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GREEN ERGONOMICS

GREEN ERGONOMICS IS AN AREA OF SUSTAINABLE DESIGN THAT LOOKS AT THE LINK BETWEEN ERGONOMICS AND SUCCESSFUL GREEN BUILDING. AMERICAN ERGONOMIST ALAN HEDGE LOOKS AT THE IMPORTANCE OF THE HUMAN ELEMENT



Most people don't realise there is an integral link between ergonomics and sustainable design. However, in the US, these areas are becoming very closely related, and there is the potential for similar opportunities in Australia, particularly with the systems already in place such as the Green Building Council of Australia (GBCA) and the Green Star rating system. On the GBCA website it states that a sustainable community starts with people, not buildings, and that a sustainable community shouldn't only be environmentally sustainable, it should also be socially and economically sustainable. In both these statements, we're looking at the human factor in creating sustainable environments. Looking at the Green Star rating system, however, there is no discussion of the human factor. Why is this human element so important?

If you look at data on the life cycle cost analysis of buildings – generally 30 years in the US – you'll find design and construction costs are about 2% of the total cost, and maintenance and operational costs – including all energy costs – are about 6%. This means that 92% of the building's costs have nothing to do with the building and everything to do with the occupants. Looking at these costs, we find that increasing productivity by just 1% is, in a typical office building, equal to 100% of the energy costs. And, this is where

ergonomics can play a role. If we can improve the health, the well-being, and the comfort of people, we can improve their productivity.

The US Green Building Council (USGBC) was founded in the late 1990s and, initially, was doing the kinds of things the GBCA does in Australia: looking at buildings purely as physical structures, or in terms of energy efficiency. They also developed a rating system, which, since its inception, has dramatically evolved. The new president of the USGBC, Sandy Wiggins, last year in his inaugural speech, made a very telling statement. He said: green building is not about buildings, it's about people. You can create a building that is environmentally responsible, carbon neutral, low-emission, energy efficient, and it can be a horrendous place in which people have to work or live. Creating a green building is one that creates the best environment for people to work or live.

We can have extremely green workplaces: sitting on a beach with a laptop is green. But, it's a lousy way to work in terms of health, safety, performance and productivity. So you can't just use measures of energy efficiency as good measures of how well the environment works. And, that's what the USGBC realised.

The modern discipline of ergonomics began in 1949 with the idea that ergonomics was about designing work systems – that is, work tasks, tools, people and environments and how they interact. Unfortunately, particularly in the US in the 1990s, that original focus was lost. We moved away from 'proactive' ergonomics – where ergonomists are involved from the beginning of the design process – and spent more than a decade practising 'reactive' ergonomics – dealing with the effects of sub-optimal environments that lead to injuries and lower productivity.



The recent writing of people like Dan Kopec (an architect writing about health and sustainability in the built environment) draws attention to the intimate relationship between architecture and ergonomics. But, it also makes the point that most architects get no training in ergonomics and vice versa. There is a need for the two to come together, and this area is called 'green ergonomics'.

Green ergonomics looks at how ergonomics can be integrated into sustainable design so that performance, productivity, comfort, health, and well-being are enhanced, resulting in increased sustainability of both the individual and the organisational system. Many energy efficient buildings are fantastic while they're unoccupied but, if people don't have the correct behaviours, then the building no longer works in the intended way when occupied. Green ergonomics examines what changes we can make to a particular environment to support more energy effective behaviours.

In the US, the Leadership in Energy and Environmental Design (LEED) rating system has trained more than 100,000 professionals over the past decade, and ergonomics has now become an integral component in all LEED processes. But why do people want to achieve these rating levels? Not everybody necessarily wants to be green or sustainable, but there's also an economic value to achieving LEED ratings. The higher a building is rated, the higher it is worth - the higher the rent, the higher the re-sale value, and the higher the occupancy rate. So, developers and organisations want to build the greenest buildings they can. The USGBC has realised if ergonomics is to be integrated into the process, it has to go towards LEED credit - and it is a relatively inexpensive way of getting LEED credit.

Ergonomics was first introduced into LEED by the USGBC in 2008, under an area called 'innovation and design'. As LEED has developed, ergonomics has been given greater weight, and an office ergonomics program is now compulsory for commercial environments with 75% full-time employees. To achieve this credit, you have to be able to demonstrate four things: that all opportunities for ergonomic enhancement have been identified in the plans; targets and evaluation criteria for improved comfort, productivity or well-being must be set; proven ergonomic work tools have to be provided; and users have to be provided with ergonomic education on how to use the tools. In the new LEED system, currently in review, ergonomics will become a separate item under indoor environmental quality, and there are discussions underway about turning ergonomics into a section in its own right. There is also discussion of a three-year re-certification process for ergonomics to ensure that the system is constantly optimal.

