

**FACTOR X,
WELL-BEING AS A KEY COMPONENT OF NEXT GENERATION
GREEN BUILDINGS**

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Abstract

Any paradigm for next generation of green buildings must include user well-being and satisfaction as primary tenets. This is not easy to achieve, but unless we do incorporate these parameters, built outcomes are unlikely to be sustainable, even if they are resource efficient.

This paper defines well-being as a holistic physical, psychological and metaphysical phenomenon, describes the benefits of well-being design and discusses the elements that are considered to be most influential in enhancing user's holistic physiological and psychological well-being.

It presents an overview of scientific research currently being undertaken in this area. Such research while in its infancy tends to validate the current intuitive design stance taken by many successful architects relative to designing for well-being and suggests that we could beneficially incorporate many of these well-being connected ideas into paradigm for next generation green buildings.

It is concluded that if integrated with sustainable technologies, well-being enhancement factors can work synergistically, in our building designs, to enhance user happiness and satisfaction, improve user productivity, health, morale and vitality and are likely to make resource efficient architecture much more appealing to a wide constituency of building users than is currently the case. A more tentative assertion is that architecture that enhances people's feeling of well-being could be an agent for positive change in relation to work ethics and values, community spirit and interpersonal relationships. If we can create places where people want to be, that delight, stimulate, rejuvenate, are in harmony

with the environment and resource efficient, then we will have succeeded in creating a truly sustainable architecture.

Introduction

Often in considering sustainability we have focused on resource efficient building practice. In our search for ever more resource efficient technical solutions we have tended to largely ignore more abstract, less easily measured human factors such as well-being. We have generally privileged quantitative over qualitative factors. Yet it is the qualitative factors by which most people relate to and judge buildings and their environments and it is these factors that make the difference between buildings that are resource efficient and those that are both resource efficient and desirable.

It has long been recognised that it is this element of desirability that separates architecture from building. This is the 'X' factor that makes some places a delight to be in where people feel alive, vibrant, stimulated, refreshed and, where absent, makes other places others unpleasant, disturbing, disquieting, where people feel unhappy or uncomfortable while others generates no feelings at all. Places that create feelings of negativity or indifference diminish us as human beings and demonstrate a crucial failure on the part of the design team. Factor 'X' is about creating environments that enhance a user's holistic sense of well-being.

This paper puts the case for incorporating well-being as one of the necessary elements of next generation green buildings. It starts by explaining what well-being is in an architectural context and discusses some of the particularly important facets of this complex field. This is followed by a description of the main benefits that accrue to the individual and the community at large if buildings enhance the well-being of their occupants. Thereafter the main areas of scientific research and outcomes are briefly described and an alternative, pragmatic approach to incorporating well-being characteristics into next generation green buildings is propounded and the viability of such an approach is demonstrated using a number of examples and one particular case study.

Context

The utopian teachings of Corbusier and the other masters of the 'Modern Movement' in the early 20th century were perverted over time, in a kind of Faustian compact (Salingaros and Mikiten, 2002) between all sectors of the building community and were used to deliver what is euphemistically referred to as 'cost efficient' architecture, but which might be more accurately described as the production of cheap, minimalist buildings. The result is that we have created generations of unlovely and unloved buildings. Such buildings have been constructed throughout the 20th century, but became particularly dominant after World War II, when the shortage of skilled labour and materials and the need for large rebuilding programmes gave an added impetus to the application of the minimalist approach already favoured by the financial community and implicitly condoned by designers.

The most banal and brutal exemplars of this breed of buildings can be seen in the many public housing schemes built after WWII. These buildings, far from realising the utopian visions of their creators regarding enhanced lifestyle quality, were often hated by their occupants, vandalised, became a breeding ground for crime, and created conditions of unrelenting misery for residents. Not surprisingly many of these buildings have now been demolished, long before they became constructionally defective. In other words despite the fact that many of these buildings were much more resource efficient, and offered better facilities to residents, than the buildings they replaced, they were not sustainable. This has been a huge waste of resources, and the human cost has been little short of catastrophic for many communities. While public housing represents the very worst of post WWII building development, many other categories of building, including most commercial developments are less extreme manifestations of the same approach. Unfortunately this thinking still dominates much of building sector thinking today and first cost still remains the primary determinant in any development, while user well-being continues to receive little of no attention.

We cannot afford, as a society, to repeat the mistakes of the 20th century by continuing to create soulless, brutalising, emotionally degrading built environments to live and work in the 21st century. The errors of the past can be perhaps be excused on the basis of ignorance and the social harm done regarded as an unfortunate unintended consequence of our negligent approach to the welfare of

building users. However, we now know the consequences of such an uncaring approach and to continue down the same path would be morally indefensible, environmentally inimical and economically perverse.

The authors suggest that well-being is a vital factor in the creation of truly sustainable architecture and as such it is an indispensable component of next generation of green buildings. If it is not included, all the invested time, effort, money and resources in making buildings more resource efficient is likely to be wasted. At a very basic level, if people don't like it and don't want to use it, how can a building be sustainable, not matter how 'green' it is in every other respect?

The Meaning of Well-being

Well-being is generally thought of as a descriptor for a holistic state of physical, intellectual and emotional health, but the term has also been attached to the notion of economic, environmental, cultural and social health. In the former case it is normally associated with the health of the individual and in the latter case with the health or otherwise of a community, organisation or system. We generally therefore refer to the economic well-being of the economy or the nation but not the individual and the physical and mental well-being of the individual but not of a community or a nation.

