Experiencing Sustainable Architecture: investigating a university's internal initiative for sustainability

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Declaration

This thesis contains no material which has been accepted for the award of any other degree or diploma in any tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference is made in the text of the thesis.

Signed

Prue Slatyer

Date

Abstract

Climate change and the concomitant need to reduce greenhouse gas emissions through living sustainably is possibly the most significant issue of our time. Sustainable built environments have the potential to make a significant contribution to reducing greenhouse gas emissions. The success of sustainable architecture relies on both technology and its acceptance by building occupants. Whilst most research on sustainable architecture has focussed on technology, there has been less research on occupant experience of sustainable buildings.

This research addresses this gap by investigating occupant experience of sustainable architecture through a case study and a review of literature relating to the phenomenological experience of architecture. The case study is the School of Architecture and Design at the University of Tasmania. The research design is based on mixed methodology, using questionnaire surveys to provide extensive quantitative data which is investigated more intensively through the qualitative research methods of interviews and focus groups.

The results show strong dissatisfaction with most of the specific variables of comfort (temperature, air, noise, lighting, personal control), satisfaction with overall comfort, health and productivity and strong satisfaction with overall design aspects. This finding is consistent with the literature on comfort and occupant experience of green buildings. It appears that occupants in the case study building are adapting to the discomfort they experience, with the

satisfaction they express for overall comfort and the building overall indicating tolerance and forgiveness of this discomfort.

The analysis and discussion is structured thematically around the themes of comfort, delight and forgiveness, as these arose as the main issues from the data and have significance for the development of sustainable architecture. The internal environments of sustainable buildings are often more variable, less predictable and have a greater temperature range than air conditioned buildings, due to the use of passive technologies for heating, cooling and ventilation which more closely follow the external climate. Forgiveness of these less-than-static conditions is a positive step in the acceptance of sustainable architecture and can bring the benefit of thermal delight. The literature indicates that good design which encourages delight can have a positive effect on occupant well-being which in turn may facilitate forgiveness. A phenomenological understanding of occupant experience supports the concept of comfort as a multi-dimensional relationship between occupant and building.

For centuries architects have been guided by the Vitruvian triad of *Firmness, Commodity and Delight* in their pursuit of architectural excellence. I propose that this is augmented by the triad of *Forgiveness, Comfort and Delight* to guide architects towards creating sustainable architecture for the twenty first century.

Acknowledgements

This research project has been a much longer and more complex journey than I imagined at the outset.

There are many at the University of Tasmania who have helped this project reach fruition and whose support and involvement in the project are much appreciated. Matt Smith, the (then) Director of Asset Management Services (AMS) gave me permission to use a university building for my case study and several AMS staff provided useful information about the building. Professor Roger Fay, the (then) Head of the School of Architecture and Design allowed me access into the busy life of his school and many staff and students of the School of Architecture and Design participated in surveys, focus groups and interviews. Two of the architects engaged by the University also participated in the study.

In the School of Geography and Environmental Studies, my supervisor, Dr Elaine Stratford gave constant encouragement, support and critical reviews of my thinking and writing. I am very appreciative of Elaine's support, especially at times when my enthusiasm and focus waned. I have also appreciated the insightful comments from my co-supervisor, Dr Aidan Davison. My fellow research students provided friendship, helpful discussions and support, especially my room mate, Phillipa Watson, who assisted with my survey work.

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I am indebted to the Usable Buildings Trust in the UK for the use of the BUS questionnaire and Adrian Leaman for his support. I have great admiration for the trust and its role in promoting a more human dimension in the design of buildings.

Contents

List of figures and plates

Figures

Plates

Chapter 1 Introduction and Research Design

1.1 Preamble

As I wrote the first draft of this introduction, aftershocks rumbled Japan and Christchurch following devastating earthquakes. Large areas of Australia experienced the worst floods in history after decades of drought. Climate change, environmental disasters, peak oil, species extinction, pollution of the land, sea and air, and the presence of increasingly obese and unhealthy populations in developed countries are driving the need to live more sustainably. Possibly the most significant global, regional and local issues of our time are climate change and the concomitant imperative for sustainability.

Built environments use vast amounts of resources, including energy, water and materials (Green Building Council of Australia, 2009) and thus constitute sites worthy of climate change mitigation and adaptation. Architects are advocating processes and practices that address this excessive unsustainable consumption, predominantly by designing systems that reduce the amount of energy expended to provide comfortable internal environments. Much of the research on sustainable architecture has focused on technical aspects of design, investigating ways to improve building performance with regard to energy and water use and other quantifiable characteristics. There has been less research on the experience of those occupying sustainable architecture, yet the success of sustainable technology relies on its acceptance by those same occupants.

Understanding the occupant experience is essential to the practice of sustainable architecture. Increased opportunities for sustainable architecture, with a concomitant increase in benefits from economies of scale, lie in looking beyond the individual building to the community and city scale. The university operates at this community scale. As an educational institution, its mission is to produce and disseminate new knowledge. In this light, leaders in individual higher education organizations can decide to use this broad mission to raise awareness in their communities of both sustainability imperatives and initiatives. Universities educate the decision makers of the future and, as communities of forward thinkers, are likely to be interested in promoting sustainability in all aspects of their operations. Universities therefore provide ideal sites for sustainability initiatives.

This research contributes to understandings of occupant experience of sustainable architecture using a case study at the University of Tasmania. The University is the only such higher education organization in Tasmania and is the fourth oldest university in Australia, being established in 1890. It operates from its three main suburban campuses: in Hobart (Sandy Bay campus), Launceston (Newnham Campus) and Burnie (Cradle Coast Campus), as well as from a small number of satellite campuses in Hobart and in Launceston.

The research concerns one such satellite campus in Launceston, known as Inveresk. A redundant railway site, Inveresk now accommodates a recycled railway workshop building adapted using sustainable design principles that, not insignificantly, houses the School of Architecture and Design. It is a post occupancy evaluation of this building, with particular consideration of issues of forgiveness, comfort and delight that are of central concern to the research.

1.2 Aims and significance

This work advances an architectural agenda with foundational concerns for societal change and sustainability. The aims of the research are threefold. First, in broad terms I seek to add new knowledge to the growing study of sustainable architecture from the perspectives provided by environmental studies. Work to advance that goal is informed by relevant scholarly, professional and popular literature and by my own experience as an architect, landscape architect, urban designer, and lecturer in an undergraduate architecture degree. Second, in more specific terms I draw on phenomenology and the literature pertaining to forgiveness, comfort and delight as tools by which to understand post occupancy evaluation of a particular building at the University of Tasmania. As part of that aim, I contribute to professional knowledge on occupant experience of sustainable buildings. Third, I propose to augment debate about the transition from traditional to sustainable university operations, and to provide recommendations which have practical application in the development of sustainable architecture and universities.

Given these aims, the question that underpins this study is:

> *What, if any, aspects of occupant experience in the University of Tasmania's School of Architecture and Designand Design building have relevance for sustainable architecture and advance the organisation's sustainability initiatives? How do they do this and to what effect?*

The research has significance on at least three grounds. First, *intellectually* it provides an original set of interpretations about the roles of forgiveness, comfort and delight in how building occupants experience, in phenomenological terms, the places in which they work or dwell. Second,

methodologically it uses a mixed methods approach, combining quantitative and qualitative methods. The decision to use mixed methods is premised on the understanding that the experience of architecture is subjective, sensorial and multi-dimensional and lends itself to various forms of data collection and analysis. In addition, the work *informs and democratizes other research* by contributing to an international quantitative database of knowledge on occupant experience which is used for benchmarking and ongoing research processes as well as adding to knowledge with new qualitative interview data and interpretations of those data. Third, the work is significant in *practical* terms, and grounds concepts by reference to the real design, construction and performance of a sustainable building for architecture staff and students as well as providing practical insights for future sustainability initiatives at the University of Tasmania.

1.3 Motivation: reflective practice, sustainability

My motivation for carrying out the research *project* is explained in terms of my commitment to reflective practice with my interest in sustainability being the motivation for the research *topic*. The concept of the 'reflective practitioner' was developed by Donald Schön (1983, 50), who describes the practitioner as one that, on encountering unique or complex phenomena in his or her practice, 'tries to make sense of it … reflects on the understandings which have been implicit in his (or her) action, understandings which he (or she) surfaces, criticizes, restructures and embodies in further action'.
This process of reflection-in-action is central to the process by which practitioners deal with situations of uncertainty, instability, uniqueness, and value conflict. We are increasingly faced with these situations.

Schön (1983) describes two types of reflection: the aforementioned *reflection-in-action*, which occurs in the middle of an action and helps to reshape

current action; and *reflection-on-action*, which occurs after an action, has no impact on that action, and yet may shape future practice. Cowan (1998) develops these definitions to include *reflection-for-action*, which describes the process of reflecting on the types of problems to be resolved more effectively in the future. In turn, Wakefield (2007, 331) describes the dynamic relationship between reflection and action as 'the melding of theory/reflection and practice/action as part of a conscious struggle to transform the world. Put simply, praxis is giving life to ideas about the way the world is – and could be – by acting on one's convictions'. The relationship between theory and practice is thus both dynamic and iterative.

My research is carried out from the perspective of a practising architect reflecting in, on and for action. The action which is reflected on is predominantly that of my professional peers through their involvement in the case study. This is informed by my past and current practice and will inform my current and future practice. I have had an abiding interest in environmentally sustainable architecture since my undergraduate days a number of decades ago. I began this research a few years ago when I was involved in the design of an office refurbishment for a local government in Hobart, Tasmania. Inspired by Melbourne City Council's CH2 building, my colleagues and I sought to make the refurbishment as environmentally sustainable as possible. As part of that commitment, I realised that many of our design initiatives had social as well as environmental benefits. For example, maximising access to natural light to reduce energy used on artificial lighting would also give occupants access to restorative views to a beautiful park. Providing opening windows so that the building could be cooled by natural ventilation rather than air-conditioning would improve the quality of the indoor air (Smith, 1997 and EPA, 2000 in Wood, 2003; Donhoe, 1997). The open plan required for the success of natural ventilation and

maximising access to natural light would have benefits for team work and social interaction (Becker, 2001).

I began to develop the hypothesis that environmentally sustainable buildings are inherently socially sustainable, and decided to test this premise by undertaking the present research with a focus on the occupant experience of sustainable buildings.

1.4 Research design

1.4.1 The case study approach

The case study involves a post occupancy evaluation of the School of Architecture and Design, a sustainable building developed in 2006 on the Inveresk, Launceston, campus of the University of Tasmania; this is discussed in detail in Chapter 4. The main reasons for choosing this building for the case study were because it was explicitly designed as an environmentally sustainable building; staff and students at the School of Architecture and Design would be likely to co-operate in post occupancy evaluation of the building; the university, as the building owner, would likely be interested in the results and use them to improve this building and inform the design of new buildings.

It was advantageous that one of my disciplines is architecture and that I had established relationships with the user client (School of Architecture and Design) and the client paying for the new build (Asset Management Services at the University of Tasmania). These relationships facilitated access to the occupants of the building, to the building itself, to information on building procurement, and to data on building performance.

The use of a case study for research involves the 'real' or phenomenal world, and deals with human activities in context rather than with experiments or

simulations. This naturalistic style of case study research makes it particularly appropriate for studying human phenomena and asking what it means to be human in the real world (Gillham, 2000). Here, the phenomenological experience of occupants of the School of Architecture and Design at the University of Tasmania forms the focus of the case study.

My case study combines quantitative and qualitative research. Quantitative research provides extensive data which gives an overview of patterns and distinguishing features (Bradshaw and Stratford, 2000) and is used as the backcloth against which the intensive and explanatory nature of qualitative research is situated. Qualitative research 'celebrates richness, depth, nuance, context, multi-dimensionality and complexity… (and) has unrivalled capacity to constitute compelling arguments about how things work in particular contexts.' (Mason, 2004, 1). As such, it is ideally suited to the real world of the case study. The use of mixed methods thus facilitates collection of data which is both extensive and intensive.

Thus grounded in 'reality', the study fits Stake's (2005) definition of an *intrinsic case study*, which has the case as the focus, and through which generalisation is typically not emphasised, especially when it is to the detriment of understanding the case itself. Nevertheless, the relationship of the data to existing theoretical understandings of sustainable architecture – and the opportunity to make use of the data for other University of Tasmania buildings –does provide scope for some generalisation. In this sense, the research has certain characteristics of the *instrumental* case study, in which the case study illustrates theory or provides useful insights into an issue. In such circumstances, the case may play a role in facilitating understanding of something that has wider salience.

As an *intrinsic* case study, the value of this research lies in providing insights about the occupant experience of the building; this has practical benefits for

the School of Architecture and Design and the University of Tasmania. As a partly *instrumental* case study, the data can be generalised to support existing research on sustainable architecture and has practical application for other UTAS buildings.

1.4.2 Methods

The study took place part-time over four and a half years, with the primary data collection carried out during the latter part of two consecutive years. There were two rounds of data collection during 2007 and 2008. As this study was a timed exercise, data collection needed to begin in 2007. Timing also had to consider the academic year (two semesters of 13 weeks) and the need to avoid the lead up to end of year assessments. However the building had only been occupied for 9 months at the time of the first round of data collection and it is generally advised that post occupancy evaluation is most effective after 12 months of occupation, which allows occupants and the building to settle. The second round was therefore considered important to validate the results of the first. The period between the two rounds provided the advantage of allowing identification of the major issues for further investigation in the second round. The two rounds of data collection also provided a greater number of responses and richer data. - The study was approved by the University of Tasmania's Human Ethics Committee (H9715). Information sheets explaining the voluntary nature of the research and arrangements for confidentiality and anonymity were outlined to all participants, each of whom signed a form acknowledging informed consent to participate in the study (Appendix B). Seeking consent is a means to recognise and respect the autonomy of individuals, and justifies engagement with others' thoughts, feelings, attitudes which may be private concerns. Seeking consent also engenders trust between researchers and participants (Gregory, 2003). As a hallmark of the consideration a researcher gives to any participant for being privy to the thoughts and feelings of others,

confidentiality was respected where asked for, and anonymity has been provided. Care was also taken to respect the privacy of individuals in photographing the building while occupied and, where an individual may be identified, permission was sought in advance of images being taken.

Various methods were selected to enable an examination of the occupants' experience of the building particularly in the areas of comfort and delight, and an exploration of the occupants' capacities for forgiveness of its shortcomings. Occupants' perspectives and insights were elicited using a written questionnaire survey, focus groups and interviews, and observation of this group in situ. Interviews were also carried out with the building's architects and the University's project manager who oversaw the procurement of the building from the design brief to completion of construction. Each of these methods is explained in more detail below .

I have always been interested in **post occupancy evaluation (POE)** as a means to facilitate reflective practice and contribution to a broader body of design knowledge. POE describes the process of surveying occupants of new or refurbished buildings to determine their satisfaction with the new or newly reconfigured environment. It is different from, but often carried out with, *building evaluation* which involves quantitative assessment of the building fabric and its performance particularly in relation to the internal physical environment.

POE was developed in the 1970s in conjunction with a growing interest in environmental issues, the development of the discipline of ecology and its links to ideas about habitat. The new field of environmental psychology, which investigated the interrelationships between human habitat and behaviour, provided the framework within which POE developed. POE has been described as the 'study or analysis of how occupants perceive, use and judge their built environment, using social science research to gather

systematic feedback from users.' (Vischer in Dodson, 2011, 81). The data obtained from POE can be used to refine the building which has been evaluated; aid building owners and facilities managers in the design of future buildings; provide feedback to the architect/building designer; and contribute to architectural design knowledge.

In general, a POE produces quantitative data from widely distributed questionnaires, followed by focus groups and interviews to investigate issues arising from the data and this is the methodology used in this study. During the 1980s, standardised POE toolkits were developed in the UK and USA. In 1985 the Usable Buildings Trust in the UK developed the *Building Use Studies* or BUS *Occupant Survey*. This tool is a 'quick and thorough but not simplistic way of obtaining professional level feedback data on building performance, primarily from the occupants. It may be used by itself, or with other techniques as part of a post-occupancy evaluation' (Leaman, 2006, 2).

To access the survey, it is necessary to register for a licence which is free to supervised post graduate students, and in 2007, cost one thousand pounds sterling for others. Usage of the BUS survey is split 60:40 between advanced design practices (along with consultancies, developers and building owners) and researchers.

The BUS survey uses a questionnaire to gather data and it is this **questionnaire** that is used in the research. The 71 questions in 2007 and 78 in 2008 cover background information, design, needs, image, storage, meeting facilities, perceived productivity, perceived health, thermal comfort, ventilation, lighting, glare, noise, furniture, space, and perceived control. Most questions ask occupants to score aspects of a building on a 7-point rating scale and open-ended questions seek other comments. Results are sent to Adrian Leaman, who co-designed and manages the BUS, in a preformatted spreadsheet and these are then returned to researchers in the

form of many pages of data and benchmarks, lists of comments from participants and graphs for up to 65 variables.

Worldwide, in 2006, over 200 buildings had been surveyed (Leaman, 2006) and in 2012, this had risen to over 500 buildings (Building Use Studies, 2012). Licensing allows the Usable Buildings Trust to establish benchmarks by incorporating data from each evaluation into the master database. Data also form the basis for scholarly articles written by staff at the Usable Buildings Trust on occupant preferences in buildings, bringing a more human dimension to the design of buildings (Building Use Studies, 2012). By contributing to a data bank of occupant evaluation responses, my work thus contributes to the democratization of research.

There are several advantages of using an established evaluation tool such as the BUS survey. The method has been used extensively internationally and in Australia by reputable organisations such as CSIRO, Melbourne City Council and Arup and has been refined over a period of over 20 years. It avoids 'reinventing the wheel'. It can be supported by other methods such as interviews and focus groups. It was developed by a non-profit organisation with worthy principles and affords the opportunity to use benchmarks and easily contribute to an international body of design knowledge.

The BUS questionnaire was distributed early in the day with an invitation to participate in the survey and a consent form to second, third and fourth year students and all staff in 2007 and to all students and staff in 2008. In 2007 collection boxes were left for responses which were collected later in the day and 112 responses were received. In 2008, student participants were invited to fill out questionnaires 'on the spot' with a collection box left for staff responses and 203 responses were received.