At present there are few buildings in the world that have actually received ergonomics LEED credit, but there are three examples worth discussing.



WORDS ALAN HEDGE

The first building to get LEED credit for ergonomics was the BD Biosciences building in San Jose, California. There are around 1,100 employees, two-thirds of which spend the majority of their day at a computer. Thus, the ergonomics team, led by Dr. Jennifer Robinson, chose a variety of ergonomic products, including task chairs, keyboard trays, foot rests, keyboards and mice. They developed ongoing metrics for measuring how effective their process was, and provided training to everyone going into the new building (with online refresher courses as required by LEED). For some products, the manufacturers trained employees, so there was no cost to BD Biosciences.

In this particular case, the ergonomics credit pushed the building from bronze to silver level accreditation, making their real estate much more valuable. But that's not the only place value was added. The year prior to the move, 7% of employees were injured. The year of the move injuries went down to 4%, and the year since the move injuries are down to 2%, which is a 5% reduction so far. It might not sound like much until you consider that the average cost of an injury in the BD Biosciences facility is US\$140,000.

The second example is the new law school at the University of California, Berkeley. Their ergonomist, Mallory Lynch, set up a complete consultative process with the architects, designers and employees.

OPPOSITE American ergonomist, Alan Hedge
OPPOSITE LOWER Ergonomic planning of reception at UC Berkeley Law School
ABOVE Interior of the BD Biosciences facility in San Jose, California
BELOW The BD Biosciences facility was the first building to receive LEED credit for ergonomics





ABOVE Entry of Manitoba Hydro, the most energy efficient building in Canada
BELOW Some of the varied workspaces and a break-out area at Manitoba Hydro

It is important for ergonomists and designers to develop a common language

ALAN HEDGE

They undertook tours of similar facilities and, together, developed a standard strategy. Lynch was then involved in reviewing all design drawings and documentation. The solution, which achieved a silver LEED rating, involved a series of different workstations, dynamic seating and task lighting.

Thirdly, there is Manitoba Hydro, the most energy efficient building in Canada, with LEED gold credit. The building was deliberately built in downtown Winnipeg, where temperatures can fall below -30° Celsius in winter, yet it uses a single-pass ventilation system with 100% fresh air tempered with a solar chimney. The building has good daylight penetration, with photo-sensors scattered throughout so that as daylight levels increase, artificial light levels decrease. In addition, the building has a raised floor system and sound masking speakers that provide the acoustic privacy of ventilation without any actual ventilation (as there is no need for additional ventilation). Every floor of the building has neighbourhood break-outs to create communities of people who work in proximity to one another. Each employee is given the choice of one of five different workstation arrangements, which were mocked up for trialling.

In the year prior to the move, there were 15 musculoskeletal injury cases, costing US\$100,000 each. In the

year after the move, there were none, suggesting the success of designing problems out at the start rather than fighting with the design later on.

But, is there any evidence that by incorporating ergonomics into green buildings you will see actual changes in behaviour or productivity of occupants?

A recent study published in the *American Journal of Public Health* looked at LEED credits of buildings in Michigan, and how this impacted ergonomic design and productivity. Looking at air quality, for example, it found that higher quality led to around two hours more productivity from people who suffered from allergies, asthma, stress, and depression. The office ergonomics factor, however, improved productivity by around 40 hours per worker – an average productivity increase of 2.6%, which translates to twice the total energy cost for a typical green building.

Looking at other reports, we can see it is reasonable to expect even better results. One such report looks at 40 buildings and quantifies productivity changes in 25. The average increase in productivity after the implementation of a good ergonomics program was 12%, which translates to nearly 20 times the energy cost of a typical green building in the US. From these figures, you can see why the USGBC is seriously looking at how to improve the ergonomic design of workplaces.

For this to happen, it is important for ergonomists and designers to develop a common language. And, to tackle this, the American Society of Interior Design has funded a website called *InformedDesign* (informedesign.org), which takes journal articles and translates them into design briefs.

Ergonomic design facilitates productivity and health. A move towards a human factor in green building rating systems worldwide is inevitable. There is a bright future for green ergonomics around the world if ergonomists, designers and architects can work together to solve problems before they arise.

Alan Hedge is a Professor in the Department of Design and Environmental Analysis at Cornell University, and a Research Professor in the Department of Mechanical and Aerospace Engineering at Syracuse University. He directs the Human Factors and Ergonomics teaching and research programs. This text is edited from a talk he gave at Schiavello on green ergonomics when he was in Australia earlier this year as a guest of Humanscale.