In the case of the built environment terms such as 'quality of life' or 'lifestyle quality' have also been utilised, both when referring to individuals and communities. The notion of 'quality of life' is similar to but not the same as 'well-being'.

Quality of life is often something that is judged or measured by a set of criteria or indices. The criteria established are often constrained or tailored to relate to the measurable outcomes sought. Results are often comparative in nature, aimed at establishing whether there has been a perceptible improvement or decline in the indices relative to others. Often the indices relate to physical norms or even physical artefacts/possessions.

Well-being, by contrast, is more to do with feelings is much more difficult to measure and relates to a holistic perception of physical, intellectual and emotional health of the individual. The well-being of the individual is difficult to measure because it is in a state of constant flux.

This paper focuses on the inter-relationship of an individual with the architectural space they inhabit and explores how spatial quality can enhance feelings of well-being in an individual or a group of individuals.

Individual well-being is a holistic concept comprising both physiological and psychological elements that can be sub-categorised into physical, intellectual and emotional well-being corresponding to body, mind and spirit. In Western culture a distinction is made between physical health and other aspects of well-being. Science based medical science and religious belief systems are regarded as being separate. Many Eastern societies regard health, healing and spirituality as inseparable and interactive aspects of the same phenomena and so view well-being much more holistically. There are a growing number of research studies suggesting that emotional wellbeing directly affects physical wellbeing, mobilising anti-stress and increased immunity functions, lowering allostatic¹ load, and even the aging process (Ryan and Edward, 2001). In this paper well-being is taken to mean the holistic physical, intellectual and emotional health of the individual.

Many, but not all, physical well-being related factors related to buildings are quantitative and are associated with scientifically recognised metrics. However environmental illnesses that manifest in physical symptoms often appear to have psychological aspects to them. So for instance a person's physical tolerance to poor indoor quality seems to depend on their mental attitude or other stress factors that they are coping with at the time of exposure.

Many ideas focused on intellectual well-being are qualitative concepts that are inherently more difficult to measure than physical health related factors. Many space related ideas are included in this notion, but in many cases social and cultural identity and the personal taste, values and mores of the individual concerned come heavily into play.

Just where intellectual well-being becomes emotional well-being is very difficult to define. This is the hardest set of ideas to work with, but in the end this is the one that creates lasting architecture of merit and value to users and the community at large. It requires the input of designers of great sensitivity and clients who can fully articulate their beliefs and dreams to generate the really successful outcomes.

Table 1 Well-being Ideas and Concepts



Physical well-being	Intellectual well-being	Emotional well-being
Body Health Physiological	Mind Healing Psychological	Spirit Spirituality Metaphysical
Related Architectural Concepts 1. Air Quality Indoor air quality Outdoor air quality Ventilation Breathing skin enclosures 2. Light Quality Sunlight and daylight glare UV 3. Temperature and humidity control 4. Water Quality 5. Safety Fire Earthquake	Related Architectural Concepts 1. Engaging with nature Working with natural cycles Working with natural ecosystems Plants Water Indoor / outdoor flow 2. Holistic sensory design Sight Touch Hearing Taste Feel Smell 3. Personalisation	Related Architectural Concepts 1. Collective cultural and individual aspirations and identity Symbolism and metaphor Beliefs/mores Ritual Narrative 2. Mood creation and modification Ambience Emotional response 3. Restorative design Relationship building Portable wellbeing Community spirit

Natural disasters	Individual control	Planetary healing
Extreme weather events	Equality	
Radiation	4. Sprit of Place	
Noise	High level of craft	
Falling	Particularity and	
Accident reduction	uniqueness	
Ergonomics	Beauty, delight, joy,,	
Home security	pleasure	
6. Pollution Control	5. Design for Variety	
Biological	Peace and harmony	
Chemical	Stimulation and	
Electromagnetic	rejuvenation	
Non-toxic materials and	Relaxation and	
furnishings	refreshment	



Research indicates that the three aspects of wellbeing; physical, intellectual and emotional cannot be considered in isolation of each other, but in fact are related and interdependent. Physical wellbeing informs intellectual wellbeing and emotional wellbeing and vice versa. You cannot therefore hope to design a space supportive of one aspect of wellbeing without considering the others as well. Some modern hospital design is at the forefront of realising that intellectual and emotional wellbeing must be considered to support physical health.

Elements of Well-Being

It is not sensible in a single paper to consider all the elements of well-being listed in Table 1. Much has already been written on physical health and therefore those elements are not covered here. Of the rest some elements are considered by the authors to be more influential than others and so it is these elements that are overviewed in this paper.

Intellectual Wellbeing

Engaging with Nature.

Well-being is often linked with open air and particularly natural environments. People often experience a heightened sense of well-being; happy, stimulated, even spiritually uplifted in natural surroundings, such as when they are on the sea shore or in forests or on the top of a mountain. Part of this euphoria can be explained by the higher concentrations of negatively charged ions (air particles) often found in these locations, but it is also to do with the sheer beauty, variety and wondrous complexity of the natural environment to be discovered at every turn. It is non-threatening, comfortable, peaceful and curiously familiar. As a species we remain connected intimately with natural ecosystems. Millions of years of hereditary imprinting cannot be wiped out in a few urban and industry dominated generations. In New Zealand this empathy with and joy in nature is still very strong and is growing despite the anomalous fact that we spend more than 80% of our time indoors. As a nation we like to think of ourselves as celebrating, conserving and protecting our natural environment and revel in the well-being it brings to our psyche when we are amongst it. Research suggests that the appeal of nature and its place in creating feelings of well-being is an international phenomenon (Ryan and Edward, 2001).