Focus groups and interviews were conducted with the architects, the University's project manager and staff and students of the School of

Architecture and Design. These methods were selected in order to provide background information on the process of planning and designing the building, elicit their insights and opinions on the building, and document their experiences of the completed building.

Both focus groups and interviews were semi-structured and relied on a prepared outline of the issues and questions to be explored with groups and individuals (Appendix 2). Those issues and questions were derived from questionnaire results and a desktop literature review, reported in Chapters 2 and 3.

For the student focus groups, participants responded to an open invitation to participate (11 participants in 2007 and 16 participants in 2008). On both occasions there was a range of year groups, age, culture and both genders represented. Staff participants in focus groups also responded to an open invitation. Two focus groups (one with two participants and one with three) were held in 2007. Academic staff, professional staff and timber research staff were represented. In addition, one student and two individual staff members who were not available at the time of the focus groups made themselves available for interviews to discuss the same issues as the focus groups.

Interviews were requested with individuals who had played significant roles in the procurement of the building: the architects, the University's Project Manager from Asset Management Services and the Head of School. All of these interviews except the final one with the Head of School were held in 2007 prior to the questionnaire survey and focussed on the design and procurement of the building rather than responding to the occupants evaluations. Two of the lead architects for the project, one from each of the practices in the collaborative design team were interviewed. In the final interview with the Head of School, held in 2009, occupant experience was discussed.

Detailed notes were taken during both interviews and focus groups and the focus group discussion and later interview with the Head of School was recorded. I was assisted in the focus groups by a research colleague. For reasons of time and cost, no transcriptions were made. More details about the data sources and responses are provided in Chapter 5.

Observation was used primarily to familiarise myself with the setting which was being evaluated to enable an easier understanding of participant responses. It was also used as a method of data collection. Observation is a set of practices indebted to ethnographic research methods and may deepen understandings of sites, people and interactions (Mason, 2006). It may illuminate tacit activity which is overlooked in other survey methods and has the advantage of immersing the researcher in an authentic place and its activity. Mason (2006) notes that observation is rarely ethically straightforward, however in this research, the fact that the setting and its occupants may almost be considered the public realm reduces the risk of ethical problems.

1.5 Structure of thesis

Chapter 2: Setting the context provides a context for the imperative of sustainability, specifically the sustainable building forming my case study, the School of Architecture and Design at the University of Tasmania. It outlines the recent history of awareness of climate change and the steps Australia is taking towards climate change mitigation and adaptation. The potential of sustainable development of the built environment to make a significant and cost effective contribution to reducing greenhouse gases is presented. Recent developments in sustainable architecture are discussed, including the move beyond individual buildings to precincts. The leading role of universities in sustainable development is elaborated, and a brief

history of international initiatives to encourage sustainable universities is presented.

Chapter 3: Experiencing architecture provides a contextual overview of contemporary theory on relevant aspects of the occupant experience of sustainable architecture. Attention is paid to phenomenology, comfort – especially adaptive comfort, building features that engender well-being and delight in architecture, and the consequent relationship to comfort. The idea of forgiveness in relation to sustainable buildings is explained, and its potential role in linking and balancing comfort and delight is proposed *as a new insight* into the development of sustainable architecture.

Chapter 4 The University of Tasmania and the School of Architecture and Design facilitates later understanding of the data by describing the University context which led to the incorporation of sustainability objectives into the design of the School of Architecture and Design building. The history and philosophy of the School is presented and the nature of architectural education and the broad and specific implications for its accommodation are discussed. The building and its performance with regard to environmental sustainability targets is described.

Chapter 5: Framework for Results, Analysis and Discussion outlines why – in three chapters that follow – the data are presented thematically in a manner consistent with the aim of the research. Each of the chapters draws deeply on the data, and moves from analysis to synthesis with the literature and the specific context of the case.

Those chapters are:

Chapter 6: Comfort

Chapter 7: Delight

Chapter 8: Forgiveness.

Chapter 9: Conclusions and recommendations summarises the research findings, their significance and limitations and concludes the thesis. It also responds to the research question with recommendations for advancing the university's sustainability initiatives through practical application of some of the findings. It identifies opportunities for further research, and recommends areas for further development and application of the major ideas.

1.6 Chapter summary

In this chapter I have outlined the aims and significance of the research, including the research question. I explained my motivation for the *project* as being a belief in the importance of reflective practice and my abiding interest in sustainability as the motivation for the *topic*. The reasons for the case study approach and post occupancy evaluation are explained. The research design, using mixed methods to quantitatively and qualitatively evaluate occupant experience of a sustainable building at the University of Tasmania is outlined. The chapter concludes with an explanation of the structure of the following chapters in the thesis.

Chapter 2 Setting the context

2.1 Introduction

This chapter provides a context for the case study of the University of Tasmania's School of Architecture and Design building on the Inveresk campus in Launceston, Tasmania. This sustainable building was one of the university's early environmental sustainability initiatives, is consistent with an international movement to create sustainable universities, and illustrates concern among a particular organisation's leaders with a set of larger social, institutional and environmental challenges. These matters are the subject of this chapter.

I begin by reference to the most pressing challenge of the times – climate change, introducing the concept of the Anthropocene as a means to understand the severity of this (and other) anthropogenic impacts on the Earth. Arguably, climate change is now the major driver for sustainability. I outline significant global actions to address climate change and steps taken in Australia to mitigate and adapt to climate change. I then argue that sustainable development of the built environment provides a significant and cost effective opportunity for both mitigation and adaptation, and has other environmental, social and economic advantages.

Next I provide an overview of the development and key characteristics of sustainable architecture, which is integral to sustainable development. The role of universities in addressing climate change by means of the framework of sustainability is discussed, and a brief history of international initiatives for sustainable universities is presented.

I conclude by presenting a case for sustainable universities, particularly by utilising sustainable architecture on campuses.

2.2 Climate Change

Human impacts on the Earth's climate, land, oceans and biosphere have now become so great and so rapid that they rival those of some of the great forces of non-human nature. The term Anthropocene, introduced about a decade ago, is now being used by members of the global change research community to describe the period in Earth history, starting around 1800 with the Industrial Revolution, when anthropogenic activity began to have significant impacts (Steffen 2011). These impacts include species extinctions, erosion and changes in sedimentation caused by deforestation, species monocultures, acidification of the oceans, sea-level rise and climate change. The scale, magnitude and significance of these changes are evidence that an epoch-scale boundary has been crossed within the last two centuries and, although only briefly sustained (to date) on geological time scales, it is likely to have significant and long lasting consequences (Zalasiewicz, 2011).

Carbon dioxide (CO_2) is the major contributor to the greenhouse gases influencing the Earth's climate by interacting with flows of heat energy in the atmosphere. $CO_2$is released into the atmosphere when people burn fossil fuels and deforest landscapes, and is the major greenhouse gas resulting from human activity. Over half of the CO_2 released into the atmosphere is offset by natural CO_2 sinks in the land and oceans, which constitute an ecosystem service helping to mitigate emissions from human activity (Cleugh, 2011).

The global severity of climate change was recognised by the United Nations in 1992 at the Conference on Environment and Development, informally

known as the Earth Summit or Rio Summit, held in Rio de Janeiro, Brazil. A pressing need was identified to adopt coherent collective responses to environmental, social and economic problems using a sustainable development framework. This defining event brought together an unprecedented number of representatives of governments and organisations, as well as individuals, who reached general – but not unanimous – agreement on the urgency and severity of the situation and on agreed actions (Williamson, 2003). Some 108 national government representatives attending the summit adopted the Rio Declaration on Environment and Development, Agenda 21, the United Nations Framework Convention on Climate Change (UNFCCC) as well as the Statement of Forest Principles and the Convention on Biological Diversity (United Nations, 1997).

The Rio Declaration on Environment and Development consists of 27 principles for achieving global sustainability. Agenda 21 outlines an action plan to halt and reverse the environmental damage to our planet and to promote environmentally sound and sustainable development in all countries on Earth (Williamson, 2003). The UNFCCC aims to stabilise greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system and has 194 signatories to date, giving it near universal membership (United Nations, 199?).

Parties to the UNFCCC have a number of commitments under the convention, including implementing national programs to mitigate climate change and to adapt to its impacts, strengthening climate change research, promoting education and awareness about climate change and regular reporting of progress in these areas (Department of Climate Change and Energy Efficiency, 20??). The UNFCCC is augmented by the Kyoto Protocol and the Cancun Agreements. The Kyoto Protocol has more powerful (and legally binding) measures than the UNFCCC. Under that treaty, the

governments of 37 industrialised countries and members of the European Community have committed to reducing their greenhouse gas emissions by an average of five per cent against 1990 levels by 2012 (United Nations, 199?). The Cancun Agreements, reached at the 2010 United Nations Climate Change Conference in Cancun, Mexico, are a set of significant decisions addressing the long-term challenge of climate change by taking concrete steps now towards actions after 2012 (UNFCCC, 2011; Department of Climate Change and Energy Efficiency, 2010).

As a participant in these initiatives and a signatory to the UNFCCC, Australia has committed to limit greenhouse gas emissions to 108 per cent of 1990 levels by 2012 under the Kyoto Protocol (Department of Climate Change and Energy Efficiency, 20??). It has also pledged under the Cancun Agreements 2010 to reduce greenhouse gas emissions by 2020 by five to 25 per cent relative to 2000 levels (Garnaut, 2011). Twenty five per cent represents an ambitious target which, if adopted globally, is considered will stabilize levels of greenhouse gases in the atmosphere at 450 parts per million CO_2. This level is regarded as equivalent to maintaining temperature rise due to global warming at no more than 2 degrees C, 'the tipping point' (Garnaut, 2011).

Presently the Australian Government's (2010) climate change strategy has three pillars: mitigating the effects of change by reducing Australia's greenhouse gas emissions, adapting to its unavoidable impacts, and helping to shape a global solution to its causes. The *Garnaut Climate Change Review*, an independent study commissioned by Australia's Commonwealth, State and Territory Governments completed in 2008, is Australia's most significant study in terms of validating climate change and its impacts – specifically its economic impacts – and confirming the need for urgent action. The report recommended policy frameworks to improve Australia's economic sustainability in an era of climate change.

More recently, the Australian Government introduced Clean Energy legislation in mid-2012. The legislation puts a price on carbon pollution, promotes investment in renewable and clean energy technologies and supports action to reduce carbon pollution on the land (Clean Energy Future, 2011). Such legislation is on the back of *The Garnaut Climate Change Review – Update 2011*, which revised and amplified the scientific research on climate change, global greenhouse gas emissions, international progress on climate change mitigation, Australia's land and electricity sectors, innovation and technology, and carbon pricing, and which made strong recommendations for Australia to adopt mitigation policies. It was noted that:

> Since 2008, advances in climate change science have broadly confirmed that the earth is warming, that human activity is the cause of it and that the changes in the physical world are likely, if anything, to be more harmful than the earlier science had suggested. I have replaced the premise of the 2008 Review that the reputable science was right 'on a balance of probabilities', with the premise that it is 'beyond reasonable doubt' (Garnaut, 2011, 2).

Garnaut has stressed the great risks for Australia of not taking strong action on climate change. 'We would be leaving really difficult challenges to the Australians who follow us. In the best of circumstances we would be bequeathing them a climate that is far more difficult to live in than the one into which we were born' (Garnaut, 2011, 10). Indeed, he recommends that strong contributions to a global *mitigation* effort are in the national interest, particularly since, along with Canada and the USA, Australia has some of highest greenhouse gas emissions per person in the world (Garnaut, 2011). The Commonwealth Scientific and Industrial Research Organization (CSIRO) also advocates strong and urgent actions to avoid the risk of dangerous outcomes from climate change (Cleugh, 2011).

Adaptation is also a necessity. Impacts of irreversible climate change include rising temperatures and sea levels, increasing storm intensity and greater risks of fire, flood and drought. There is need to adapt to these impacts on a scale far more extensive than currently occurring if we are to limit the environmental, social and economic consequences of climate change (Cleugh, 2011).

2.3 Sustainable Development

Sustainable development is one of the most effective responses to address the global issues referred to above. My focus here is the *sustainable development* of the *built environment* which has, as its end goal, the 'creation of buildings and communities that are part of the natural world, living off nature's abundance but being regenerative and supportive of all other living systems' (Mendler et al, 2006, 3). Of eight key objectives in Agenda 21, four are directly related to the physical and built environments which are altered through human activity: promoting sustainable land-use planning and management; providing environmentally sound infrastructure facilities; promoting energy-efficient technology, alternative and renewable energy sources, and sustainable transport systems; and promoting sustainable construction industry activities (Williamson, 2003).

Sustainable development of the built environment represents the greatest challenge and most significant opportunity in tackling greenhouse gas emissions globally. The challenge is due to both the enormity of the scale of the built environment in developed countries such as Australia, where more than 80 per cent of the population lives in cities and towns; and to the scale and rate of rapid urbanization being experienced in developing countries. Opportunities lie in the significant use of energy and resources within the built environment sector, and in the fact that the means of achieving major

reductions are generally well understood, readily available and cost effective. The building sector has been described as the 'lowest hanging fruit' in terms of abating emissions by the United Nations Environment Program (UNEP) (Marusiak, 2011).

Although the actual figures vary slightly, there is general consensus from international and national organizations on the significant amounts of greenhouse gases generated by the built environment; the energy, water and other resources consumed; and the waste generated. These encompass construction, operation and demolition of buildings as well as the embodied energy in materials and their transport to sites.

Let me elaborate by reference to both international and Australian examples. First, according to the UNEP's chief of sustainable consumption and production, globally the building sector accounts for roughly one third of greenhouse gas emissions, 40 per cent of energy consumption, 25 per cent of water consumption and a significant proportion of other resources such as metals, timber and sand. The world's existing buildings consume 60 per cent of electricity produced globally (Marusiak, 2011). Second, the Green Building Council of Australia (GBCA) estimates that globally buildings generate 40 per cent of greenhouse gas emissions, use 40 per cent of global energy (including embodied energy), consume 12 per cent of global water resources, consume 32 per cent of the world's resources in construction and produce 40 per cent of the waste going to landfill (Green Building Council of Australia, 2008). Third, according to the CSIRO, 26 per cent of Australia's greenhouse gas emissions comes from energy use in buildings and on Australia's hottest days air conditioners consume up to 22 per cent of all the energy generated in the nation (CSIRO, 2010). Fourth, according to the Australian Institute of Architects (AIA), 23 per cent of Australia's total greenhouse gas emissions are accounted for by the residential and commercial building sectors. AIA estimates that these emissions can be halved by 2030 and reduced by over 70

per cent by 2050. In summary, the figures above indicate the potential for substantial reductions in greenhouse gas emissions to *mitigate* climate change impacts.

At the same time, significant potential also exists in terms of *adaptation* and, to such ends, in 2007 the Australian Government established the National Climate Change Adaptation Research Facility (NCCARF) to coordinate, manage and disseminate research into climate change adaptation. 'Settlements and Infrastructure' is one of its eight research themes (National Climate Change Adaptation Research Facility, 2009) and illustrates the importance of sustainable development of the built environment in climate change adaptation, particularly in terms of the three sub-themes through which much research is organised. The first sub-theme relates to the impact of climate change on coastal settlements; public and private infrastructure including building and facility design and construction; urban water security; flooding and stormwater overflow. The second sub-theme includes the social, economic and institutional implications of these impacts. The third covers the implications for planning, design and management of settlements and infrastructure.

Noting insights from the discussion so far, and acknowledging that climate change is the major driver for, and beneficiary of, sustainable development (and hence gives it an environmental focus), there are also social, economic and broader environmental drivers and beneficiaries. Certainly, Agenda 21 combines the three aspects of the triple bottom line in its preamble, stating that the participating governments at the Earth Summit agreed that the integration of environment and development concerns will lead to fulfilment of basic needs, improved standards for all, better protected and better managed ecosystems and a safer and more prosperous future (United Nations, 1997). Although its record is patchy, as a signatory to Agenda 21, Australia has made concerted efforts to observe the triple bottom line over

time. Therefore, it should come as no surprise that the Garnaut Review considered the interrelationships among environment, society and economy. Garnaut's modelling showed that strong mitigation of greenhouse gas emissions was clearly in the national interest, given the cost of the impacts of climate change on the Australian economy, including impacts on agricultural productivity, Australia's trade, and infrastructure as well as the value of Australians' lives beyond the twenty-first century, the value of our natural and social heritage, health, and the value of insuring against worse than average outcomes (Garnaut, 2011).

The Intergovernmental Panel on Climate Change (IPCC) also acknowledges the interrelationships among environment, society and economy in stating that energy-efficient buildings reduce greenhouse gas emissions and demand upon infrastructure, and improve indoor and outdoor air quality, social welfare, comfort, health and quality of life; create jobs and business opportunities and enhance energy security. In developing countries, safe and efficient cooking devices and high efficiency electric lighting will abate greenhouse gas emissions, and reduce mortality and morbidity due to indoor air pollution by millions of cases worldwide annually (Levine et al, 2007).

The following three key statements on sustainable development link human needs and the environment. First, the universally accepted definition of sustainable development found in the 1987 report of the World Commission on Environment and Development entitled *Our Common Future* (also known as the *Brundtland Report):* 'Humanity has the ability to make development sustainable – to ensure that it meets the needs of the present without comprising the ability of future generations to meet their own needs' (World Commission on Environment and Development, 1987, np). Second, the leading principle of the Declaration on Environment and Development resulting from the Earth Summit held in Rio de Janeiro states that 'Human beings are at the centre of concerns for sustainable development. They are

entitled to a healthy and productive life in harmony with nature' (United Nations Conference on Environment and Development, 1992, 1). Third, architect William McDonough's Hannover Principles for sustainable design announced at the Earth Summit held in Rio de Janeiro include as Principle 1: 'Insist on the rights of humanity and nature to co-exist in a healthy, supportive, diverse and sustainable condition' (McDonough, 1992, in Nesbitt, 1996). In these statements, meeting human needs is considered integral to sustainable development.

