, illustrations and data credited to other organisations) for educational purposes only under the [Creative Commons Attribution-Non-Commercial-Share-Alike 2.0 England & Wales licence](#). If you spot any errors in the paper then please contact the author so that the paper can be corrected.