E.O Wilson (1984), author of *Biophilia*, a term he coined to mean “*the tendency to focus on life, and life-like processes*”, suggests that the evolution of the human brain in natural surroundings and various survival factors associated with that, mean we need to have connection with nature or at least natural views and that points out that human cultures also evolved in this natural environment. Heerwagen (Herman Miller Inc, 2004) writes about the importance of evolutionary psychology and in a similar vein biologist Nicholas Humphrey (Herman Miller Inc, 2004) suggests that we feel better with a connection to nature because nature’s diverse patterns link to our survival instinct to constantly learn

Environmental psychologists of the eudaimonic suggest that it may also be that connection with plants or nature and therefore natural cycles is often a significant component in our deeper and perhaps more fulfilling sense or understanding of life which gives a greater feeling of well-being. It is also thought that connection to nature is a large component in emotional wellbeing, relieving stress and

other negative conditions². Even the presence of plants in windowless environments has been documented as having a positive effect on wellbeing and productivity in the workplace (Lohr, 1996).

Our bodies are attuned and adapted to nature's rhythms and cycles. This is not at all surprising as our bodies have developed over millions of years to operate in harmony with our environment. Nature is in constant flux and change. Our bodies tend to be stimulated by exposure to these constantly changing conditions and become somnambulant when exposed to conditions of stasis (Wilson, 1984). Through the use of artificial environment controls, the increasing use of electronic devices at home and work, shift working, deep plan buildings or windowless buildings and the high proportion of time we spend in buildings, we are becoming more and more isolated from these natural fluxes, cycles and rhythms.

To take just two examples of how these conditions affect us:

1. If our access to bright sunlight is disrupted we can develop a hormone imbalance which can lead to a condition known as Seasonal Affective Disorder (SAD). This can result in severe depression and in extreme cases suicidal tendencies develop.
2. The planet earth pulses at an average rate³ of 7-8.5 beats per second (hertz) and our own bodies pulse at a rate that responds sympathetically to this rhythmic beat. People who are out of ground contact for long periods are known to suffer from disorientation effects. To combat this effect NASA installs electronic oscillators in its spacecraft to "ground" the crews. Both the increased levels of electronic 'smog' are being generated in our buildings and the Faraday cage effect created by some building techniques tend to isolate people from the earth pulse. As we all spend a great deal of time in buildings and an increasing amount of time in front of electronic devices we are all becoming increasingly disconnected from the earth pulse and this in turn increases our levels of stress and reduces our feelings of well-being.

We need to reconnect people with natural fluxes, rhythms and cycles in next generation buildings if users are to flourish.

Holistic Sensory Design

We experience spaces with all our senses even though we privilege sight. This is particularly so when we experience a new space and gain 'our first impression'. This too is linked to our embedded survival instincts. Once the place is thought of as safe our senses become less sharply focused. However, the total sensory impact of a space, its ambience, is difficult to change from that first impression. This idea of total sensory impact is very seldom accommodated in architectural designs, but is often present in domestic situations. Changing the ambience of a space can elicit mood changes in occupants and this ability to change the ambience of a space while perhaps most important in homes, is likely to provide positive working conditions, particularly if the user can control the change themselves.

The authors suggest that in order to enhance user well-being we need to design spaces that appeal to all the senses and allow user initiated change. Such measures are likely to enhance a user's feeling of well-being and would be a major contribution to the attainment of the elusive 'X' Factor.

Personalisation

Heerwagen (2004) suggests that lack of personal control in workplaces can produce withdrawal, negative moods and physical symptoms such as headaches. This, along with other factors increases stress levels which she argues leads to restricted thinking or 'tunnel vision' which is not only detrimental to creativity, but may impact on our holistic well-being.

Autonomy in general life and in the work place has been studied in a number of ways and cross culturally (Ryan and Edward, 2001). In general it has been found that people with greater freedoms in life to determine their own goals experience a higher subjective level of wellbeing and interestingly higher collective levels of economic growth (Sen, 1999).

According to Ryan and Edward (2001), the idea of relatedness, and with it attachment and intimacy is very important to subjective human wellbeing. It is important for people to be able to relate to the space they are in, to modify it to reflect their own personalities and tastes. Perhaps this makes sense in terms of being able to have a relationship with surroundings. Spatial design inhibits or facilitates

relatedness between humans and the consideration of this is thus very important. Internal streets and neighbourhoods, centralised circulation space and generous landings are examples of considered spatial design to address this. The Max Planck Institute in Dresden, Germany deliberately creates opportunities for people to 'have as many chance meetings as possible' (Bonetta, 2003).