> Sustainability is about much more than millions of Btus saved or tons of paper recycled. It is a heartfelt way of looking at the world that encompasses mindfulness of place, respect for natural processes, discernment of true needs, honesty and civic responsibility (Uhl, 2004, p 35)

The third component in the triad, economic sustainability, is demonstrated by reference to the following studies. The *Construction Sentiment Survey*, a recent report on the state of the Australian and New Zealand property and construction industries found that representatives from the sector ranked sustainability as the most significant opportunity they face in the next five years and identified failing to adapt to a carbon constrained future as the major risk facing the industry (Davis Langdon, 2011). There are obvious economic implications for both these points. Similarly, *The Dollars and Sense of Green Buildings*, a Green Building Council of Australia (GBCA) report, examined the business case for green or sustainable buildings in 2006 and reviewed the findings in 2008. In both cases green buildings were found to have significant economic advantages via increasing demand for sustainable buildings by corporate and government tenants, savings in operating costs, increase in health and productivity of staff, improved public relations and creation of an innovative culture (GBCA, 2008). The GBCA has also investigated the economic impact of carbon pricing on the property and

construction industries and found that expected impacts include increasing demand from tenants and landlords for sustainable buildings to mitigate rising energy costs from traditional (fossil fuel based) energy sources; increasing demand from builders and developers for greener products and processes to avoid rising costs of emissions-intensive building materials; and new opportunities for clean energy solutions, greener products and processes (Feldman and Mellon, 2011).

The studies described above identify the economic opportunities which may be generated by environmentally sustainable development of the built environment, reinforcing the links between environment and economy.

The triple bottom line is often represented graphically by three interlocking circles. This schema suggests equal priority is being given to the three components: environment, society and economy. However, early concepts of sustainable development used the term ESD standing for '*ecologically* (or *environmentally)* sustainable development' which prioritised the environment component. This term was used by the Council of Australian Governments (COAG) when in 1992 it endorsed the National Strategy for Ecologically Sustainable Development (NSESD) and defined ESD as 'Using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be increased' (Ecologically Sustainable Development Steering Committee, 1992, np). ESD was later replaced by the generic term 'sustainable development' because its focus on environmental impacts was deemed too narrow (and politically difficult) in comparison with the apparently holistic function of the triple bottom line (House of Representatives, 2007). 'Sustainable development' however, is more easily misused and is sometimes used in situations where economic or social considerations dominate to the detriment of environmental considerations.

My preference is the concentric model of sustainability which recognises the triple bottom line, but places economy as subordinate to society, which is in turn subordinate to environment. This hierarchy reflects the need for a paradigm shift from twentieth century decision-making primarily based on economic considerations to twenty-first century decision-making prioritising environmental considerations. In architecture, for example, there are many cases of environmental initiatives bringing social and economic rewards. An example is Melbourne City Council's CH2 building, Australia's first '6 Star Green Star – Design' certified rated commercial office building by the GBCA. Opened in 2006, CH2 incorporates many environmental features which increased the initial capital cost but are bringing savings in operating costs, including the significant cost associated with increased staff productivity due to improved health and well-being. CH2 is projected to pay off its many environmental features in approximately six years. Office spaces have 100 per cent fresh air which is calculated to save the council over $2m a year in increased staff effectiveness and productivity, whilst lower light levels supported by task lights, save 2/3 of normal energy use and have a beneficial effect on staff. All fit-out materials are recycled and/or non-toxic and are also expected to improve the health of staff (City of Melbourne, 2011).

2.4 Sustainable Architecture and Sustainable Building

Sustainable architecture is an integral component of a sustainable built environment. In broad terms, sustainable architecture moves away from 'extractive and disposable systems that are energy-intensive, resource inefficient and toxic, toward cyclical, closed–loop systems that are restorative, dynamic and flexible' (Mendler et al., 2006, p 2). The Organisation of Economic Co-operation and Development (OECD) defines sustainable buildings as those that have minimum adverse impacts on the

built and natural environments, in terms of the buildings themselves, their immediate surroundings and the broader regional and global setting (OECD, in GBCA, 2008). This description incorporates the notion that sustainable buildings have impacts locally, regionally and globally. The GBCA defines green or sustainable buildings as those that 'incorporate design, construction and operational practices that significantly reduce or eliminate the negative impact of development on the environment and occupants with strategies for addressing: energy efficiency; greenhouse gas emission abatement; water conservation; waste avoidance, reuse and recycling; pollution prevention: noise, water, air, soil and light; enhanced biodiversity; reduced natural resource consumption; productive and healthier environments; flexible and adaptable space'(GBCA, 2008, 4). This definition includes considerations of buildings' whole of life cycle, the major features of sustainable buildings and the triple bottom line of sustainability.

The term 'sustainable architecture' is relatively recent, but the practices which inform and typify the field are not new (Vale, B and R, 1991). It will be useful to describe some of the key elements of its broad history to set the context for later discussions about how the higher education sector has engaged with sustainable development through sustainable architecture. The following overview is drawn primarily from my knowledge of sustainable architecture gained through my professional interest in the subject over three decades complemented by observations in the field.

Many of the principles of sustainable architecture were being incorporated into traditional buildings centuries before the ready availability of cheap energy from fossil fuels in the latter half of the twentieth century enabled technology, rather than the buildings themselves, to provide thermally comfortable internal environments. Traditional sustainable buildings relied on passive systems, using the building fabric, to provide comfortable shelter from the external climate. They were generally constructed from local

materials due to their ready availability and for reasons of economy. As early as the fourth century BC, Socrates described his ideas for a solar house, designed to maximise sun penetration in winter and exclude it in summer; and around 100AD Pliny the Younger wrote about the passive solar design of his Tuscan villa, describing the southern solar orientation and the colonnade which allowed the low-angled winter sun into the villa but excluded the higher altitude summer sun (Weaver, 2004). In hot arid environments, traditional buildings of stone or adobe use thermal mass to act as a heat sink and wind towers to increase air circulation through the building. Shade is provided by locating buildings close to each other around courtyards with lush planting and water pools. The sixteenth century Moorish palace of the Alhambra in Granada has massive stone walls, providing thermal mass which acts as a heat sink, as well as courtyards with dark green foliage plants for shade; and water pools and fountains to cool the air and provide psychological cooling with the sound of trickling water. The eighteenth century Villa Campolietto in Herculaneum is a Baroque building of four apartments arranged around a central rotunda creating a Venturi tower. The massive walls provide heat and coolth storage capacity. Large windows capture sea breezes and, with a system of ducts and grilles and the Venturi tower, allow for cross ventilation. On days of extreme heat, the Venturi tower draws air from the basement water cisterns and ice stores for extra cooling. Gardens provide shade, ponds, fountains and a sunken date grove to contribute to cooling the villa and its occupants (Roaf, 2005). Traditional Japanese buildings use a variety of sliding screens on their external walls to adapt to variations in climate. Wooden shutters insulate in the cooler months, latticed timber screens provide shade and ventilation in the warmer months and rice paper screens provide natural light with privacy. Traditional buildings in cooler climates such as Scandinavia used sod roofs for insulation. In Australia, the traditional Queensland house with

its wide shady verandahs, elevation above the ground for cooling air circulation, external shading of openings and ventilated roof spaces is an example of sustainable architecture.

Traditionally, many people migrate within their buildings in both daily and seasonal patterns to take advantage of the various microclimates the buildings provide. For example in Tunisia the traditional two storey house encloses a central courtyard with colonnades on all sides. In summer when the sun is high, the colonnade provides deep shade. The family lives in the ground floor rooms where the thermal mass of the building protects them from the sun's heat. At night they move out onto the open roof which quickly loses its heat to the clear night sky. In winter they spend time in the sun on the roof and the upper loggia where the winter sun reaches. At night they retreat to the rooms in the upper storey whose walls have retained heat from the day's sun and where they can take advantage of any heat rising from below (Heschong, 1979).

There was some excellent work done on designing buildings to suit the climate and make use of solar energy in Australia, the United Kingdom (UK) and the USA in the 1950s, 1960s and 1970s. In Australia, the Commonwealth Government Experimental Building Station and its equivalent in the UK, the Building Research Station, carried out valuable research and produced useful resources on climate appropriate building design for architects and building designers. One example is R O Phillips 'Sunshine and Shade in Australasia: a study of the principles involved in finding the extent and direction of sunlight and shadows on buildings, together with a series of charts for different hours and seasons for the latitudes of Australia, New Zealand, Papua New guinea and Pacific island nations'. This was used extensively throughout Australasia and was published regularly from 1948 until 2002 when computers took over the calculation of sun and shade in and on buildings (Phillips, RO, 1948).

However, it was not until the supply of cheap energy was threatened by the oil crisis in the early 1970s that energy efficiency was seriously considered in the design of buildings. Also around that time, the autonomous house became popular with those seeking an alternative, self-sufficient lifestyle. *The Autonomous House* by architects Robert and Brenda Vale was published in 1975 and was influential in promoting this approach (Vale, B and R, 1975). Energy efficiency continued to be incorporated into a small proportion of domestic buildings in Australia throughout the 1980s, but began to be more widely adopted in the 1990s as awareness of peak oil, sustainability, and climate change became more widespread and energy prices began to increase.

Heschong (1979) has observed that the ethos of the passive solar house contrasts with the 'appliance approach' to thermal comfort. It engenders a more intimate even symbiotic relationship with nature and has come to be seen as a symbol of it. A solar house geared to both the people who live in it and the cycles of the sun, is seen to exemplify the human relationship to the natural world.

Then, in 1992, architect William McDonough announced his Hannover Principles at the Earth Summit in Rio de Janeiro. These principles form broad ethical guidelines for sustainable design and are based on the premise that solutions to environmental problems will be found once humankind ceases to attempt to dominate nature and instead views natural systems as a model. They begin by stating the significance of nature as the primary support for human life while acknowledging its susceptibility to degradation by human activities. Responsibility for the consequences of design is then expanded to include protecting natural systems, human settlements and future generations (Nesbitt, 1996).

The ten principles are:

1. Insist on rights of humanity and nature to co-exist in a healthy, supportive, diverse and sustainable condition.
2. Recognise interdependence. The elements of human design interact with and depend upon the natural world, with broad and diverse implications at every scale. Expand design considerations to recognise even distant effects.
3. Respect relationships between spirit and matter. Consider all aspects of human settlement including community, dwelling, industry, and trade in terms of existing and evolving connections between spiritual and material consciousness.
4. Accept responsibility for the consequences of design decisions upon human well-being, the viability of natural systems, and their right to co-exist.
5. Create safe objects of long-term value. Do not burden future generations with requirements for maintenance or vigilant administration of potential danger due to the careless creation of products, processes, or standards.
6. Eliminate the concept of waste. Evaluate and optimise the full life-cycle of products and processes, to approach the state of natural systems, in which there is no waste.
7. Rely on natural energy flows. Human designs should, like the living world, derive their creative forces from perpetual solar income. Incorporate this energy efficiently and safely for responsible use.
8. Understand the limitations of design. No human creation lasts forever and design does not solve all problems. Those who create and plan should practice humility in the face of nature. Treat nature as a model and mentor; not an inconvenience to be evaded or controlled.

9. Seek constant improvement by the sharing of knowledge. Encourage direct and open communication between colleagues, patrons, manufacturers, and users to link long-term sustainable considerations with ethical responsibility, and re-establish the integral relationship between natural processes and human activity (McDonough, 1992 in Nesbitt, 1996, 408).

Then, in 1993 at the World Congress of the Union Internationale des Architectes (UIA) or International Union of Architects, a declaration was written recognising that architects should frame their work in terms of sustainable design. The declaration includes the following five commitments:

- place environmental and social sustainability at the core of our practice and professional responsibilities;
- develop and continually improve practice, procedures, products, curricula, services and standards that will enable the implementation of sustainable design;
- educate our fellow professionals, the building industry, clients, students and the general public about the critical importance and substantial opportunities of sustainable design;
- establish policies, regulations, and practices in government and business that ensure sustainable design becomes normal practice; and
- bring all existing and future elements of the built environment – in their design, production, use and eventual re-use – up to sustainable design standards (Union Internationale des Architectes, 1993).

While economic considerations are implicit in the declaration's commitments –by reference to products, professionalism and the building industry, for example –the declaration privileges social and environmental components of

the triple bottom line, and stresses the need to consider the whole life cycle of the built environment, including adaptive re-use of buildings.

Australians were not immune to these international developments over various decades. Certainly, as a member of UIA, the Royal Australian Institute of Architects (RAIA), now called the Australian Institute of Architects (AIA), adopted the UIA declaration during the 1990s. Soon afterwards, it developed the RAIA Environment Policy, which contains objectives and strategies for delivering sustainable buildings; initiated and published the Environment Design Guide on behalf of the Built Environment Design Professions (BEDP); and became a founding member of the Australian Sustainable Built Environment Council (ASBEC) (AIA, 2008).

Since that time, such has been the energy around this issue that, when asked to define the principal design idea of the decade 2000 – 2010 in an interview on the Australian Broadcasting Corporation radio programme 'By Design', sociologist and design commentator Adrian Franklin nominated sustainability as the key focus (ABC Radio National, 2008). Franklin's observation requires some qualification however, since the adoption of sustainability principles and practices in architecture has not been entirely straightforward. For instance, around 2005 when Melbourne City Council's aforementioned CH2 building and the University of Tasmania's school of Architecture and Design were being designed in separate exercises, those involved in sustainable architecture were considered 'early adopters' and faced some resistance from the property and construction industry. This resistance often resulted from the increased initial cost of constructing sustainable buildings, the limited availability of green building materials and products, and a lack of understanding about the benefits of sustainable architecture (GBCA, 2008).

Then in 2008, there was a fundamental shift in attitude from the property and construction industry with the realisation by its members of the realities of climate change; the need and urgency to incorporate sustainability principles into all stages of the building life cycle; as well as the understanding that sustainable buildings made economic sense. Building and facilities managers in the corporate sector became aware of the economic benefits of sustainable buildings, including healthier and more productive work places and the reduced cost of insuring against risks of climate change impacts in buildings designed for adaptation to climate change. Commonwealth and state governments began setting minimum sustainability standards in the accommodation guidelines for their offices (GBCA, 2008). These factors resulted in sustainable buildings becoming the norm for new commercial construction in the CBD. A recent study into the performance and perceptions of green commercial buildings in Australia found that Green Star certified buildings were almost double as energy efficient as average Australian office buildings and owners, tenants and their staff showed high satisfaction levels with their green buildings (Kato and Murugan, 2010).

There is also now recognition that 'green' buildings may play a significant role in promoting an organisation's environmental values with new aesthetics making more visible that fact that green principles have been adopted (Heerwagen, 2000). For example, CH2's timber sun shade clad facade; water tanks with super graphics at the UTAS School of Architecture and Design building in Launceston and the photovoltaic array on the roof of the Students Association building at the Australian National University, described as 'a highly visible symbol of the commitment to reduce carbon emissions' (ANU Green – Sustainability Office, 2013).

Green buildings are also liked by occupants. Data from POEs of 177 UK buildings were analysed and used for comparisons between conventional

and green buildings. In evaluating the summary variables, green buildings scored significantly higher for overall satisfaction variables especially design and image than conventional buildings. Occupants like the idea of green buildings, and also green buildings have many features which occupants like (Leaman and Bordass, 2007). A similar study in Australia looking at data from POEs of 22 green and 23 conventional buildings also found that green buildings were rated more highly than conventional ones for design, image and other overall satisfaction variables (Leaman et al, 2007).

Sustainable residential development in the suburbs has followed the development of sustainable commercial architecture, albeit at a slower pace. As a consequence of increasing interest in sustainable buildings, there has been a continuing rise in demand for green building materials, products and services (GBCA, 2008).

In 2008, responding to the urgency of climate change, the AIA augmented its existing Environment Policy by developing a Sustainability Policy, with a radically different tone – one embracing a call to action. Specifically, the Sustainability Policy outlines strategies which architects, the design and construction industry, government and the community were encouraged to adopt to contribute to achieving a sustainable future (The Australian Institute of Architects, 2008).

At the same time, AIA advocated the need to 'understand the impact of our actions to date, continually improve the efficiency of buildings through design and use, and innovate in our design and building procurement processes to move progressively toward a built environment that *positively contributes to natural systems*' (AIA, 2008). This latter trend is echoed by the chair of the GBCA who writes 'in a few short years we have moved from recognising that buildings are depleting our natural resources, to looking at how we construct carbon-neutral, energy-, ecology- and water-positive

buildings. From being part of the problem, buildings have become a big part of the solution' (GBCA, 2011, np).

Whilst Australia's total greenhouse gas emissions have increased by 7% during the first decade of the 21st century, from 507MT CO2-e in September 2001 to 545MT CO2-e in September 2010, subsequent years have shown a decrease in total emissions. Emissions decreased by 1.0% From September 2010 to September 2011, and by 0.5% from September 2011 to September 2012. The impact of sustainable buildings on these results is difficult to ascertain without a detailed breakdown, however two of the three sectors related to buildings (stationary energy excluding electricity and industrial processes) showed decreases of 1.3% and 5.0% respectively in the year to September 2012. The transport sector, also relevant to buildings, showed an increase of 2.2% (Department of Climate Change and Energy Efficiency, 2013).

Recent achievements in sustainable architecture include buildings which have zero emissions and are aiming to be carbon neutral. Although it is now possible to achieve zero net operational carbon emissions from buildings, truly carbon neutral buildings are a significant challenge. To be truly carbon neutral, buildings need to have zero net operating emissions in their construction, operation and embodied energy. Initiatives required to achieve carbon neutrality include passive design, on-site generation of energy from renewable sources, efficient appliances and fittings, purchasing green power, reducing embodied energy of building materials and construction processes, optimising or removing air conditioning systems and behaviour change (GBCA, nd).

The UK Government, as part of its commitment to reduce UK's greenhouse gas emissions by at least 80% from a 1990 baseline by 2050, is intending to introduce legislation in 2013 requiring all new houses constructed after 2016

to be zero carbon. (Department for Communities and Local Government, 2012). According to the UK Green Building Council, the proposed target for zero carbon homes by 2016 has created a shift in the mindset of housebuilders who are now completely rethinking house design rather than tinkering around the edges of energy efficiency. It is thus driving innovation (Kentish, J and Peterson, A, 2009) In Australia, a number of zero carbon buildings have been designed, including Zero, a large commercial complex in Melbourne which is energy and resource efficient and designed to run solely on renewable energy (GHD, 2008). In South Australia, the government's Land Management Corporation has recently held a Zero Carbon Challenge to select a zero carbon house design to build in suburban Adelaide. The winning design uses a 3kW photovoltaic system to generate more electricity than the house will ever use. It has been constructed and is now for sale (Collaborative Future, nd). The CSIRO, leading a consortium of government and industry partners, has developed a Zero Emissions House (AusZEH) which was constructed north of Melbourne to assess how significant cuts in greenhouse gas emissions can be achieved in typical suburban housing. AusZEH is designed to release no greenhouse gases into the atmosphere as a result of consuming or producing energy on site. It is designed to minimise energy consumption through a design which considers the climate, the hot water system and appliances used in the house. It showcases renewable energy generation with 6 kW of photovoltaic panels supplying all the operating energy needs and energy management technologies that balance energy supply with demand and storage. It is expected that energy consumption will be 70 per cent less than a conventional - house of a similar size (CSIRO, 2008). There has been some criticism of the lack of consideration of the broader implications of the ZEH house. Michael Mobbs, well known in Australia for his sustainable house in Chippendale, Sydney, is critical of the fact that the house does not provide

for on-site food production and waste treatment and is located well away from Melbourne's CBD (Ball, C, 2010).

To some extent, the growth in sustainable architecture initiatives has been driven by increasingly stringent requirements in regulatory frameworks such as building codes and planning schemes and – in the Australian context at least – these mechanisms have themselves been informed by federal government commitments to (ecologically) sustainable development (Stratford, E. 2008). The Building Code of Australia (BCA), which specifies the minimum standards to which all new building work, including alterations and additions to existing buildings, must comply, introduced energy efficiency provisions for housing in 2003 and has progressively included provisions for other building classifications in 2005 and 2006. The stringency of the provisions has been increased and the scope widened in the BCA 2010. These energy efficiency provisions were developed as a joint initiative of the Australian Building Codes Board (ABCB) and the Australian Greenhouse Office in response to concerns about climate change (ABCB, 2010). Planning schemes have also been influential in encouraging sustainable architecture. An example is the Leichhardt Council's Development Control Plan 2000, which requires residential development to have thermal mass, solar water heating, rainwater tanks and water efficient shower roses amongst other environmentally sustainable initiatives (Leichhardt Council, 2011).

Most of these regulatory documents, particularly the BCA, rely on tools to assess the energy performance of the proposed building. Green Star is the widely accepted standard for design that awards a rating on the basis of a building's design features; in Australia it is administered by the GBCA. The criteria for Green Star ratings vary slightly with building type, but are based on awarding credits within the following nine environmental impact categories: management, energy efficiency, water efficiency, indoor

environment quality, transport, material selection, land use and ecology, emissions, innovation (GBCA, 2008). Green Star therefore provides a comprehensive assessment of a building's sustainability at the design stage. The other widely used rating tool, National Australian Built Environment Rating System (NABERS) administered by the NSW Office of Environment and Heritage provides guidance for owners of existing buildings (NABERS, 2010). It awards a rating on the basis of what the building achieves irrespective of design features. The two rating systems are complementary. Green Star makes assumptions at the design stage, while NABERS measures the validity of those assumptions in operating buildings. Both play a valuable role in moving the property and construction industry towards greater sustainability and are increasingly becoming used in marketing buildings to potential buyers or lessees, reinforcing the relationship between environmental and economic sustainability. Green Star and/or NABERS energy ratings (5 and 4.5 stars respectively) are now conditions for earning the Property Council of Australia's Grade A and Premium office classification (Property Council of Australia, 2011)

Much of the discussion around sustainable architecture and buildings focuses on new buildings. However the retrofitting and adaptive re-use of existing buildings to improve their sustainability is critical, given that 50 per cent of the Australian building stock of 2050 exists now (The Allen Consulting Group, 2010). The term coined by William McDonough, 'cradle to cradle', (as opposed to the linear, one-way 'cradle to grave') aptly describes this cyclical and whole-of-life approach to the design and management of the built environment (McDonough and Braungart, 2002) and is consistent with the description of sustainable architecture at the beginning of this section moving towards 'cyclical, closed-loop systems' (Mendler et al., 2006, 2). Adaptive re-use involves conversion of an existing building for a use other

than its present one, retaining as much of the original building whilst upgrading its performance to suit contemporary uses and standards (Iyer-Raniga and Pow Chew Wong, 2010).

Adaptive re-use has the potential to make enormous energy savings due to the embodied energy in the existing building stock, which is estimated to be equivalent to about 10 years of the total energy consumption for the entire nation (Newton et al, 2001 in Australian Bureau of Statistics, 2003). Embodied energy is the energy consumed by all of the processes associated with the production of a building, including the acquisition of natural resources through to product delivery. Embodied energy includes mining, manufacturing of materials and equipment, transport and administrative functions. Although conserving this embodied energy is the major environmental advantage of adaptive reuse, other significant environmental, social and economic benefits may include: avoiding unnecessary consumption of materials and energy; reduction of land acquisition; reduction of construction costs; contribution to avoidance of urban sprawl; maintenance of heritage and architectural integrity; revitalisation of existing neighbourhoods and unproductive property (Iyer-Raniga and Pow Chew Wong, 2010).

In the development of sustainable architecture, many architects, developers, NGOs and government bodies consider the next move to be going beyond individual buildings to precincts. Green precincts are able to harness greater economies of scale for sustainable infrastructure such as sustainable buildings, shared renewable energy generation, water harvesting and processing, recycling and sustainable purchasing. It can also bring efficiencies through sharing building and other resources such as vehicles. Socially there is greater motivation at a community level than at the individual level and community action towards sustainability can also strengthen communities and contribute to social sustainability. Many

institutions such as hospitals, prisons, schools and universities as well as residential neighbourhoods, retirement villages and strata titled residential complexes provide opportunities to implement sustainable initiatives at a campus, precinct, or community scale. The GBCA is in the process of developing a rating tool for Green Communities to support moves in this direction.

The shift in focus from buildings to precincts parallels the idea of moving beyond the individual to collective or community action in the built environment and supports the definition of sustainability as a social change movement (Uhl, 2004). How people perceive design, technology and processes can affect whether they are accepted or not. Therefore understanding human perceptions and the process of behaviour change is crucial to the successful implementation of sustainability initiatives, especially sustainable architecture. Indeed, cultural and behavioural characteristics have been identified as barriers to the adoption of technology and processes that reduce greenhouse gas emissions in residential and commercial buildings. Conversely the adoption of lower-energy consuming behaviour and lifestyles is considered an effective means of reducing greenhouse gas emissions (IPCC, 2007). Notably in this regard, the CSIRO Science into Society group was formed specifically to address the adoption of actions on issues of strategic national importance, including sustainability, by facilitating discussion and sharing knowledge and information with a range of community stakeholders. The group aims to understand community perspectives so that issues and concerns can be addressed early in the development of initiatives, to potentially improve the outcome and its relevance to society (CSIRO, 2011).

2.5 Sustainable universities

Universities are both precincts and communities, and these characteristics present significant opportunities for the implementation of sustainability initiatives, in particular sustainable architecture. Given their future-oriented educational mission, universities have a role to play in demonstrating leadership in response to the major issues and challenges of the time, with climate change being the most important and urgent contemporary issue. 'This phenomenon [the transformation of the Earth's surface environments by human activity] is now arguably the most important question of our age – scientifically, socially and politically. We cannot think of a more urgent challenge' (Zalasiewicz, 2011, 838).

The foregoing is reflected in the United Nations Decade of Education for Sustainability 2005-2014, the Talloires Declaration and numerous global and national networks of sustainable universities. Several of these networks exist in Australia specifically for Australian universities. The Talloires Declaration originated as early as 1990, at an international conference in Talloires France, when twenty university leaders from around the world composed a 10 point action plan for environmental sustainability in higher education. This was the first official statement made by university administrators of a commitment to sustainability. The Talloires Declaration has now been signed by over 275 university leaders in over 40 countries (University Leaders for a Sustainable Future, nd).

As a precinct, the university's physical environment generally comprises a significant collection of buildings, infrastructure and spaces, continually changing in response to structural and functional change within the organisation. This ongoing evolution of the university campus provides opportunities for the implementation of environmentally sustainable development, making manifest the university's commitment to sustainability

in response to the issue of climate change. Most Australian universities now have departments which are dedicated to managing sustainability initiatives specifically in the areas of capital works and operations. These include the design of new and retrofitted buildings and spaces, and operational aspects of energy efficiency, water conservation and recycling, waste minimisation and recycling, sustainable transport and sustainable purchasing.

However the university is more than just a physical campus, and the nature of the university community brings great potential for behaviour change leading to a more sustainable world, now and in the future. There are many people involved in the university community: students, academic staff, support staff and visitors. Students are the decision-makers of the future and a sustainable campus can influence future policy on environmental matters. Academic staff carry out activities of an exemplary nature: teaching, research, publications and media exposure and these have the potential to be very influential both within and outside the university campus. Professional staff, especially in the area of facilities management, have the opportunity to promote sustainability in many areas of the university operations and capital works. Visitors to universities expect to find innovative solutions towards sustainability (den Heijer, 2010). Many people of diverse types and ages involved in a sustainable university will carry that changed behaviour to their homes and other work places now and in the future.

Fostering a more sustainable world is arguably the most logical outcome of the higher education endeavour. University mission statements generally identify a purpose higher than the creation and dissemination of knowledge. Higher education consistently aspires to instil in graduates such qualities as good citizenship, moral integrity, leadership, critical thinking and care for the environment. These are qualities required for the work of building a sustainable world. Because universities are uniquely equipped to help achieve sustainability through innovation in teaching, research and

institutional practice, it would seem incumbent upon them to rise to this challenge (Calder and Datremont-Smith, 2009).

Universities therefore have the potential to be sustainable in the following ways: creating the material conditions for a sustainable workplace and developing sustainable ways of working (for both students and staff): making buildings sustainable as objects; making the campus sustainable as a setting or organisation as a whole; engaging in sustainable business processes and practices; and working on a sustainable mindset (also visible outside the university) (den Heijen, 2010).

2.6 Chapter summary

I introduced this chapter by reference to the Anthropocene and the significant impact of climate change. I then outlined the significant global actions to address climate change and the steps Australia is taking to both mitigate and adapt to it. I then argued that sustainable development of the built environment provides a significant and cost effective opportunity for both mitigation and adaptation as well as having other environmental, social and economic advantages. Next I provided an overview of the development and key characteristics of sustainable architecture, which is an integral aspect of sustainable development. The key characteristics in the development of sustainable architecture over the last fifty years have been a move from domestic to commercial scale, a move from a consideration of energy efficiency to one of reducing greenhouse gases and of the triple bottom line of sustainability, and a move from individual buildings to precincts. The role of universities in addressing climate change through sustainability was discussed and a brief history of international and national initiatives for sustainable universities presented. I concluded by presenting a case for

sustainable universities, particularly through sustainable architecture on university campuses.

Chapter 3 Experiencing architecture

3.1 Introduction

This chapter provides a context for research on occupant experiences of architecture, and particularly in respect of those experiences which have relevance for sustainable architecture. The chapter draws on varied sources: scholarly articles, professional references, philosophical and scientific books, and popular non-fiction books. It is structured to move from general to specific concepts, beginning with a discussion of phenomenology as a framework for understanding the experience of place, architecture and sustainable architecture. A common feature of occupant engagements with buildings is that each constitutes a *phenomenological* experience of architecture (Bachelard, 1994; de Botton, 2006). This experience is rich, complex and involves multiple interactions between the occupant and the building. It is consistent with the phenomenological interpretation of place as lived space rather than geometric space (Dovey, 1993). Under consideration also is the importance of place (Mackay, 2010), the manner in which experience of building occupancy may bring well-being and delight, including thermal delight (Bradley, 2008, Heschong, 1979, Sternberg, 2010, Kaplan, 1998), comfort in sustainable architecture (Deuble and de Dear 2010, Chappells and Shove, 2005, Humphreys, 1005, Leaman, 2007), and forgiveness of discomfort (Leaman and Bordass, 2007, Baird, 2010). Allied with comfort and forgiveness are issues of expectation, adaptation and personal control over the indoor environment. These variables of engagement can all be understood as phenomenological relationships between occupants and architecture. The final section summarises the chapter and concludes by

proposing a relationship between and among forgiveness, comfort and delight to provide a new insight into the development of sustainable architecture.

3.2 Phenomenology of place

Phenomenology is the interpretive study of human experience: 'the exploration and description of phenomena, where phenomena refers to things or experiences as human beings experience them' (Seamon, 2000, 3). Here, phenomenology is used as a framework to investigate the experience of place, and specifically of architecture.

One of the major tenets of the phenomenological approach to place is that a distinction exists between geometric space and lived space. Geometric space is objective and can be defined by dimensions such as coordinates on a map or lines on a drawing. Dovey (1993) defines it as a representation of a set of relationships among value-free locations, achieving accuracy and predictability at the expense of depth. He suggests that it is purged of cultural meaning. It is such absence or silence that troubles Bachelard (1994, 4), who argues that we 'must go beyond the problems of description—whether this description be objective or subjective'. For Bachelard, a key concern in philosophical discussions of place is that we go beyond mere description to 'reveal an attachment that is native in some way to the primary function of inhabiting' (ibid). Thus, lived space is more than a mere setting for everyday life; it is an integral part of being-in-the-world. Since all interactions with the physical environment occur within social, political and economic contexts, lived space is socially and culturally conditioned, personal and idiosyncratic (Dovey, 1993); for Dovey and Bachelard lived space transcends geometric space. Indeed, for Bachelard buildings—places where we dwell—provide among the greatest powers for the integration of

memories, thoughts and dreams. Thus, they represent a dynamic integration of past, present and future. Houses and work places arguably are among the most potent of these buildings in terms of such dynamism; whether such intensity pertains to the latter—my focus—will emerge as part of this research.

One significant implication in phenomenological thought of the asserted transcendence of lived space over geometric space is that people and place compose an indivisible whole, and affect—indeed constitute—the other. Seamon (2006, 5) uses the term *place ballet* to describe 'an interaction of time-space routines and body routines rooted in space'. The result, he says, is 'an environmental whole that is integrated, ordered, alive and a new entity of place considerably different from its human and environmental parts' (Seamon, 2006, 10). Experience of place as a ballet occurs at a number of levels: sensorial, intellectual, emotional, spiritual. This multi-dimensional experience arises because, as Stefanovic (1994, 72) describes it, human beings 'are not simply materially placed within a world, nor do they simply occupy space, as do tables and chairs'. For her, humans experience the world subjectively, and are immersed in environments—recalling that environ means *that which surrounds*. One implication of that immersion is that people are actively engaged in 'interpreting, intuiting, sensing, responding emotionally and intellectually, and meaningfully assigning signification in a complexity of ways' (ibid). The other part of this phenomenological relationship is that place initiates, directs and organizes behaviour and movement. 'A building is not an end in itself; it frames, articulates, structures, gives significance, relates, separates and unites, facilitates and prohibits" (Pallasmaa, 2005, 45).

Experience of place, which includes architecture, contributes to sense of identity. For example, Mackay (2010, 36-37) identifies the desire for place as one of ten that 'make us tick'. We desire:

> a place that seems in harmony with us: that welcomes and comforts us; that says things about us we're pleased to have said. The sense of place … helps not only to locate us, but also to frame us, to define us, to contribute to our sense of who we are … we need to feel that some physical place stands as a symbol of our uniqueness and acceptance.

The idea of place contributing to human identity is evident in Pallasmaa's (2005) description of architecture strengthening the existential experience, one's sense of being in the world, and essentially engendering a strengthened experience of self.

3.3 Architecture and delight

Meanings arise out of the more profound experiences that have accumulated in place over time (Tuan, 1974). Place is a repository of meanings valued by members of a culture or sub-culture/s, and itself also acquires value by association with those meanings. One can value a place because it gives physical reality to the ideas it embodies (Heschong, 1979).

Place and architecture express meaning through their potential to 'speak'. As de Botton (2006, 71) writes:

> Buildings speak—and on topics which can be readily discerned. They speak of democracy or aristocracy, openness or arrogance, welcome or threat, a sympathy for the future or a hankering for the past.

This ability extends architectural discussion to values rather than merely how things should look (ibid). Through its capacity to express values, architecture exemplifies the *zeitgeist* or *spirit of the times.* Or, put in other terms:

> Buildings and cities are instruments and museums of time. They enable us to see and understand the passing of history, and to participate in time cycles that surpass individual life…The great works of modernity have forever halted the utopian time of optimism and hope; even after decades of trying fate they radiate an air of spring and promise (Pallasmaa, 2005, 36-37).

This ability of architecture to 'speak' is recognised in the corporate sector. Among the most visible manifestations of corporate values and ethics, architecture provides a unique insight into the nature of organisations (Heerwagen, 2000). Three examples illustrate this capacity. First, take the practice of French vignerons in the Bordeaux region to engage internationally renowned architects to design innovative buildings for their vineyards in order to express their unprecedented success in the history of the last millennium. 'Fields unchanged for centuries are attracting diggers, cranes and men with yellow hats as the top wines seek an image makeover to match their global status'(Sage, 2011, 22). One enthusiastic vigneron described his new building, designed by French architect Christian de Portzamparc, as 'chic and sober, just like the wine itself' (ibid). Second, consider an advertisement placed in an Australian newspaper by the Menzies Research Institute at the University of Tasmania, seeking a new director (Weekend Australian, 2012). The large advertisement has three images: two of research students at work and the third of the award-winning Menzies Research Institute building. The last 'speaks' of an organisation that is contemporary, progressive, state-of-the-art and high-achieving. Third, promotional materials for the Salk Institute overlooking the Pacific Ocean in La Jolla, California, emphasize spirituality, inspiration and creativity. Designed by architect Louis Kahn in the 1960s for Jonas Salk (who developed the vaccine for polio), the buildings aim to recreate the sense of place which inspired Salk when he lived in the town of Assisi in Italy while developing the vaccine. The institute has become world-famous for its research and is a mecca for architects and medical researchers alike. It is suffused with natural

light and has an atmosphere of calm and serenity—effects that are redolent of healing and well-being (Sternberg, 2009).