Spirit of Place

Ideally buildings should enable and enrich the lives of users, aid personal growth and expression, be simultaneously stimulating, revitalising, comforting and bring harmony and balance to the occupant's life. Achieving these objectives is not at all easy, but is the very essence of what architects aim to do. If successful the building will have a particular personality a unique spirit of place. Success is most likely to be achieved when the end users are known, because then the building and its spaces can be designed as a direct response to their personalities and the context. In other circumstances the designer has to strive to create a spirit of place that still provides plenty of opportunity for the eventual user to personalise and adapt the spaces to suit their own needs and sense of self. It is a difficult balance to achieve; too little character and the building can be bland and uninspiring, too much and the individual often has little opportunity to imbue it with their own personal stamp and will come to resent its inhibiting nature. A number of architectural ideas and elements are used to help create this spirit of place. Designing for the particular physical, social and cultural context; the introduction of unique design elements that are inspired by the users own personalities; use of craft at all scales with opportunities for designers, builders and users to demonstrate their ability and personality, when brought together with skill and care create a unique spirit of place that most users identify with and creates both an affectionate pride in place and bolsters personal well-being.

A building which has obviously been carefully designed and built may increase feelings of being cared for the user. In a domino effect, Existing in a nurturing space may in turn allow people to care more not only for the space but for other and the natural world.

Emotional Wellbeing

Emotional or spiritual well-being is a difficult concept to define, because of its intimately subjective and personal nature. Dealing not necessarily with spirituality in terms of organised religions, here, spiritual wellbeing refers more to a sense of holistic wellbeing; of meaningful engagement with life and worthwhile and valuable interactions with others, and perhaps even personal aspiration. It ascribes much more closely with a eudaimonic take on well-being and is particularly difficult to describe. The following spatial design concepts may contribute to holistic or spiritual wellbeing and may closely relate to the successful intellectual wellbeing design concepts previously described.

Collective Cultural and Individual Aspirations and Identity

Different belief systems mean different cultural conventions and customs and a different set of subconscious and conscious associations which make design more or less appealing to different groups or individuals. Identification with particular symbols and metaphors in spatial experience may establish and enhance a feeling of relatedness to immediate cultural surroundings. A feeling of relatedness has been identified as crucially important to human wellbeing (Ryan and Edward, 2001).

Ritual and narrative are two important ways in which designers can create a special personality for a building that at once enhances well-being. The spiritual and cultural, intricately linked to personal wellbeing, are often celebrated through ritual. Spatial design can support or hinder ritual. In this case the question is, not what do we want to look at, but how do we want to live? What are our routines? What is important to us? Design elements that facilitate and celebrate personal/cultural ritual add to particularity and personality of the space and helps to make it unique. (Specified space for taking off shoes is a good example).

Narrative architecture, if designed consciously, can move architecture into the realm of experiential design. Focal points are one of a number of techniques to create this. They may be nooks, small windows, a change in colour, texture, materiality, or level, but should be related to spatial journey through a place. In some circumstances this can be a direct expression of the personality of the

owners in other cases where we are dealing with less personal buildings it might be a celebration of a shared community beliefs and ideas.

Thomas Barrie suggests movement and circulation in space is a key component of sacred experience in space. He cites numerous examples of spaces successful in this regard such as Bernini's square in front of St Paul's. (Arnheim, 1997).

Buildings that do incorporate cultural meaning and identity are ones that are held dear not only by their users but also by the community at large. It is suggested that sustainable architecture must take cultural memory and aspiration into account, particularly if the building is to be loved, cared for, cherished and engaged with the wider community. Should we not aim to incorporate such cultural values in next generation green buildings?

Metrics

The current generation of green buildings are generally assessed on the basis of fulfilling particular criteria in relation to resource efficiency. LEED New Buildings, for instance, focuses on site use efficiency, water efficiency, energy efficiency and reducing atmospheric pollution, use of environmentally friendly materials and material resource efficiency, indoor environmental quality and innovation and design process. In other words assessment is based almost entirely on the basis of technological and essentially quantitative metrics. Even within the Indoor Environmental Measures category technical criteria like air quality, noise, lighting, temperature, humidity are taken as the principal factors impacting health, with the implicit suggestion that when we refer to health we are dealing with physical health. In reality of course, we know that health is a complex interaction between physical, psychological and metaphysical factors that together create our sense of well-being.

It is recognised that the focus on technical issues is in part due to the need to have easily applied and transparent metrics associated with the points awarded. This might be acceptable in a first generation tool but it is not, we would suggest, acceptable in next generation green buildings. Incorporating qualitative factors into green buildings will be no easy task especially if we want to relate them to an

assessment tool. This however should be seen as a challenge rather than a reason to exclude these fundamentally important aspects of green architecture. We need to do the right things not just the easy ones.

Benefits of Well-being Design

Creating places that enhance the well-being of occupants has always been one of the objectives in domestic architecture. Making people happy, comfortable, safe, relaxed, creating places that support their lifestyle aspirations is the objective of homemaking and the essence of what transforms a house into a home. Yet outside the home the well-being element of design has often been essentially ignored.

In most post-industrial societies, workplaces have generally been designed around the idea of creating optimal conditions for equipment and machines or providing the cheapest and smallest space and minimum tolerable environmental conditions for a task to be carried out. The assumption is that people will adapt to the conditions. People are flexible; they are, for the most part, able to cope, but their stress levels go up commensurately. Their total allostatic load rises, their creativity and productivity declines, they fall ill more easily and they take every opportunity not to be at work.

John Bergs (2002), a researcher from the Netherlands sums up the problem: *“In essence, no regard is paid to people’s ‘basic functioning’ and ‘instinctive behaviour’, survival skills learned over the course of evolution: the need for change, the ability to act on the environment and see the effects, identifying the meaning of stimuli, the need for one’s own territory, a place with its own identity and contact with the outside world”*.