The ability of architecture to express social and cultural values relies on a building's capacity to 'speak'. Such values are important to organisations and individuals, and underpin corporate and private psychological well-being, both of which are influenced by the congruence between people's values and activities (Ryan and Deci in Heerwagen, 2005). The idea that buildings communicate values also explains why sustainable architecture is appreciated by occupants with so-called green principles. Sustainable architecture speaks of environmental values and when these values are shared by occupants, the resonance brings great satisfaction, delight even, which engenders a positive mood possibly contributing to the sense of identity of occupants. As a case in point, in Australia Deuble and de Dear (2010) have found that people identified as having pronounced environmental concerns and occupied a green building also had high satisfaction levels in terms of their occupancy, and were prepared to overlook and forgive less-than-ideal comfort conditions.

Architecture-as-place, then, has the potential to delight: to inspire, engage and stimulate, and promote psychological and physiological well-being. Delight incorporates more than beauty, which has an implied emphasis on the visual (Bradley, 2008; Wernick, 2008). Rather, delight is experienced with *all* the senses and at a variety of levels – physical, emotional, intellectual, and sometimes spiritual. According to Pallasmaa (2005, 28), 'every touching experience of architecture is multi-sensory; qualities of space, matter and scale are measured equally by the eye, ear, nose, skin, tongue, skeleton and muscle.'

There is growing evidence that the presence of particular, positive, 'spirit lifting' design features in buildings may promote positive emotional

functioning and serve as a buffer to discomforts or stresses. These features include natural light, sun patches, window views, contact with nature and overall spatial design (Heerwagen, 2000). Being near a window can be psychologically and physiologically beneficial, especially if the view contains natural features such as trees and flowers. Research on restorative environments by the Kaplans (1998) has shown that contact with nature through window views enhanced mood, reduced stress and promoted perceptions among respondents that they enjoy a high quality of life. Ulrich has found that hospital patients recovering from gall bladder surgery improved faster and with less pain relief when they had views to natural areas (in Sternberg, 2009). Studies of indoor air quality indicate that employees sitting near windows experience lower building related health problems than those located in building interiors—even though the windows are not operable and thus the effect cannot be due to increased ventilation (Fisk and Rosenfeld in Heerwagen, 2005). For Bradley (2008), social interaction is a crucial determinant of well-being and happiness depends on the quality of relationships with others. As an architect, Bradley's designs focus on in-between spaces such as circulation areas where informal social interaction occurs and relationships, friendships and communities are formed. He describes architecture as a 'sociological art' which, at its best, provides environments which are transformational (ibid, 29).

Design references (for example, Rasmussen, 1959) guide architects on ways to inspire delight through sensory experiences. Although vision is the dominant sense, other senses often inspire equally or more powerful and memorable responses to place. Among the sensual experiences in architecture is something that might be termed thermal delight—a sense that is particularly evident when moving from one thermal environment to another contrasting one. Bachelard (1994, 39-40), for instance, writes of the pleasure of being in warm internal environments overlooking snowy

landscapes: 'And we feel warm because it is cold out-of-doors …A reminder of winter strengthens the happiness of inhabiting….. Everything comes alive when contradictions accumulate'.

As Heschong (1979) notes, people seem to enjoy a range of temperatures which can be extreme; for example, the Japanese have a tradition of enjoying scalding baths and Finns sit in saunas before jumping into snow banks or cold lakes. The contrast has an aesthetic element, with the extremes made more acute by contrast. Even the suggestion of the contrasting extreme can bring thermal delight: the warmth of the fire is enjoyed more when there is a cold winter storm outside.

According to Fordham (2008), the conventional heated, ventilated and air conditioned (HVAC) building that has dominated commercial construction in the last century has divorced people from subjective responses to physical sensations of the environment. Referring to the static optimum temperature range in HVAC offices Fordham suggests that building occupants may be as comfortable or more so in temperatures outside that range if they could open a window. He makes a plea for a return to an understanding of the happiness and joy that comes from feeling a wide range of natural conditions through a variety of senses.

Pleasant memories of places often have a thermal association and thermal variability encourages awareness of place; take, for example, the gazebo, the hearth, southern American porch swings, Roman baths or Islamic paradise gardens. Places with desirable thermal qualities tend to become social places. In Mediterranean cultures, the social life of the streets and plazas is generated by the thermal comfort they offer in comparison to hot, stuffy buildings (Heschong, 1979). In Hobart, Tasmania, the microclimate of Salamanca Place provided by the north facing wall of sandstone buildings makes this area the liveliest outdoor space in the city, even on the chilliest

winter days. On the other side of the nearby Sullivans Cove, the wide south facing pavement, which is usually in shade, is rarely occupied, even though it is flanked by interesting buildings and activities. Clearly, what is lacking in this place is thermal delight.

3.4 Comfort

3.4.1 Significance of comfort in sustainable architecture

The most basic role of shelter is to provide protection from the excesses of adverse climatic conditions and to create internal environments with favourable microclimates appropriate for dwelling. This role involves satisfying requirements for survival (safety) and biological sustainability (health), which extend to include degrees of psychological stability (privacy and security, for example) and biological stability (warmth, dryness, cleanliness or quietness). 'Comfort is the *optimal* degree of psychological and biological stability, and optimal shelter therefore means the achievement of both psychological and biological comfort' (Pidcock and Cowdrey, 1996, 1).

Comfort impacts on well-being, motivation and productivity. Conversely, discomfort and loss of well-being are linked to poor productivity, industrial unrest and psychosomatic disorders. Building-related health symptoms can also be linked to a failure to provide comfort. Ethically, every person has the right to a sense of well-being and to comfortable shelter (ibid); this is enshrined in Article 25 of the International Declaration of Human Rights (1948).

In pursuit of comfort, from the latter part of the twentieth century people in developed countries, and the most well-off in emerging economies, have increasingly relied on energy consuming forms of heating, mechanical ventilation and air-conditioning (HVAC) to deliver internal environmental

conditions for comfort. Over the last decade or so, awareness of the alarming magnitude of greenhouse gas emissions attributable to HVAC has crystallised (Deuble and de Dear, 2010). A significant amount of the energy consumed in a building over its life span—from construction, through operation, and demolition—can be attributed to HVAC. It is estimated that 40% of total building electricity consumption is attributable to HVAC (Council of Australian Governments, 2012). This significant energy consumption makes comfort one of *the* critical issues in environmentally sustainable architectural practice.

3.4.2 Defining comfort

The American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) defines thermal comfort as 'that condition of mind which expresses satisfaction with the thermal environment' (ASHRAE in Howell et al, 2005, 80). This definition expresses the notion of perceived comfort based not just on normative thermal data, but on an interactive relationship between the whole person and their environment (Pidcock and Cowdrey, 1996). Perceived comfort is a phenomenological relationship.

ASHRAE's Standard 55 'Thermal Conditions for Human Occupancy' (ASHRAE in Howell et al, 2005) specifies a combination of environmental and personal factors which will produce thermal environmental conditions acceptable to 80 per cent or more of the occupants of a space. Environmental factors are air temperature, thermal radiation of surrounding surfaces, air speed and humidity. Personal factors are activity/metabolic rate and clothing/thermal resistance. Combining these factors, ASHRAE provides 'optimum and acceptable ranges of operative temperatures' for building occupants engaged in different activities with different types of clothing (ibid).

However, people are substantially different from one another and their needs also differ from one time to another. Comfort is flexible and contextual, subject to cultural and historical variation and not completely constrained by physiology (Humphreys, 2005). In this sense, Chappells and Shove (2005, 34) state that comfort is a 'provisional and always precarious social and cultural achievement'. Research supporting this assertion includes field-based empirical work involving 21,000 respondents across four continents by de Dear and Brager (Luther and de Dear, 2003). Analysis of the data demonstrated a link between perceived comfort and external climate. Those from hotter climates were comfortable at higher internal temperatures than those from colder climates who conversely were comfortable at lower temperatures.

Expectations of what constitutes a comfortable environment vary widely. People have reported being comfortable at temperatures ranging from 6–30 degrees Celsius (Goldsmith, 1960 and Nicol et al, 1999, cited in Chappells and Shove, 2005), and different social and cultural groups manage, value and maintain very different indoor conditions and perceptions of comfort. Comfort expectations may be based on habituation, or on being used to particular thermal conditions.

Variations in perceptions of comfort exist as a result of physiological and psychological influences. For example, in relation to the activity/metabolic rate defined by ASHRAE, there can be significant variation according to physiological factors such as weight, body fat, fitness, age, gender, level of activity, or meals consumed. Psychological factors such as the emotional and mental state of occupants will influence metabolic rate and perception of comfort (Ong, 1995). Other psychological influences include the impact of certain internal environmental factors which are thought to increase the perception of comfort, including colour, sound, light, air quality and internal layout (Pidcock and Cowdrey, 1996).

McIntyre (1981) states that a person's reaction to a temperature deemed less than ideal will depend on expectations, personality and activity. Rohles (2007) has observed that when he is catching fish in water so cold that the water from his line is freezing in the guides on his rod, the coldness seems to get worse when the fish stop biting, although the temperature is the same. His experiments found that subjects in a room with carpet, timber panelled walls, comfortable furniture and soft lighting perceived the room as significantly warmer than a room at the same temperature with bare walls and fluorescent lighting (ibid).

In a similar experiment with two identical hospital isolation rooms, one with painted concrete walls, the other decorated with natural materials, Ohta et al. (2007) determined that hospital patients felt warmer, experienced reduced stress and maintained a stable core body temperature in the cold season in the room decorated with natural materials, even though both rooms had identical thermal conditions. Patients did not feel thermally comfortable in the concrete walled room and experienced no reduction in stress levels felt.

On the strength of these various findings, it is perhaps not surprising that Chappells and Shove (2005) propose understanding and exploiting the diversity and variety both in people's expectations and in the built environment in moving towards a sustainable future, or that Ong (1995) calls for an *elaboration* of our understanding of thermal needs, not a *simplification.* This statement relates to two different approaches to energy efficiency in sustainable architecture: one using systems which are more closely linked to the external climate and hence have greater variability and a broader temperature range; the other pursuing more energy-efficient ways to maintain a constant temperature of 23 degrees Celsius, which Ong (1995) believes has a consequent commitment to a standardized and unsustainable future.

The trend in Australia over the past few decades has certainly been towards comfort expectations converging on the ASHRAE standard of 23–24 degrees Celsius with a relative humidity of less than 65 per cent, and which is increasingly provided by air-conditioning. Comfort expectations are increasing more rapidly (that is, becoming more demanding) than the climate is changing (Strengers, 2008). In the United Kingdom, people were on average comfortable at about 20 degrees Celsius in 1978 and about 23 degrees Celsius in 1998 (Humphreys and Nicol, 2000 in Leaman and Bordass, 2007). Without intervention, the increase in comfort expectations is a self-perpetuating phenomenon, however Strengers' (2008) research demonstrated that comfort expectations are highly malleable and constantly evolving.

3.4.3 Adaptive comfort

Increasing comfort expectations and consequently increasing use of HVAC in buildings makes comfort of paramount importance in the twenty-first century building; concomitantly, a radical paradigm shift in understanding of comfort has occurred in the last decade. Deuble and De Dear (2010) describe the shift in technical terms as a departure from:

> static isothermal indoor climates to which building occupants attained thermal steady state with minimal expenditure of temperature regulatory effort … towards dynamic, anisothermal environments placing the occupants into a moderately non-steady-state thermal condition in which their physiological and behavioural temperature regulatory mechanisms are reactivated.

In lay terms, this shift can be described as a change from considering building occupants as passive recipients of the thermal environment to active participants in the interaction between themselves and the building. This shift infers moving to a phenomenological understanding of comfort: occupants are more actively involved—experientially engaged—in the building to achieve comfort. In this sense, comfort 'becomes the goal which the individual will seek, rather than a product provided by building services'

(Shove in Nicol, 2011, 105). As a corollary, the role of buildings changes such that they provide the *means* for occupants to achieve comfort rather than providing comfort *per se* (Nicol, 2011).

This new comfort paradigm is known as adaptive comfort. The Build Up (nd) web site of the European Union describes it thus:

> Adaptive comfort builds on the principle that people experience differently, and adapt, up to a certain extent, to a variety of indoor conditions, depending on their clothing, their activity and general physical condition. Therefore, contrary to the conventional cooling which is based on pre-calculated temperatures and humidity levels, the adaptive approach is based on a non-fixed set of conditions, taking into account thermal perception and behaviour of the user, requiring him [sic] to take an active role in controlling his indoor environment.

Adaptive comfort is based on the assumption that the thermal sense is part of the mechanism by which body temperature is controlled and drives thermoregulatory behaviour. If discomfort occurs, people react and adapt in ways that tend to restore their comfort. The process of adaptation to changing thermal needs involves both voluntary and involuntary actions. Any discomfort is usually transient, lasting only a few minutes. Occupants will take steps to adjust their clothing or environment by donning or removing garments, opening or closing windows, or adjusting window treatments or heating or cooling systems. If these strategies are not successful, the body will act involuntarily by shivering or sweating (Nicol, 2011).

Adaptive comfort has relevance for productivity, which Leaman and Bordass (2007, 1, 18) define as 'the ability of people to enhance their work output through increases in the quantity or quality of the product or service they provide.' Of the five variables which Leaman and Bordass identify as having a critical influence on perceived productivity, three are related to adaptive comfort. These include having personal control of environmental conditions;

responsiveness to occupant needs, especially comfort; and ventilation type which includes the spatial arrangement of the building. The authors distinguish between comfort provision (as in the HVAC building) and discomfort alleviation (adaptive comfort), and stress the importance of adaptive behaviour to mitigate the worst effects of discomfort and turn intolerable conditions into tolerable ones without undue management intervention. In like vein Heerwagen (2000) identifies adaptive comfort as important for productivity, with key factors being the thermal environment, air quality and lighting, along with personal control of them. However, Heschong (1979) and de Dear (2011) suggest that adaptive behaviour is about more than negative avoidance of discomfort, and argue that responding to thermal variation can bring positive thermal delight, thus allaying the thermal monotony of the conventional HVAC building.

In phenomenological terms, adaptive comfort exemplifies the tenet that place is an indivisible whole comprising mutual and co-constitutive relations between people and their physical environments. Thus, adaptive comfort is part of a 'place ballet' in which individuals and groups actively immerse themselves in, and engage with, their environments.

Adaptation to achieve comfort has psychological as well as physiological benefits. In the case of adapting to the environs of sustainable buildings, internal conditions of sustainable buildings are often less predictable and more variable than those in HVAC buildings. Experiencing changing environmental conditions gives different perspectives on the environment and these perspectives affect individuals' internal psychological worlds. This experience requires and encourages flexibility. Dealing with changing environmental conditions that enhance adaptive comfort requires strategies, processes and practices to cope in physiological and psychological terms, and that engenders resilience. Successfully mastering adaptive comfort

processes provides building occupants with a sense of personal control over their physiological and psychological comfort, and quality of life. Achieving comfort through adaptation requires engaging in creative processes which are positive and strength-building; change-making, in the form of adaptive comfort is a creative process (Truneckova, 2012, pers. comm.). This insight adds another dimension to the phenomenology of adaptive comfort, and infers that building occupants acquire flexibility, resilience and creativity in the process of adaptation; all such factors are important values in occupying sustainable architecture and, indeed, in dealing more broadly with climate change and sustainability.

3.5 Forgiveness

Forgiveness may be considered a form of adaptation to the environment. If pigs are confined in a cold box they will quickly learn to operate a switch to obtain infra-red heat, and can be shown to keep themselves in a thermo-neutral condition by this means; they are presumably selecting a 'preferred temperature'. However, if the pigs are presented with a choice between occupying a sty with an infra-red heater and a switch and a much colder and windier paddock, they spend most of their time in the paddock, tolerating 'discomfort' or forgiving certain environmental conditions because of the presence of others (Baldwin in Cena and Clark, 1981).

The habit of building occupants tolerating discomfort and at the same time expressing satisfaction with overall comfort in the internal environment has been termed forgiveness and Building Use Studies (BUS) have developed a Forgiveness Index for their BUS questionnaire (Leaman et al., 2007). This is the ratio of the score for overall comfort to the average score for the six questionnaire variables relating to comfort (air in winter, air in summer, temperature in winter, temperature in summer, lighting and noise). Typical

values for forgiveness range between 0.80 and 1.20. Forgiveness values greater than 1.00 indicate relatively more forgiveness (ibid) and these higher levels of forgiveness are associated with higher ratings for comfort overall combined with lower ratings for the individual comfort variables.

It appears that forgiveness is a characteristic of many sustainable buildings, especially those using mixed-mode, natural ventilation and other passive approaches to indoor environmental control (Leaman 2007). Generally these buildings tend to be hotter in summer and colder in winter, contain more glare from sun and sky, and have a more variable indoor climate than conventional air-conditioned alternatives. They also tend to be more fragile in their performance, relying on different aspects working well together (Leaman and Bordass, 2007). In Australia, sustainable buildings tend to have 'poor' thermal comfort conditions in summer, be 'too' cold in winter, and have internal noise but good lighting (Leaman et al., 2007). However, occupants tend to be more forgiving and tolerant of discomfort in these sustainable buildings than are the occupants of conventional air-conditioned buildings (Deuble and de Dear, 2010, Leaman and Bordass, 2007).

Using the BUS questionnaire to survey occupant evaluation of 30 sustainable commercial and institutional buildings from 11 countries, Baird (2010, 13) describes the Forgiveness Index as representing 'an attempt to quantify users' tolerance of environmental conditions in the building'. The mean Forgiveness Index for the buildings Baird surveyed was 1.08, with 22 of the buildings having a value greater than 1.00, around half having values greater than 1.10, and two having values greater than 1.20. These results support the idea that occupants of sustainable buildings are forgiving of less-than-ideal indoor environmental conditions.

Drawing on the BUS database of 22 green and 23 conventional HVAC Australian buildings surveyed between 2003 and 2006, Leaman et al. (2007)

found two-thirds of the green buildings had a Forgiveness Index greater than 1.00, and that forgiveness was higher in green buildings than conventional HVAC ones. They attribute this result to the facts that occupants like the idea of green buildings and that such buildings have many features which occupants value: more natural ventilation and/or fresh air; narrow plan forms with less 'deep' space in the middle; better use of daylight; more user controls for windows, blinds, lights and ventilators; higher floor to ceiling heights; more open plan workspaces close to windows; and more care taken in their briefing, design and management generally, to achieve comfortable conditions—especially in summer.

Elsewhere, Humphreys (2005) investigated occupant satisfaction of overall comfort using data from a survey of 26 offices in Europe. He found that dissatisfaction with one or more specific comfort variables does not necessarily produce dissatisfaction with the overall comfort of the building. Occupants subjectively balance positive and negative aspects of comfort to produce an overall satisfaction rating, and may be influenced by other features of an environment. Humphreys found that satisfaction with temperature and air quality was more important in the overall comfort rating than lighting and humidity. However, the weightings for different aspects varied from one country to another, a finding that supports Chappells and Shove's (2005) previous description of comfort as a provisional and precarious socio-cultural construct.

In their post occupancy evaluation of two buildings at Macquarie University, in Sydney, Deuble and de Dear (2010) found that occupant satisfaction levels for comfort are positively associated with environmental beliefs. Although participants were critical of indoor environmental qualities in the buildings they occupied, those with 'green' values were more prepared to overlook and forgive these conditions than others. This finding supports the hypothesis that broad environmental attitudes are closely associated with the

presence of a strong forgiveness factor often observed in green-intent buildings.

That study demonstrates that forgiveness in green buildings can be cultivated by working with occupants to enhance their understanding about the role that buildings can play in climate change mitigation and adaptation and in communicating building design intent to occupants. The results also suggest that people have a wide tolerance of variations in indoor thermal conditions if they are in a position to exercise control over them; and that individuals in the same environment exhibit significant differences in preferred temperature.

Although use of the term forgiveness is generally restricted to satisfaction with *overall comfort* in spite of dissatisfaction with specific aspects of comfort, there is evidence that the same phenomenon—usually termed *tolerance* in the literature (Baird 2010, Heerwagen 2005, Humphreys 2005, Leaman et al 2007, Leaman and Bordass 2007)—occurs in relation to satisfaction with the *overall building* in spite of dissatisfaction with specific aspects of comfort. I propose extending the idea of forgiveness to include satisfaction with overall aspects of a building, in spite of dissatisfaction with specific comfort. These overall aspects include design, image and satisfaction of occupant needs.

In relation to sustainable buildings, the incidence of occupants rating the *overall building* more highly than its *component parts* is typical. In BUS post occupancy evaluations, overall aspects of the building such as design, image, satisfaction of needs and health are generally rated higher in sustainable buildings than in air-conditioned buildings in spite of discomfort, and occupants are more tolerant of that discomfort (Leaman et al, 2007). In Baird's (2010) BUS survey, design, image and satisfaction of needs all averaged close to a score of 5 out of 7, in spite of scores for the specific comfort variables being lower (3.5 – 4.5 out of 7). The surveyed buildings in

the (American) Centre for the Built Environment (CBE) database also showed satisfaction with the overall buildings in spite of discomfort and in a post occupancy evaluation of the Philip Merrill Environmental Center, Heerwagen (2005) found that satisfaction with the overall workspace was high despite problems with acoustics and thermal discomfort. In another study of seven Energy Edge buildings in the Pacific Northwest of the USA, Heerwagen et al. (in Heerwagen, 2005) found 90 per cent satisfaction with workspace even though 40 per cent were dissatisfied with acoustics and 36 per cent were dissatisfied with thermal conditions.

Of relevance to this research is that in BUS evaluations of office buildings occupied by design practices and research organisations, designer occupants were more tolerant of less-than-ideal conditions than other occupants. The authors attribute this tolerance to designer occupants being less critical possibly because as knowledgeable users they understand design intent better (Leaman and Bordass 2005, Part 3). The impact that this may have on the study results is discussed in the final chapter on page 207.

In sustainable buildings, forgiveness in relation to satisfaction with the overall building is attributed to these buildings having features which occupants like: for example, views out; shallower plan forms; personal control; optimal use of natural light and care taken in the briefing, design and management that underpins their construction and maintenance. Occupants are more tolerant of discomfort when they understand the design intent, when their needs are met quickly, if they like the design, and if their experience of using the building supports their work tasks, even if there are chronic problems with it (Leaman and Bordass, 2007). Nevertheless, while forgiveness should be encouraged and utilized in the practice of sustainable architecture, it is also important to pay heed to the chronic faults that have been forgiven by occupants and that might be addressed in design solutions for new buildings or retrofits of existing structures. Poor thermal comfort

and acoustics can have a significant association with productivity (Leaman and Bordass, 2005, Part 2).

3.6 Chapter summary

I began this chapter by describing the importance of place and the phenomenological approach to understanding architecture as lived space rather than geometric space. This approach better interprets the complexity of human-environment experiences which engage us physically, emotionally, intellectually and spiritually. Our phenomenological experiences engage all the senses. In good architecture they bring delight, which positively affects well-being. One aspect of delight is thermal delight which brings pleasure through varied and sometimes extreme thermal conditions.

Thereafter, I sought to elaborate on notions of comfort, including the changing paradigm of comfort, from a condition which is a steady state provided by building services to the idea of adaptive comfort, which is a flexible state of mind changing in response to social, cultural and environmental factors. Adaptive comfort has important ramifications for sustainable architecture. In designing for it, professionals accept that building occupants perceive internal environmental conditions differently depending on their physical, emotional and mental states, can be flexible about comfort, and are prepared to adapt their behaviour to achieve comfort; all such accommodations are necessary given the variability of many energy efficient systems. Adaptive comfort alleviates discomfort, brings thermal delight and engenders psychological benefits such as flexibility, resilience and creativity, which are important values for occupying sustainable architecture and more broadly, in dealing with climate change.

On this basis, I argued that forgiveness may perhaps be considered a form of adaptation describing the ability of building occupants to tolerate variability and discomfort in internal environments and still experience satisfaction with a building's overall comfort. The Forgiveness Index attempts to quantify the degree of forgiveness. There is evidence that building occupants also experience satisfaction with the overall building in spite of discomfort and I have extended the definition of forgiveness to include this phenomenon.

Encouragement of forgiveness can be attributed to a number of environmental factors that bring delight to building occupants such as: the values expressed by a building, aesthetics, clear communication of design intent, the ability to control conditions, contact with nature through views, sun patches and natural light, and the design of the space to enhance social interaction. While forgiveness should be encouraged and utilized, it is also important to pay attention to any chronic faults in a building which have been forgiven by occupants and, where appropriate, take remedial action. In the final analysis, based on aspects of phenomenological experience of architecture, new ways of thinking about *sustainable* architecture are warranted—methods of approach which involve understanding the relationships among forgiveness, comfort and delight, whose interconnections are not always obvious.

> If buildings are delightful and perceived as comfortable, and their occupants are forgiving and adaptive in how they deal with internal environmental conditions then perhaps what is forged are new forms of environmental aesthetics and ethics, leading to more sustainable architecture. (Stratford, pers. comm. 2011).

Chapter 4 The University of Tasmania and the School of Architecture and Design

4.1 Chapter introduction

This chapter describes the case study building, the School of Architecture and Design, within the context of the University of Tasmania in order to facilitate understanding of the data which are presented in the following chapters.

In the context of the history of the case study building, attention is first paid to the University of Tasmania's sustainability policies and initiatives which led to the incorporation of sustainability objectives into the design brief for the building. Reasons for the need for new accommodation for the School are then outlined, and reference made to the nature of architectural education, the particular implications for its accommodation, and the specific requirements determined by the school in relation to their accommodation. The design process and resulting building are then described, and mention made of the building's sustainability credentials by reference to empirical data on its performance.

The chapter draws on interviews with Professor Roger Fay, the then Head of School, with Eng Seow, the project manager from the University's Asset Management Services (AMS), with Peter Mallat from Six Degrees Architects, and with Chris Barnett from SBE architects. Analysis is also indebted to my experience lecturing in the undergraduate architecture programme at the

University of Tasmania in Hobart prior to the program's relocation to its northern campus at Newnham in Launceston, as well as to my experience working in Asset Management Services at the University several years before the case study building was proposed.

4.2 The University of Tasmania Context

The University of Tasmania (UTAS) was slower than some other Australian universities to establish a dedicated sustainability office overseeing the incorporation of sustainability principles and strategies into university capital works and operations. Nevertheless, by the mid 2000s, at the time the School of Architecture and Design was being planned and designed, a number of UTAS policy and strategic documents expressed values which were indicative of an organisation open to environmental initiatives. These included: 'leadership in the community', 'excellence in communication and application of knowledge' in the 2005 UTAS Mission and a vision of being 'a world leader in its specialist, thematic areas' (two of which *Environment*, and *Community, Place and Change* have relevance for sustainability) and 'recognised for its contribution to state and national development' in the 2005 UTAS Vision. EDGE, the UTAS Strategic Plan for 2005-2007, its title standing for the cornerstones of excellence, distinctiveness, growth and engagement was also indirectly supportive of sustainability initiatives (UTAS Council, nd). Within this context, in 2005, the university approved a set of Governance Level Principles, one of which addressed environmental management. GL9 set priorities for environmentally sustainable development at the University, the promotion of environmental awareness amongst members of the University community and the achievement of better understanding of environmental issues and sustainable development in the broader community (UTAS Council, 2008). Asset Management Services, the University department responsible for campus operations

including capital works and maintenance of infrastructure, translated these GL9 priorities into a set of ESD Principles forming one of ten sections in their UTAS Design Guidelines dated May 2006. These ESD Principles included the requirement for all building works to address sustainable design and for architects designing university buildings to submit an ESD report outlining the sustainability initiatives incorporated into the design, as well as the environmental benefits and targets, budgets and monitoring and verification measures (UTAS Asset Management Services, 2006). These principles were current when the case study building was being designed.

By 2007, the first year of occupation of the case study building, UTAS had established an Environmental Management Group, chaired by Professor Roger Fay, the Head of the School of Architecture and Design (UNITAS, 2007). This group successfully promoted environmental management at UTAS, developing amongst other initiatives, an Environmental Management Plan for the University and supporting the establishment of a sustainability office dedicated to promoting sustainability in all areas of UTAS operations and capital works projects.

4.3 School of Architecture and Design background

In 1999, the UTAS School of Architecture and Design in Launceston became Tasmania's only option for tertiary architectural education with the disestablishment of a sibling school in Hobart in the south of the island and amalgamation and relocation of effort to the northern city. That change was not supported by the architectural profession in Tasmania. Rather, it was deemed a political move to inject life into a rather conservative campus at the Launceston suburb of Newnham and benefit a marginal electorate and not a genuine attempt to improve architectural education.

The Newnham campus is relatively small and has only a limited number of courses, most of which have little relevance to architecture. Arguably, architecture students benefit from being in urban locations with highly active planning, development and construction industries, and compared to the larger capital of Hobart, Launceston was seen as less likely to provide this context. Furthermore, approximately 80 per cent of Tasmanian architectural practices are located in the south and arguably the mutually beneficial relationship between the university and the profession was considered not as easy in Launceston.

In spite of such apparent locational disadvantage, under the headship of Professor Roger Fay the School of Architecture and Design developed an excellent reputation, particularly for its teaching of environmentally sustainable design and also its 'learning by making' program. In the latter, students use a well-equipped workshop to build public furniture and small buildings for community projects as well as architectural models for their design projects. Another successful arm of the school has been the Timber Research Unit (now called Centre for Sustainability and Wood or CSAW) which receives funding from the timber industry. The School has one of the university's highest ratios of international students to local students and this has had an impact on increasing student numbers in the School. In such light, according to Professor Fay, the school became the flagship of the Newnham campus as a result of its growing enrolments, vibrancy, visible activity and community projects.

By the mid-2000s, with growing enrolments the school at Newnham had a shortage of space and staff considered that they were operating under a number of other limitations. School operations had spread into adjacent buildings; there was no studio culture as the studios were used for other activities; the workshop was separated from the studios; and the Timber Research Unit was distant from the rest of the school.In 2005, AMS began

looking into accommodation options for the school and preparing an architectural brief outlining spatial requirements as the basis for a feasibility study. Expressions of interest to carry out the feasibility study were requested from a number of Tasmanian and Victorian architects with experience in environmentally sustainable design. It was considered important by staff in the school that consultants reflect their values with regard to such design and that the new accommodation be an exemplar of it. Victorian architects, SBE (the initials standing for 'sustainable built environments') and Six Degrees were selected to carry out the feasibility study. Three options for new accommodation were investigated in the feasibility study: renovation of the existing accommodation at Newnham, a new building on a greenfield site on the Newnham campus and a move to Inveresk to occupy a retrofitted railway building. According to Professor Fay, the Inveresk option was a late inclusion to the feasibility study and was not investigated to the same level of detail as the other options.

As with all UTAS building projects, the feasibility study and design process were directed by the University's Project User Group (PUG), which included the Head and staff members from the School, a senior academic external to the school and the project manager from AMS. This group was formed at the beginning of the feasibility study and disbanded once the construction contract had been let.

The feasibility study identified as the preferred option the greenfield site at Newnham. Although the most expensive, it would provide a building tailored to needs with room for expansion. The major disadvantages of this option were the cost and the suburban location of the campus which staff considered inappropriate for a progressive architecture school with an agenda involving environmentally sustainable design.

The Inveresk option was the second preference in the feasibility study. It had the advantages of being reasonably affordable; would make use of a distinctive heritage building; would be near the city centre; and would be collocated with the School of Visual and Performing Arts and the Queen Victoria Museum and Art Gallery. This position was supported by state and local government as the Inveresk site was being developed as a cultural and sporting precinct for the city. The buildings at Inveresk are owned by the Launceston City Council and leased from them by the university.

Renovating the existing building on the Newnham campus was the least preferred option in the feasibility study. It would be a complicated process requiring staff, students and operations to decant for one year; thereafter, there would still be no scope for expansion. This option was supported by neither AMS nor the School.

Eng Seow, the AMS project manager, reported to the PUG that the school had a strong preference for the Inveresk option. Conceptually the move from a suburb deemed rather drab to an inner city cultural precinct provided an appropriate setting for architecture. The recycling of an old diesel train workshop supported the school's vision of sustainability, and the industrial aesthetic of the building was deemed ideal for a school with a focus on 'learning by making'.

The school's preference would likely have been supported by the university's new Vice Chancellor, Professor Daryl le Grew, an architect who was an advocate of city based campuses and whose legacy includes a number of major capital works projects in the city centre of Hobart, including Medical Sciences 1 and 2 and the Institute of Marine and Antarctic Studies.

Once it was decided to proceed with the Inveresk option, the same architectural team, SBE with Six Degrees, was engaged to continue with the design of the building. The design process commenced in 2005 with a design

charette led by the architects and involving all staff from the school as well as interested students. The vision and preliminary design ideas for the school were developed in a collaborative manner at the charette. The stated aims for the school were to make visible sustainability and 'learning by making'; facilitate active studios; and create a building where vibrant activity was visible through visual connections between the spaces. The output from the charette was a sketch design report prepared by the architects which proposed three schemes.

From the perspective of AMS, the school and the architects, a sound working relationship typified the design development; it was described by staff in AMS as an easy relationship with a client group which knew what it wanted and which was consulted frequently by the architects. On that basis, the focus of the AMS was generally on cost and time, while the functional issues, design details and finishes were competently dealt with by the school. From the school's perspective, agreement characterised its relationship with the architects and between the two architectural practices forming the design team. The design process was more a partnership between the architects and the staff and students of the school than the usual architect-client relationship.

4.4 Design of the case study building

The site of the School of Architecture and Design, the Inveresk Rail Yards, had been redundant since the discontinuation of passenger rail services in Tasmania in the late 1970s and the subsequent downgrading of freight services in the state. The redevelopment of the rail yards was an initiative of the Australian Government's Better Cities Program of 1991-1996.

Most of the buildings at Inveresk were constructed when energy was readily available. Many were workshops where occupants were engaged in manual work activity and/or working with heat-generating equipment. Thermal comfort was obviously not a significant design consideration in these buildings. They were designed to suit their function and for ease of construction. The heritage-listed diesel workshop which was adapted to accommodate the School of Architecture and Design was built in 1951 and was a substantially intact single storey industrial shed with a footprint of approximately 2600 square metres and a height of 12 metres. Internally it is divided into two structural bays with concrete columns supporting gantry cranes and a timber truss saw tooth roof structure. The floor slab and lower parts of the walls are concrete, and the remainder of the walls consist predominantly of single glazing in steel frames. The roof cladding is corrugated steel roof. Roller shutters at the north and south ends of the workshop provided access.