It seems complaints from office workers have been increasing since the seventies, when not only new equipment and duties at work came about, but new ways of working, such as the open plan organisation of office space came into being (Bergs, 2002). It is probably no co-incidence that there was a concurrent rise in the incidence of Building Related Illness (BRI) in office buildings.

Much play has been made in recent times about the discovery that there appears to be a direct correlation between provision of better environmental conditions in a workplace and improved productivity. The authors suggest that it would be much more surprising if there was no such correlation. If people feel more cared for, happier or more comfortable they will feel less stressed and able to devote more of their effort to their work. It is generally recognised that in most commercial and professional situations roughly 25% of possible inputs comes in the form of a worker's discretionary effort. It seems likely that an improvement in the well-being of the individual brought about by improved working quality environment will result in a greater expenditure of discretionary effort. This is not an easy thing to measure and in many cases the only measure has been the fall in the number of absences from work.

Scientific research into these and many other related notions is still in its infancy. Kibert and Grosskopf (2006) suggest that we might be able to obtain "*a factor 10 payback in the health and performance of building occupants compared to, for example (investment in) energy savings*". Many other pieces of research substantiate this assertion, and a great deal of work is being carried out by environmental psychologists in this area.

What is emerging from research from various disciplines as will be discussed is that human emotional and even spiritual wellbeing, as well as physical health, play a large part in our ability to work properly and relate to each other well.

The financial case for investing in improving worker well-being through the provision of better quality architectural space is becoming ever clearer, but there is also a recognition that creating and investing in enhancing the well-being of building users does not only make sense from a financial viewpoint. Should we not also be actively promoting well-being design from a social and environmental viewpoint and because it is 'the right thing to do'? Are not people who are healthier, happier and less stressed, more likely to have the time and energy to be environmentally and socially responsible? Perhaps if we, as designers and building providers nurture building occupants they in turn will be more inclined to adopt the attitudinal shift that is necessary to change green building design from a marginal into the mainstream approach to making our future built environment.

Such factors could also impact on the natural environment. If the workplaces we spend so much time in, are devoid of human wellbeing considerations spatially, the psychological distinction between living and working environments can be considerable. Could this in some measure account for the different attitudes to the environment that the same people appear to display in domestic and work situations?

Scientific Research Approaches

Traditional Codexes

While 'Western' societies have tended to develop systems that separated physical from intellectual and emotional well-being many other societies have adopted a much more holistic view concerning the well-being of the individual. Many of these systems connect architectural space with well-being. The best known of these is Feng Shui' the Chinese art of placement to promote harmony, well-being and prosperity. Tibetan, Indian, Greek, Incan and Islamic systems also exist, though these are less well known.

In the 'West' we are 'late adopters' in this respect and, as with all things, we are trying to develop a scientific understanding of the interaction of different aspects of well-being. Even now we still tend to separate them out rather than integrate them into a holistic system.

Building Science

Scientific research into physical health and well-being has largely been the realm of the building scientist and the medical researcher, sometimes in combination. Some aspects of physical health related to buildings already have recognised quantifiable tools and metrics associated with them. There is of course still a huge amount of scientific research to be carried out in this area, particularly in the area of indoor air quality. Much of the current indoor air quality work relates to the effects of chemical off-gassing, bacteriological moulds and spores and dust particles on human physical well-being.

Much of the scientific evidence tends to back up the anecdotal evidence that many designers working in the area of environmentally friendly design have been working with for many years. The findings

are at once comforting and irritating for many green designers. They are comforting in the sense that designers' assertions are now able to be backed up by scientific evidence and therefore are now accepted by building providers, and irritating in that many of the results coming through seem to verify what seems so obvious and self-evident to designers working in the field that the tentative results offered appear to be rather naïve and simplistic. The hard questions such as the effects of the many chemical cocktails we find in our homes and workplaces, a tool related to establishing total allostatic loadings, the effects of absorbency on prolonging off-gassing and so on, still seem to be well beyond the scientific community.

Environmental Psychology

Roger Barker coined the term 'environmental psychology' half a century ago (Berdik, 2005). This investigates the influence architectural space, form and environments can have on the mood and behaviour of individuals. Much of this work has been carried out on the behalf of commercial organisations and the results are often not available in the public domain.

Heerwagen (2004) suggests that more time has been spent on designing for psychological wellbeing of animals in zoos than on humans in workplaces. According to research of Ryan and Edward (2001) who examine the notion of well-being from a psychological perspective, most well-being research falls into two main camps. One which sees well-being as a measure of how happy a person is, the *hedonic approach*, and the other which sees well-being as defined by the self-realisation and self-determination a person possesses, called the *eudaimonic approach*. This has been described as the difference between 'pleasure' and 'enjoyment' as discussed by Bryce and Haworth (2002).

Although sometimes complimentary, the two approaches are also radically different at times. The debate stems from both contemporary discourse and ancient ideas on the matter from historical figures such as Aristippus and Aristotle. The questions asked when looking at well-being depending on which viewpoint one subscribes to and the different methods utilised for achieving wellbeing.

An eudaimonic approach to facilitating well-being through architectural experience entails the consideration of elements such as cultural and individual interpretation and past experience or

expectations in any consideration of how people relate to space. Perhaps it is these qualities however, that if present in a space, represent that 'Element X' in architecture which can transform functional space into truly special space, that has maximum beneficial effects on human well-being. If we consider that humans are part of a larger ecosystem and that human and planetary wellbeing are intricately and irrevocably linked, we may draw the conclusion that radically sustainable architecture must strive to understand and create this 'element x' in building if its goals are to be truly sustainable.