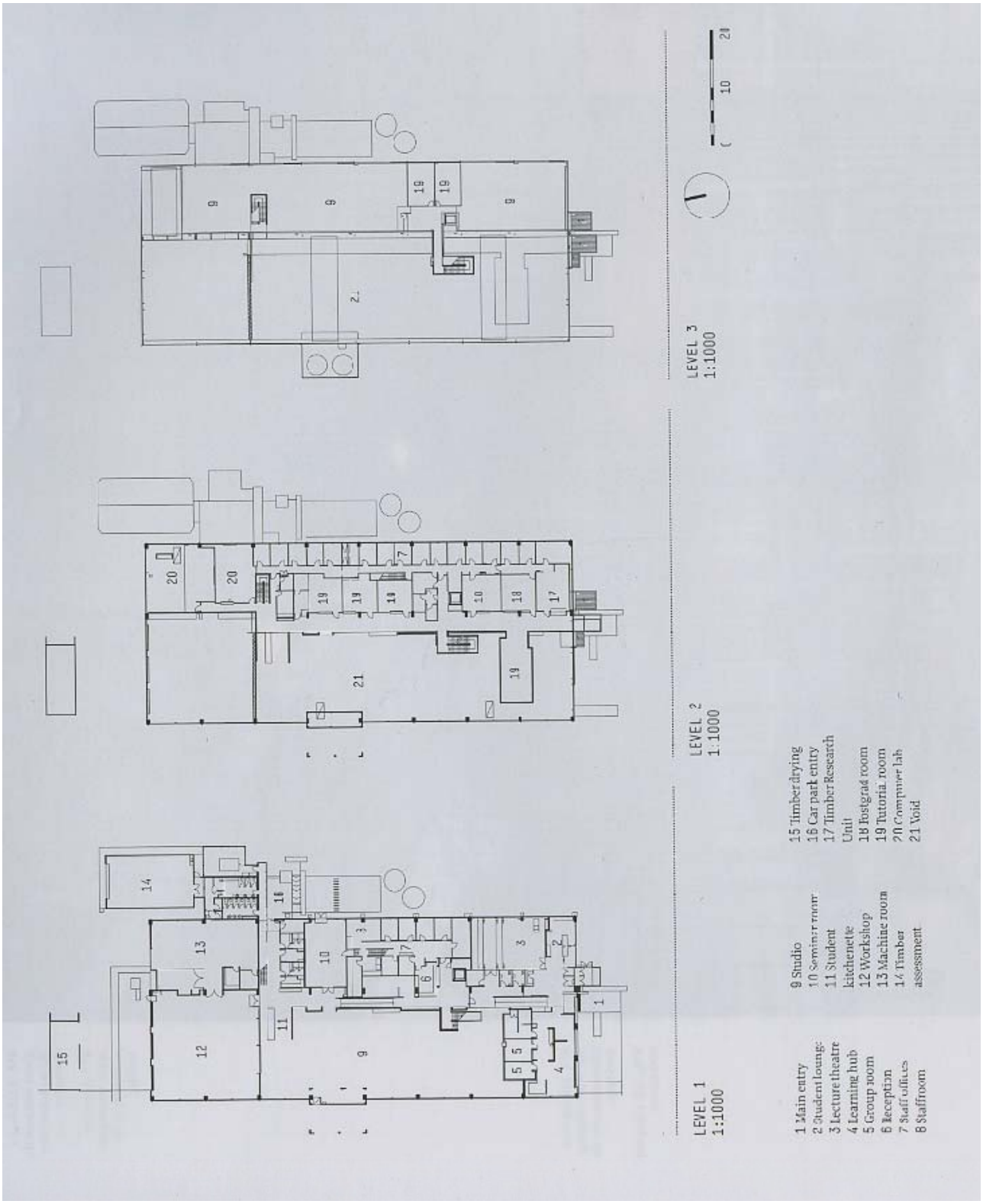
The building came with a number of challenges for sustainable design. The orientation of the rectangular footprint is problematic, with small façades facing north and south and long façades facing east and west. The western wall is a three storey height of single glazing. Under the building's heritage classification, façade treatments to provide sun shading or reduce opportunities for heat loss or gain with bulk insulation are not permitted. The conversion of a vast uninsulated shed to a comfortable and sustainable teaching and learning space within a tight budget was a major challenge.

Accommodation for architectural education also brings specific requirements which pose an additional challenge for sustainable design. Architectural education throughout Australia is based on the design studio, with this term describing both the physical space and the pedagogy. It involves students working on a design project over a period of several weeks in an interactive and often collaborative manner with frequent presentations by staff and

students throughout the design process. Design studio classes typically last one half to a full day, twice a week, and are held in large open studios which accommodate the whole year group. The most successful learning takes place as students work on their projects in the studio, discussing their ideas with their peers as their designs develop. It is a resource intensive type of education, in terms of the amount of space required for the studio as well as numbers of staff required (usually about one staff member to 15 students), and amount of staff time.

The approach taken by the design team was to insert a three storey stack of teaching spaces and offices along the eastern half of the building, leaving the western half as a dramatic full height space. On the ground floor of this large volume are the first and second year studios and a small learning hub at the southern end; and the workshop at the northern end. A full height glazed wall separates the workshop from the studios, providing a visual demonstration of the school's commitment to learning by making. The three storey stack contains the lecture theatre, a seminar room and administrative offices on the ground floor. The publicly accessible lecture theatre and administrative offices are located at the southern end, close to the main entry to the building. The first floor of the stack contains staff offices and computer labs along the external eastern edge with tutorial rooms located in the centre of the building without direct natural light and ventilation. Studio space for third, fourth and fifth year students occupies the top floor of the stack with the saw tooth roof above. The main circulation spine runs the length of the building along the edge of the teaching spaces and offices as a stack of open corridors, rather like long balconies, overlooking the studio and workshop areas on the ground floor.

Figure 4.1 Floor plans and long section of the School of Architecture and Design, UTAS
(Source: Architecture Australia, 2007)



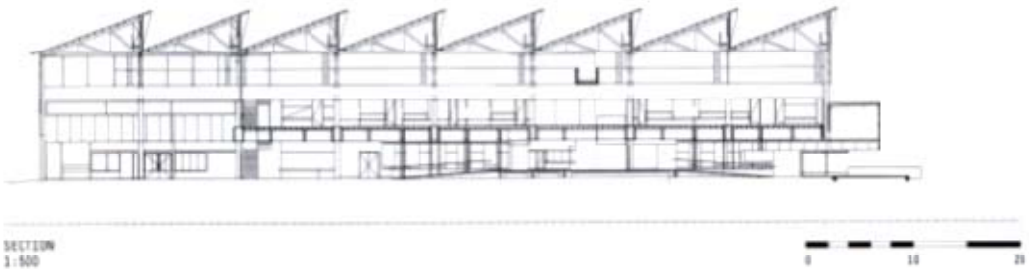


Plate 4.1 Exterior 2007. Entry and south elevation(left), west elevation showing extensive glazing and one of four rainwater tanks (right). Author's photos.

Plate 4.2 Exterior 2007 showing south (entry) and west elevations. Photo by Six degrees and SBE Architects.

Plate 4.3 Ground floor studios with west facing glazing on left and workshop beyond glazed wall at rear in 2007 (left) and 2008 (right). Note carpet and cardboard shade devices on window in 2008. Author's photos.

Plate 4.4 Top floor studios in 2008. Author's photos.

4.5 Sustainability initiatives

The baseline sustainability credentials of the School of Architecture and Design relate to its central location, and adaptive reuse of an existing building. The location of the Inveresk campus provides an incentive for students and staff to use active transport (walking or cycling) or public transport. It is located within walking distance of Launceston's CBD and is connected to the Newnham campus, some five kilometres to the north, by a regular bus service and a cycle route along the river. The adaptive reuse of

an existing building takes advantage of the embodied energy in the structure and saves a significant amount of energy over the building's life compared to new construction. A review of studies on embodied energy from Australia and internationally found that embodied energy is equivalent to 20-25% of life cycle operational energy in conventional commercial buildings and 40-60% for highly energy efficient commercial buildings (Horne and Moore, 2008).

A number of sustainability initiatives have been incorporated into the provision of heating, cooling, ventilation and lighting; as well as material selection. The following details were provided by Head of School, Professor Fay (Fay, R 2008). The design of servicing was based on an early decision by the client to accept a broader range of thermal comfort conditions in certain areas. This allowed areas requiring greater thermal and acoustic control (offices, lecture theatre, seminar room, computer labs and tutorial rooms) to be located along the eastern side of the building and those with reduced servicing (ground floor studios and workshop) on the western side. The movement of occupants between these spaces constitutes adaptive comfort and is part of the thermal and acoustic control strategy for the building.

A hydronic heating system fired by a gas boosted air-sourced heat pump was selected as having the best balance between cost and greenhouse gas emissions. Hot water for space heating is circulated at 65 degrees C through radiators in offices and computer labs and to an air handling unit in the lecture theatre. For the top floor studios, hot water is circulated through heating coils under the plywood floor. A gas boosted evacuated tube solar hot water system provides 70% of the domestic hot water requirements for the school with excess heat directed to the hydronic heating system. Ground floor studios are heated by overhead radiant heaters.

Passive cooling strategies have been used where possible. These comprise operable windows in offices, studios and computer labs with stack ventilation in the main building volume. The stack ventilation exits through louvres in the saw tooth roof and is controlled from the ground floor. Louvres in the northern and southern ends of the building are controlled by the building management system (BMS). A raised floor was required to bring the ground floor offices above the 100 year flood level and this created an opportunity to use the subfloor space for a labyrinth to to provide cooling to the lecture theatre and seminar room. The labyrinth is a maze-like arrangement of a 0.5 metre high, 623 metre long brick wall. The labyrinth is purged at night to provide sufficient coolth for the following day. Cool air from the labyrinth is admitted through floor ducts into the lecture theatre and seminar room. The labyrinth also provides some winter heating with warm air from the upper floors exhausted through the labyrinth in the afternoon, providing stored heat for the following day.

Passive ventilation strategies enable the building to operate on 100 percent fresh air intake. The only air-conditioning in the building is a split-system unit servicing the computer labs and server room. In 2008 it was planned to install mechanical ventilation in the internal tutorial rooms and other internal spaces to improve air quality. The building has an abundance of natural light through extensive glazing on all four facades and the south facing clerestory windows in the saw tooth roof. The large full height volume on the western side maximises the penetration of natural light into the building, however this comes with glare and heat gain via the extensive western glazing. Walls of the internal tutorial rooms and offices have walls of translucent acrylic cladding to maximise light penetration to internal rooms and corridors. Artificial light is provided by T5 fluorescent lighting with additional task lighting in the top floor studios. .

Energy is provided to the building in the form of electricity and natural gas. Although most electricity generated in Tasmania is renewable hydro-electricity, Tasmania's grid electricity is contaminated with non-renewable electricity coming into the state from Victoria via the Basslink cable. This has the effect of increasing the carbon emissions for off-the-grid electricity to the extent that natural gas has lower carbon emissions. According to the National Greenhouse and Energy Reporting (Measurement) Determination 2008, natural gas has an emission factor of 0.185 kg CO_2-e/kWh, the Tasmanian grid's emission factor is 0.30 kg CO_2-e/kWh and the Victorian grid's emission factor is 1.21 kg CO_2-e/kWh. According to the UTAS Energy officer, natural gas also costs one half to one third the price of electricity. Natural gas is used in the school to boost the temperature of solar heated water and as a back-up for the heat pump which becomes inefficient in cold, icy weather (White, M pers comm., 2013).

Water harvesting in the form of rainwater collected in four 22, 700 L poly tanks is used for toilet flushing, cleaning and irrigation. The tank sizes were designed to meet 100% demand in years fo average rainfall with mains backup provided for drought years.

Materials were selected on the basis of amount of embodied energy and greenhouse gas emissions, toxicity, durability and maintenance. Materials selected included: in situ concrete, concrete block walls, plantation hoop pine plywood wall and ceiling cladding, flooded gum plywood, flooring, routed plantation formwork –plywood feature cladding, metal and fibreglass walls cladding, hardboard and caneite wall finishes, linoleum benches, rubber flooring and carpet manufactured with post consumer recycled content. In many instances, surfaces have been left in their natural state, rather than painted. Natural oils and water-based polyurethane have been used where finishes were required.

Insulation in the form of 30mm foil backed polystyrene panels is provided to the external walls and underside of the existing roof.

The building was constructed on a modest university budget, and cost $1,450/ square metre including fees and services (Fay, 2008).

Modelling of the design predicted a 40-50 per cent energy cost saving and greenhouse gas reduction and a 54 per cent saving in water use compared to conventional university buildings. In its first year of operation, energy use (electricity and gas) for the building was 0.42 GJ/square metre which was slightly less than the target energy consumption at the design stage of 0.43 GJ/square metre, 68% of all UTAS buildings and 58% of the average for Australian university buildings. By 2008, energy consumption had increased, but still compared favourably to other UTAS buildings (81%) and the average consumption for Australian university buildings (72%) (TEFMA, 2007 and 2008). These figures are summarised below.

Figure 4.2 Energy consumption (electricity and gas) of School and Architecture and Design

	School of Arch and Design GJ/sq m	UTAS average GJ/sq m	National average GJ/sq m	Target GJ/sq m
2007	0.42	0.62	0.73	0.43
2008	0.51	0.63	0.71	0.43

The increase in energy consumption between 2007 and 2008 may be partially explained by the increase in student and staff numbers. During this period, student numbers increased by 5% and staff numbers increased by 19%. The total number of building occupants increased by 7%. It could be argued that the increase is staff numbers is likely to have a greater impact on energy consumption than the increase in student numbers as staff tend to spend more time in the building on a daily, weekly and annual basis. Nevertheless

the 21% increase in energy consumption is greater than can reasonably be attributed to the increase in building occupants. The installation of radiant heaters on the ground floor would also be likely to increase energy consumption. The provision of additional comfort in the form of heaters and carpet may have increased the attractiveness of the building so that students stayed longer and occupied the building more after hours. Although energy consumption for this building has increased, it is still performing better than the national average.

Savings in water consumption are less conclusive. The AMS record of water usage for the building in 2007 was 466kL of mains water and 35kL of rainwater. However the rainwater tanks have a capacity of 132kL, so it was likely that they had not been filled sufficiently to cope with demand. These figures indicate that rainwater has the potential to contribute about 30% of the water consumption for the building.

After being occupied for only a few months, the building won the Public Architecture Award, the Sustainability Architecture Award and the Heritage Award at the Royal Australian Institute of Architects (RAIA) Tasmanian Architecture Awards 2007. Later that year, it won the RAIA National Award for Sustainable Architecture and the Lachlan Macquarie Heritage Award.

The citation for the Tasmanian Sustainability Architecture Award (RAIA, 2007) included:

> The UTAS School of Architecture and Design stands out not only for its demonstration of architectural excellence but also for its demonstration of best practice sustainable architectural design…. The resultant flexible, adaptable, healthy, naturally ventilated and visually stimulating environment for learning has been realised at a highly affordable cost….The building stands as a working demonstration to the generations of architectural students passing through, that environmental sustainability can be aspired to without compromise to architectural excellence.

The Head of School, in a paper on the building's sustainability, wrote:

> From the first day of occupation, students and staff have enjoyed working in the building. The ambience of the spaces, the quality of natural light, the extensive use of exposed timber, the innovative use of materials and technologies and the visible application of sustainability principles represent to the community of users the values developed within the school and described by one colleague as 'humane modernism' (Fay and Owen, 2008).

4.6 Chapter summary

In this chapter I have discussed the background to my case study to facilitate understanding of the data in the following chapters. I have provided an overview of the University of Tasmanian context which supported the sustainability initiative of the adaptive re-use of a heritage listed diesel workshop for the School of Architecture and Design. This University context included policy which both indirectly and directly encouraged sustainability.

The history and philosophy of the School of Architecture and Design was presented to explain the reasons for the requirement for new accommodation, the design constraints, design process, and the resulting building.

The resulting building is described with an overview of its sustainable features.

Chapter 5 Framework for Results, Analysis and Discussion

5.1 Introduction

This chapter sets up the framework for ensuing discussion of results, analysis and discussion for the research. The survey of occupant experience constitutes a partial post occupancy evaluation of the School of Architecture and Design building at Inveresk—partial insofar as I have selected particular aspects of the evaluation data which have relevance for my research question. Recall that this question is:

> *What, if any, aspects of occupant experience in the School of Architecture and Design building have relevance for sustainable architecture and advance the organisation's sustainability initiatives? How do they do this and to what effect?*

The *evaluations* of the building belong to participants in the study, and are not my personal assessments. My background as an architect has made for easy communication between participants and researcher about a familiar subject. At the same time, while it is tempting to express my opinion on the design I have consciously endeavoured to step back from doing so. Nevertheless, *analyses* of those evaluations are mine, and they seek to demonstrate clear relationships between occupants' phenomenological experiences of the building and the experience and theorisation of comfort, delight and forgiveness, reflecting the most significant and obvious aspects of the data.

5.2 Data sources and description

The following three chapters draw on all the sources listed in the table below, but primarily on the data from questionnaires. Insights from focus groups, interviews and unobtrusive observation are used to exemplify points under discussion.

Figure 5.1 Data sources

DATA SOURCE	PARTICIPANTS	NUMBER OF PARTICIPANTS	DATE
Questionnaire 1	Building occupants: students, academic staff, general staff	112	25 Sept 2007
Questionnaire 2	Building occupants: students, academic staff, general staff	203	16 Sept 2008
Focus Group 1	Students	11	25 Sept 2007
Focus Group 2	Students	16	16 Sept 2008
Interview 1	Student	1	16 Sept 2008
Interview 2	UTAS Project manager	1	23 March 2007
Interview 3	Architects	2	6 Sept 2007
Focus Group 4	Academic staff	2	5 Oct 2007
Interview 4	Professional staff	1	5 Oct 2007
Focus Group 5	CSAW staff (research & professional)	3	4 Oct 2007
Interview 5	CSAW staff (research)	1	3 Oct 2007
Interview 6	Fay (then Head of School)	1	17 Sept 2007
Interview 7	Fay (then Head of School)	1	19 June 2009
Observation	Informal participation of all building occupants: students, academic staff, professional staff in the field	All building occupants at the time of observation	2007: 23 March, 25 Sept, 5 Oct 16 Sept 2008 19 June 2009

The questionnaire is a standardized format developed by Building Use Studies (BUS) in the United Kingdom, and in its 2007 iteration at UTAS 71 questions were posted, with 78 asked in 2008. Apart from the additional seven questions in 2008, the questionnaires were identical; those additional questions asked about any requests for changes and about whether occupants had changed their behaviour because of the building. I assume these questions were added as a result of research indicating that a prompt response to an occupant's request for change positively influenced satisfaction with a building (Leaman and Bordass, 2005, Part 1). The question

about changed behaviour may have been to ascertain the extent of adaptive behaviour to achieve comfort. In both years 20 questions were asked about participants' backgrounds and journeys to work and included rated-response and open-ended questions.

The majority of the questions had rated-responses based on a seven point scale. Three different scales were used. A-scales are right handed with 'best' at the right hand end of the scale; B-scales are centred with, with 'best' at the centre of the scale and C-scales are left handed with 'best' at the left hand end of the scale. This variation prevents participants thoughtlessly ticking the same box in response to all questions and allows for those scales which have centre points (for example, air quality's dry-humid rating scale) which are normally the preferred points, according to BUS. These centred scales effectively contain two variables in the one question (for example, dry and humid) (Paevere and Brown, 2008).

The license to use the BUS questionnaire enables subscribers to receive the details of responses to each question, including averaged responses to the rated questions ('scores') graphed against a benchmark and scale midpoint. The benchmarks are based on the last 50 buildings surveyed in Australia using the BUS questionnaire (at least at the time of writing). As there was a delay in sending my 2008 data to BUS (due to a short suspension in my candidature), the benchmarks for my 2008 results include buildings surveyed in 2009 and 2010. I expect that this issue will have no significant effect on the benchmarked data, as the survey date is not necessarily related to the construction date.