Evolutionary Psychologists

A further scientific strand is the work of evolutionary psychologists⁴ who have been delving into the spatial attributes that contribute to subjective wellbeing, basing their hypotheses for what will work, survival conditioning and imprinting inherited from our ancestors.

'The chief difference between the map of the archaic and traditional societies and humans in modern societies ...lies in the fact that the former feels indivisibly connected to the cosmos and natural rhythms, whereas the latter insists they are connected only with history...'

Eliade (1965)

Neuroscience

An encouraging recent development has been the establishment in of The Academy of Neuroscience for Architecture⁵, (ANFA) as joint venture by the American Institute of Architects (AIA) and the Neuroscience Institute. This academy has been established to research how the brain reacts to different environments. . The American Institute of Architects announced the new venture in 2003 and the Executive Vice president, Norman Koonce summed up the need for the new academy by asking the following question:

'What would it mean for architects to move beyond an intuitive and anecdotal rational in their design? How much better could be serve our clients and the public if we could understand how their brains enable perception of their physical environment and generate physical responses to it?

Although it seems such questions have not yet been solved, with key Academy personnel admitting '*we have no clue how design affects the nervous system*', and '*we don't even know the right questions to ask*' (Bonetta, 2003), it is interesting that effort is being made to find evidence to validate or modify architectural intuition and anecdotal evidence in this area.

Over time the work of these researchers may provide scientific evidence and a set of rules and metrics relating to well-being. For now however we must rely on a combination of creativity, instinct, intuition and empirically learning garnered from the careful study of successful precedents combined with anecdotal evidence and experience that successful architects have employed for many years past.

Scientific Research Outcomes

Research in the whole area of well-being is still in its infancy. This is particularly true of research that considers well-being as a holistic state that comprising physical, intellectual and emotional components.

Physical Well-being

Most of the research carried out in this sector relates to comfort and to a lesser extent physical health and well-being. In the case of physical health much of the research has been focused on indoor air quality. Most of the scientific results tend to bear out the anecdotal evidence gathered by 'green' designers over the years. Scientific, evidence based results tend to be rather general and tentative even at this stage, mainly due to the huge variability of human responses to any given set of circumstances. It is likely that in many areas of physical health we still have to operate on the precautionary principle.

Intellectual and Emotional Well-being

A growing amount of research is being undertaken in the area of psychological well-being particularly by commercial companies wishing to better understand consumer preferences. Unfortunately commercial organisations tend to regard these results as commercially sensitive and do not always place them in the public arena. However an increasing body of evidence suggests that emotional well-being, is directly affected by their experience of spatial elements (Venolia, 1988).

A growing body of research looks at human wellbeing and relation to natural views. Ulrich (1984) published the first work detailing a quantifiable connection between access to natural views and human wellbeing. He looked at recovery rates of patients after surgery and found access to views of the natural environment had a positive impact. Work carried out in 2003, by researcher Lisa Hescong, also established a series of causal links between the enhanced performance of office workers and views through windows (Herman Miller Inc, 2004).

Heerwagen (Herman Miller Inc, 2004) suggests that we have an instinctive affinity with nature dating back to our anthropogenic roots that engenders a deep seated need to be connected to nature. Hence the need for us to have natural lighting and views, elements of discovery in environments to stimulating the quality of mystery and surprise found when in natural environments, elements of refuge and privacy mixed with open areas related to need for surveillance and organic patterns.

Work undertaken by Heerwagen with various colleagues into new workplace environments that replicate nature in terms of diversity, pattern and form, found that problem solving capability and positive emotions can be enhanced by surfacing of furniture and screens with patterns derived from nature (Herman Miller Inc, 2004).

This apparent empathy with things natural has led to a suggestion by the Academy of Neuroscience for Architecture (ANFA) that sloped ceilings, overhangs supported by canopies, and certain colours, may subconsciously be associated with certain landscapes and therefore be psychologically preferential.

An Alternative Approach

It is clear from the above that if the only information available in this sector was from scientific researchers then we would need to wait for a very long time before we had a useful amount of well-being related information with which to work. Fortunately other sources of information are available. Many societies have codified knowledge concerning the interaction between physical space and well-being over thousands of years and we can certainly learn a great deal from such accumulated wisdom

as Chinese Feng Shui or Indian Vastu teachings if we are prepared to put in the effort to obtain a clear understanding of the precepts underlying the various codes. Vernacular architecture too holds many lessons that we could learn from. Many architects have also been operating in this area without necessarily recognising that they were dealing with well-being. There is a huge amount of anecdotal evidence and literature written concerning the creation of beautiful, inspiring, stimulating, relaxing, rejuvenating architecture. Learning how to design to capture the spirit of place and integrate buildings with their context has been a fundamental part of architectural education for many years. Generations of beautiful, inspiring, delightful buildings and spaces are available for us to use in precedent studies.

There are many contemporary examples of such buildings. Louis Kahn's Salk Institute is one such building. Jonas Salk was a firm believer, from his own personal experience of the power of architecture to affect experience and performance of individuals (ANFA 2006), and he instructed Louis Kahn accordingly. Another such example is the work of Austrian architectural designer Hundertwasser, who passionately believed in the need for people to have direct connection with nature and crafted personalised space and designed accordingly. But perhaps the most holistic contemporary exemplar of many of the ideas and concepts covered in this paper is the Nederlandsche Middenstands Bank (NMB) administration headquarters building.

The building was designed over a three year period and finished in 1987 it was the outcome of an inspirational collaborative effort between by architect Anton Alberts, a multidisciplinary design team consisting of a construction engineer, an energy expert, acousticians, an occupational therapists, artists, contractors a landscape architect together with future users. Future users had a significant input into the design process, selecting the architect, helping to determine the number of people in a work group which determined the size of tower footprints, the proximity of people to opening windows and the siting of the new building in the closest possible proximity to the greatest number of employees. Construction costs were comparable to a conventional office building but running costs are much lower due to the energy saving features. The building is a good example of a 'green' building in terms of energy and material use but in the context of this paper it is the consideration of wellbeing components that is truly remarkable.

The building, described as a ground-scraper (Browning, 1992), consists of ten undulating towers of varying heights linked by pedestrian bridges and a central ground level street lined with restaurants, art features and meeting rooms. More than 2000 people work in the building, and the building itself and the consequent working environment has been cited as a reason people want to work there. The 15% less employee absenteeism compared with the bank's previous headquarters has been directly attributed to the attractive work environment (Browning, 1992). The building so enhanced the company's image that it went from the number four bank in the Netherlands to the number two bank soon after the building was completed.

As well as using less than one tenth of the energy of the bank's previous building, and being an example of a well integrated sustainable building, there is an understanding of the importance of connection to nature and sensory stimulation in the building. No desk is more than 7 meters from a window, a requirement that determined the floor depth. Natural lighting is used in most of the spaces through clever use of interior louvers that bounce light deep into spaces.



Natural materials, plants and flowing water are integrated into the building. Plants are used as humidify the space. There is variety in the types of spaces people can inhabit with different landscaping and art features, and the internal street connected the towers and generous staircases are designed to promote walking between offices rather than the use of

escalators and encourage the serendipitous interaction of people. Individual artworks are incorporated into the interiors and the exterior garden spaces. "The garden spaces are designed to break down the barriers between 'inside and outside', 'life and work' and 'nature and artefact'" (Fowles 2001) and are of several different kinds.

Table 2 NMB Bank adapted from Fowles 2001

NMB Bank - Sustainability Design Profile	
NB: the same quality or design characteristic can apply to more than one section of the profile (inter-connectedness)	
HEALTH Impact on health of people: physical psychological feeling of well-being Impact on health of planet.	No air-conditioning. Night flushing of air through the building expels any contaminants Non-spirit based paints and stains Water: flow-forms, pools and water sculptures soothe, cool and oxygenate the air Planting: improves air quality and creates a 'natural' atmosphere. Soft coloured surfaces Absence of 'imposing' rectilinear layout. Domestic scale: internal street and to the workspaces Irregular form gives domestic scale and allows daylight/sunshine into mass of the building Everyone has the right of space next to a window which opens All occupants have views out from their workplaces, many into gardens Generally, environmental control is in the hands of the occupants Slope of walls deflect traffic noise Gardens help break down barrier between 'outside-inside', 'life-work', 'nature-artefact'
SPIRITUAL Sacred Cultural Reverence Personal transformation	Solar calendar and time of day indicator Slope of walls at base give 'earth bound connection'. Towers bring light in to filter down to the internal street Water: flow-forms, pools and water sculptures create calming ambiance All occupants have views out from their workplaces, many into gardens Gardens help break down barrier between 'outside and inside', 'life and work', 'nature and artefact' Internal street displays of local hand-crafted works: paintings, sculpture, stained glass, mirrors and textiles Brickwork traditions of Amsterdam School Employees worked with the collaborative design team
ECOLOGICAL Nature Eco-systems Bioregionalism	Planting: improves air quality and creates a 'natural' atmosphere All occupants have views out from their workplaces, many into gardens Gardens help break down barrier between 'outside and inside', 'life and work', 'nature and artefact' Irregular form gives domestic scale and allows daylight/sunshine into mass of the building Rainwater collected, stored and filtered for internal flow-form use Water: flow-forms, pools and water sculptures soothe, cool and oxygenate the air Solar calendar and time of day indicator Employees worked with the collaborative design team which included acousticians, landscapers, occupational therapists, artists, contractors, plus engineers and architect. Computer controlled sun blinds
ENVIRONMENTAL Design with climate. Building as climatic modifier. Environmental impact.	No air-conditioning Maximum use of natural lighting (workstations near windows, window to window maximum distance is 6m-7m, deflectors at tops of windows to place light in depth of building) Everyone has the right of space next to a window which opens Generally, environmental control in hands of the occupants. Computer controlled sun blinds Access towers bring light in to filter down to the internal street Solar energy pre-heats air before it is drawn down into the building Irregular form gives domestic scale and allows daylight/sunshine into mass of the building Slope of walls deflect traffic noise
ECONOMIC Local economy Job creation Community resource	Democratic decision by the bank's employees on where the building was to be sited Internal street displays of local hand-crafted works: paintings, sculpture, stained glass, mirrors and textiles Local brick industries
SOCIAL Social process Participation Equality Stake-holding	Domestic scale: to the internal street and to the workspaces Internal street displays of local hand-crafted works: paintings, sculpture, stained glass, mirrors and textiles Elected employee committee selected the architect Democratic decision by the bank's employees on where the building was to be sited Employees worked with the collaborative design team that included acousticians, landscapers, occupational therapists, artists, contractors, plus the more usual engineers and architects. Generally, environmental control in the hands of the user. Social organisation of work Spaces: 20 person groups. Irregular non-institutional circulation routes. Absence of 'imposing' rectilinear layout
ENERGY Conserving Consumption	No wide spans in the structure. No air-conditioning High insulation. Heat gains are from people, computers, lighting and sunlight Maximum use of natural lighting (workstations near windows, window to window maximum distance is 6m-7m, deflectors at tops of windows to place light in depth of building) Access towers bring light in to filter down to the internal street Solar energy pre-heats air before it is drawn down into the building. Waste heat is recycled
MATERIALS Sources Life cycle	Non-spirit based paints and stains Local brick industries

Conclusion

Sustainability in architecture is generally thought of in terms of resource conservation, pollution, impact on natural ecosystems, and other measurable effects on planetary health. It can be argued however that human wellbeing and planetary well-being are intricately interwoven and interdependent, with these precepts because we as a species impact so dramatically on the whole planet, as there are few aspects of either human or planetary health that do not affect the other. It can also be reasoned, that individual wellbeing is intricately cross-linked with cultural or community well-being.

People spend a great deal of time indoor in most developed countries now. Even in New Zealand where the population is keenly interested in nature and sees itself as an outdoor country we still spend in excess of 80% of our time indoors. The spaces we create therefore have a huge impact on our psyches. If the spaces we inhabit enables us to develop a holistic sense of well-being that encourages us to act in harmony with each other and the planet this is of immense benefit not only for us as individuals but for the community at large. For us to become physically, emotionally and spiritually healthier individuals is likely to have a flow-on effect and result in the development healthy communities and positively impact on the environment at large.

If incorporating well-being characteristics into all of our buildings is seen as being important, how do we move forward in this sector? Do we wait for the evidence based research outcomes before we act? Do we use what evidence we have now and just operate in those sectors where we can be reasonably sure that the weight of evidence will support the moves we make? If so how much evidence is enough? There is a certain element of *deja vu* in this circumstance. In the 70's and 80's we were not sure of very much at all when it came to 'green' architecture but that did not stop us challenging the way things were done. There was a high level of uncertainty in many areas and from this uncertainty the precautionary principle was devised. Fundamentally this argues that if we wait until we have all the information we want it will be too late to use it, so we should do the best we can with the information at hand always acting to promote the welfare of both people and the planet.

While the notion of a space having an impact on the well-being of people seems to have been a recent discovery in the scientific community, it is likely that those same people live in houses where all the

essential well-being qualities we have discussed in this paper are present but because they are so ubiquitously most family homes they go unremarked. Codexes are available from many non-Western societies that link physical environments with holistic well-being. Some of these codexes have been under development for over 5000 years. There is a huge amount of literature about the creation of beautiful, inspiring, mood enhancing architecture and thousand upon thousand of buildings worldwide that lift our spirits designed on the basis of accumulated anecdotal evidence passed down from one generation of architects to the next.

So a great deal of information is there, but it is not necessarily in a form that can easily fit into our preconception of a 'green' building paradigm. Given the will it is quite certain that we could analyse and codify this information for use in next generation green buildings. Such a code can be easily modified if and when evidence based research comes to hand, just like every other aspect of the 'green' architecture paradigm. It would be a work in progress but as the saying goes "a task well started is a task half completed". The authors strongly advocate this approach.

If integrated with sustainable technologies, well-being enhancement factors can work synergistically, in our building designs, to enhance user happiness and satisfaction, improve user productivity, health, morale and vitality and are likely to make resource efficient architecture much more appealing to a wide constituency of building users. A more tentative suggestion is that architecture that enhances people's feeling of well-being could be an agent for positive change in relation to work ethics and values, community spirit and interpersonal relationships. If we can create places where people want to be, that delight, stimulate, rejuvenate, are in harmony with the environment and resource efficient, then we will have succeeded in creating a truly sustainable architecture.

If we can accept that engendering human well-being is of fundamental importance to us as individuals and to the communities we live in, future green buildings must incorporate this notion into the paradigm for next generation of green buildings. Without this 'Factor X' our buildings might be resource efficient, non-polluting but they will not be truly sustainable. The basic question the fundamental challenge is do we do the right thing or simply the easy thing when we develop the paradigm for next generation green buildings

'Sustainability is about poetry, optimism and delight... The unquantifiable is at least as important as the quantifiable.' Thomas (2003)

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End Notes

¹ Allostatic Load is a measure of all the inimical factors we are attempting to cope with at the same time such as stress, physical illness, fatigue, resistance to pollution, noise etc. This may account to some extent for the large differences individuals' exhibit to similar conditions.

² The Netherlands Institute for Health Promotion and Disease Prevention (NIGZ), with the support of the European Union have a website dedicated to this with a number of academic papers available. <http://www.healthygreenatwork.org/> (April 2006)

³ The earth's pulse itself is not static. It is said to vary between 7 and 8.5 Hz and is part of many frequencies that make up the earth's harmonic signature. It varies depending on geographical location and can even have naturally occurring interruptions. It has been suggested that humans may need this variety and the problem with new electronic devices is that they override fluxing harmonics with steady harmonics adding to isolation from nature. Buildings also have their own harmonics depending on their height and width.

⁴ A number of such people are cited in Herman Miller Inc (2004).

⁵ Links to recent publication from ANFA or about neuroscience and architecture can be found at <http://www.anfarch.org/> (April 2006)