In addition to the rated-response questions, the questionnaire had open-ended questions—13 in 2007 and 15 in 2008—providing the opportunity to write comments. Leaman, who operates the BUS, supplied the comments written in response to these open-ended questions, listed separately under

each question. He also developed the following indices from the scores of selected variables: comfort index, satisfaction index, summary index and forgiveness index.

BUS uses a traffic light rating to summarise survey results. Green represents 'good' scores which are significantly better than both the benchmark and the scale midpoint limits (that is, outside the limits of the benchmark and the scale midpoint); amber represents 'typical' scores which are not significantly different from either the limits of the benchmark and/or the scale midpoint; and red represents 'poor' scores which are significantly worse than the benchmark and the scale midpoint limits.

The BUS Licence Agreement (Appendix 1) does not allow access to the questionnaire apart from its use in surveys, nor to the benchmarks. This is to protect the intellectual property invested in the development of the questionnaire and the benchmarks. Thus I am unable to include the questionnaire or the actual benchmarks in this thesis.

Data from the focus groups and interviews comprised notes from all sessions and recordings of most sessions. Notes from the focus groups were taken by me, with the aid of another doctoral candidate, also an architect, for whom I provided similar services on her own and quite separate project. No formal transcriptions were made for reasons of time and cost. However additional notes, including transcribing useful quotes, were made after repeated listening to recorded sessions.

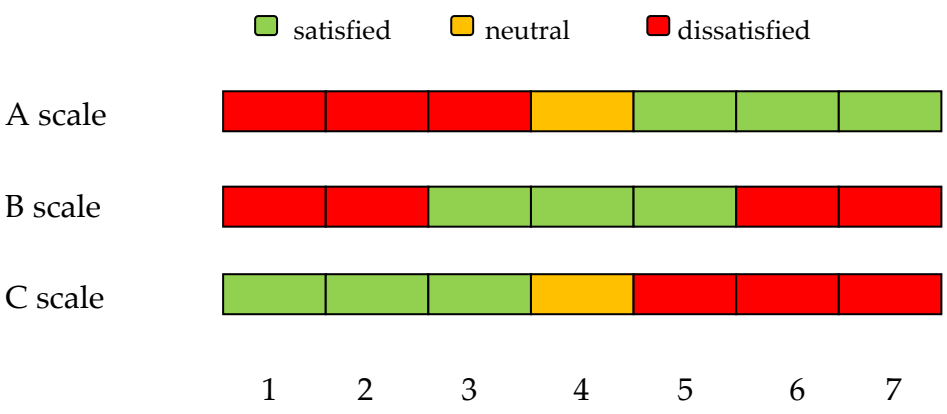
Observation data comprised notes and photographs taken on my numerous visits to the building. Activity, or traces of activity such as signs, which had relevance to the research question were noted and photographed.

5.3 Data analysis and discussion

Responses to the rated-response questions were analysed to determine levels of satisfaction with elements of the sustainable building that houses the School of Architecture and Design, with relevant variables charted to illustrate satisfaction/dissatisfaction. The charts of satisfaction provide comparative summaries of individual responses to questions about the building and occupant experiences of it. The definition of satisfaction on the rating scales is consistent with that used in the BUS.

For the A and C scales, I have assumed the midpoint of four out of the seven-point scale to be 'neutral' and considered that responses either side to represent 'satisfied' or 'dissatisfied' depending on the direction of the scale. The position of satisfaction on the centred scale is less obvious than the continuous scales. For the B-scales which are centred, I have assumed that the three central points (that is, 3, 4, 5) represent 'satisfied' responses and those either side represent 'dissatisfied' responses. This interpretation of the centred scale response has been used for the sake of consistency with BUS, but may emphasize satisfaction (due to central preference bias) and perhaps misrepresent the response in a more positive light. Figure 5.2 illustrates the approach used to determine satisfaction/dissatisfaction.

Figure 5.2 Determination of satisfaction/dissatisfaction



Comments responding to open-ended questions in the questionnaire were analysed and coded according to the issues aired in each comment. Comments often covered more than one issue. Where possible the terms used for the codes to identify the issues were consistent with the variables in the rated-response questions. Comments were grouped according to whether they were positive, negative or contained either neutral statements or both positive and negative statements . For example, the comment 'Good form and feel. Lacks in functionality eg heating and cooling systems, sound etc.', in response to the 2008 question on building design overall was analysed as covering issues of image, thermal and noise. In the table of comments and their major issues, it was grouped with the comments containing either neutral statements or both positive and negative statements. Not all participants took the opportunity to write comments. In 2007, approximately 45 per cent of participants wrote comments and in 2008, approximately 35 per cent of participants wrote comments. It is interesting to note that the majority of comments were negative, even when the related rated-response question received a positive score. Other POE researchers have also found that building users are more likely to complain than praise (Baird, 2010).

Charts were created to illustrate the range of major issues in the comments and the frequency with which they were mentioned. The charts also show whether statements in the comments were negative, neutral or positive. Tables listing all comments and their coding can be found in Appendix 3 and the charts derived from them are used in the following chapters. The breadth of issues covered in the responses to the open-ended questions dealing with the building overall, makes each chart relevant to a number of themes, and therefore not easily categorised according to the thematic chapter structure. For example the majority of comments in response to the open-ended question on design overall were about comfort, but also included a range of issues relevant to the delight and forgiveness themes. It is also useful to be

able to see the major issues in the comments on building overall together, so that trends in the data can be identified. The charts have therefore been included at the end of this chapter in Figure 5.5.

The charts illustrating responses to both types of questions are an effective way to present an overview of the questionnaire data and have been useful in developing the analysis and discussion. They identify the trends in participant experience of the building. They are not intended to be used for quantitative comparison.

Notes from focus groups and interviews were analysed and coded, using terms for codes consistent with questionnaire data where possible. This process facilitated the use of such data as exemplification of the questionnaire results, deepening insights from them.

The quoted comments in the following chapters are derived from both the written open-ended questions and data from the focus groups and interviews. They are not intended to be representative of the study sample, but to provide an insight into the way participants live their experience of the building in their own voice. They are used in an illustrative manner to exemplify the major issues arising from the data sourced from rated-response questions and contribute richness, depth and nuance which are characteristic of qualitative research (Mason, 2004).

5.4 Participants

The questionnaire was distributed to students in Years 2, 3 and 4, and academic and general staff on 25 September, 2007 and 112 responses were received. The same questionnaire, with the aforementioned addition of 7 questions, was distributed to students from all years, and academic and

professional staff, on 16 September, 2008 and 203 responses were then received.

In both years a significant majority of participants were aged under 30 and there was a slightly higher proportion of male participants. In 2007, 84 per cent of participants were aged less than 30 years and 16 per cent were aged more than 30 years; 57 per cent of participants were male and 43 per cent were female. In 2008, 90 per cent of participants were aged less than 30 years and 10 per cent were aged more than 30 years; 59 per cent of participants were male and 41 per cent were female. These background characteristics appear to reflect the demography of the occupants of the building.

UTAS statistics for 2007 state there were 354 students and 32 staff in the School. Of the students in 2007, 60% per cent were male. In 2008, there were 373 students and 38 staff. Of the students in 2008, 62% were male. These numbers are effective full time loads.

It was decided not to separate staff and student responses to the questionnaire as both occupy the same spaces in the School. During design studio classes, which are the dominant mode of teaching and learning, staff and students together spend most of the day in the studio. Focus groups and interviews provided opportunities for raising any issues specifically related to either students or to staff and their office spaces. The majority of participants identified this building as their normal work base (76 per cent and 88 per cent in 2007 and 2008 respectively). I speculate that the remaining participants were either part-time staff or part-time students, considered home as their normal work base (only attending university for required contact hours) or made a perceptual error. As the building was first occupied by the university in February 2007, that year all but one participant had worked in the building for less than a year. I speculate that this was a perceptual error. However, one staff member assisted with construction of

the building and may have been the one participant who reported working in the building for one year or more. In 2008, 33 per cent of participants had worked in the building for less than a year; most of these would have been first year students. The remainder would have been students or staff who commenced work or study in 2008. By 2008,67 per cent of participants would have worked in the building for 19 months. This length of time allowed them to experience the building through all the seasons and to adapt to the conditions.

Around half the participants (59 per cent and 41 per cent in 2007 and 2008 respectively) reported sitting next to a window. This relatively high proportion is possibly because the student population is very mobile within the building and most would have spent some time sitting next to windows. The top floor studios have small horizontal windows, restricting access to sun, natural light and external views to the occupants sitting adjacent to the windows. These window seats are available to all students but limited in number and highly sought after. Most students would have had some experience of sitting adjacent to these windows. The ground floor studios have a long and very high wall of windows, allowing all occupants of the studio access to sun, natural light and external views. Some participants in those studios may have reported sitting next to a window because of this situation. All staff offices, with the exception of one shared office, have windows.

In 2007, the participants spent an average of 4.5 days each week and 6.4 hours each day in the building. An average of 4.6 hours each day was spent at desks and 3.5 hours each day was spent at a computer screen. The figures for 2008 were not provided by BUS, but it can be assumed they would be similar to 2007 figures. This assumption is based on an understanding that the contact hours for architecture students are approximately 20 hours each week and that many students carry out their project work using university

computers with specialised CAD and graphics software and/or working on individual and group design projects in the design studio.

Students and staff involved in the focus groups participated on a voluntary basis. In 2007, 11 students from Years 2, 3 and 4 participated. In 2008, 16 students representing all year groups participated in discussions, and an interview was conducted with one student who wished to be involved in the POE but was unable to attend the focus group. The age and gender of focus group participants was similar to that of participants in the questionnaire survey.

In 2007, five staff participated in two focus groups. Interviews were held with two other staff who were not able to join the focus groups. Two interviews were held with Professor Fay given his role as Head of School—one at the beginning of occupation of the building and the other at the end of the survey process.

Interviews were also held with two of the architects, representing the practices of Six Degrees and SBE and the UTAS project manager for the building during its procurement.

5.5 Structure of following chapters

I have chosen to structure three of the following chapters around the major themes and sub-themes arising from the data. Each chapter synthesizes the presentation, analysis and discussion of results within each of the three themes.

Figure 5.3 on page 101 shows traffic light ratings of the results from the rated-response questions. The purpose of this table is to give a graphic overview of the results and major patterns in them. It reveals two clusters:

the most negative responses occur for the comfort variables and the most positive responses occur for the variables relating to the overall building. Because of the positive ratings for these overall building variables and mindful of the fact that BUS uses some of them to calculate the Satisfaction Index, I have used the term delight for this group. The two clusters, comfort and delight, become the themes which frame the content of the following two chapters and are also the chapter titles. The relationship between comfort and delight, which is deemed here to be forgiveness, forms the third theme and chapter title. Reinforcing the significance of these three themes is the fact that they are the subjects of the indices (comfort index, satisfaction index, forgiveness index) used in the BUS to summarise questionnaire results. The fourth of the following chapters is the conclusion to the thesis.

Figure 5.3 BUS traffic light ratings for results from questionnaire's rated-response questions

		VARIABLE	2007		2008
COMFORT VARIABLES	TEMPERATURE	Temperature in winter: uncomfortable/comfortable			
		Temperature in winter: hot/cold			
		Temperature in winter: stable/varies			
		Temperature in summer: uncomfortable/comfortable			
		Temperature in summer: hot/cold			
		Temperature in summer: stable/varies			
	AIR	Air in winter: still/draughty			
		Air in winter: dry/humid			
		Air in winter: fresh/stuffy			
		Air in winter: odourless/smelly			
		Air in summer still/draughty			
		Air in summer: dry/humid			
		Air in summer: fresh/stuffy			
		Air in summer: odourless/smelly			
	CONDITIONS OVERALL (TEMPERATURE AND AIR)	Conditions in winter: unsatisfactory/satisfactory			
		Conditions in summer: unsatisfactory/satisfactory			
	NOISE	Noise form colleagues: too little/too much			
		Noise from other people: too little/too much			
		Other noise from inside: too little/too much			
		Noise from outside: too little/too much			
		Noise overall: unsatisfactory/satisfactory			
		Unwanted interruptions: not at all/very frequently			
	LIGHTING	Natural light: too little/too much			
		Glare from sun and sky: none/too much			
		Artificial light: too little/too much			
		Glare from lights: none/too much			
		Lighting overall: unsatisfactory/satisfactory			
	PERSONAL CONTROL	Heating			
		Cooling			
		Ventilation			
		Lighting			
		Noise			
	COMFORT	Comfort overall			
DELIGHT VARIABLES		Design overall			
		Satisfaction of needs			
		Effective use of space			
		Image			
		Facilities meet needs			
		Productivity			
		Health			

The sub-themes around which each chapter's content is structured represent the major issues arising from the data, which are generally the same as the variables in the questionnaire. Figure 5.4 outlines the themes and sub-themes of the next three chapters.

Figure 5.4 Themes and sub-themes arising from data

THEMES	COMFORT	DELIGHT	FORGIVENES
SUB THEMES	Temperature Air Noise Lighting Control Adaptation Comfort overall	Design Image Needs Specific needs Productivity Health	Building overall Relationship between the comfort and delight themes

The questionnaire data are restricted to variables which are most relevant to the research question. Questionnaire variables such as availability of meeting rooms, cleaning, suitability of storage arrangements, usability of furniture and amount of space at the desk are not considered relevant to the research emphases on comfort and delight. These variables relate to minor details and/or facility management and are therefore not presented.

The questionnaire variables discussed in the following chapters are:

Comfort variables:

- Temperature in winter
- Air winter
- Conditions in winter
- Temperature in summer
- Air summer
- Conditions in summer
- Noise
- Lighting
- Personal control of heating, cooling, ventilation, lighting, noise
- Importance of control of heating, cooling, ventilation, lighting, noise
- Overall comfort

Delight variables:

- Building design
- Needs (whether facilities in the building as a whole meet needs)
- Space (effective usage)
- Image of the building
- Specific needs (whether facilities meet individual work needs)
- Productivity
- Health

Contributing to the analysis and discussion around these questionnaire variables are the comments responding to some of the open-ended questions. Only those open-ended questions which are related to building issues (as opposed to background questions) and that pertain specifically to the research question are included. Open-ended questions which are building related but not relevant to the research and not discussed are: meeting rooms, storage, desk or work area. Many of the open-ended questions are sufficiently broad to encourage comments dealing with a range of issues. For example, many comments on design overall are relevant to both comfort and delight.

Open-ended questions discussed in the following chapters are:

- Design overall
- Needs overall
- Hinder effective working
- Work well
- Noise and its sources
- Lighting conditions
- Comfort
- Productivity
- Health
- Requests for changes (2008 only)
- Changed behaviour due to conditions in the building (2008 only)

Figure 5.5 Major issues in open-ended question responses for questions dealing on building overall

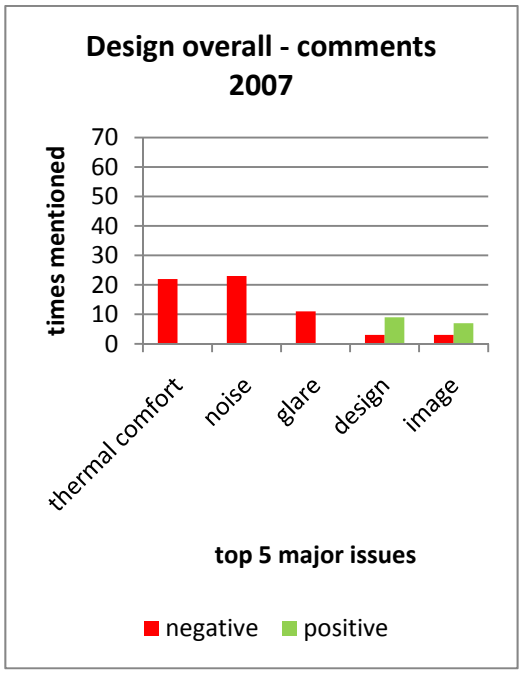


Figure 5.5a

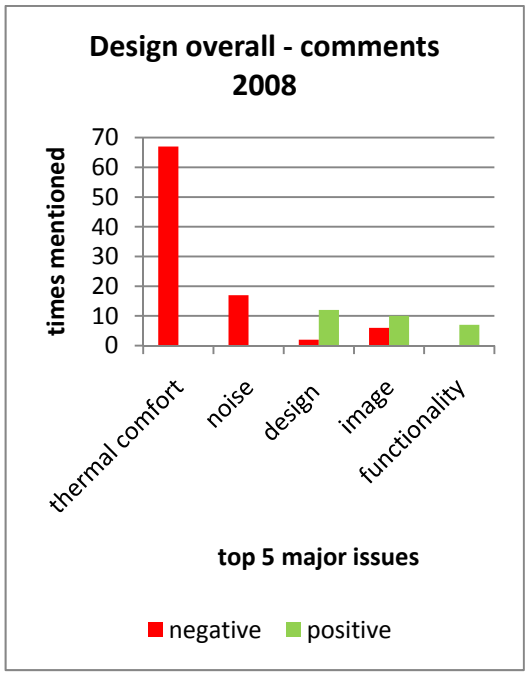


Figure 5.5b

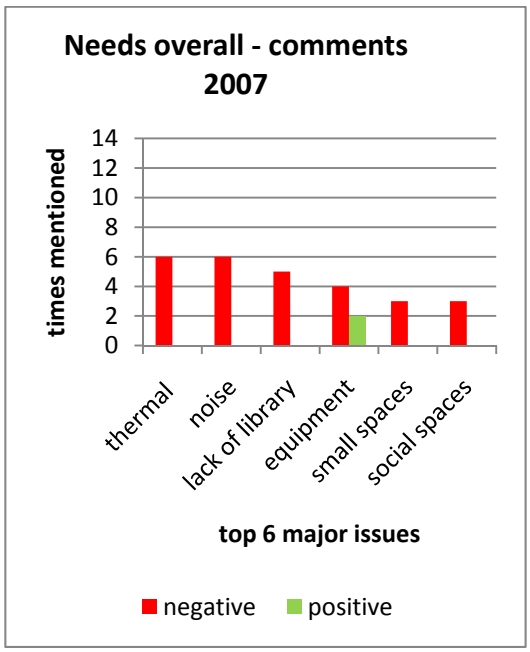


Figure 5.5c

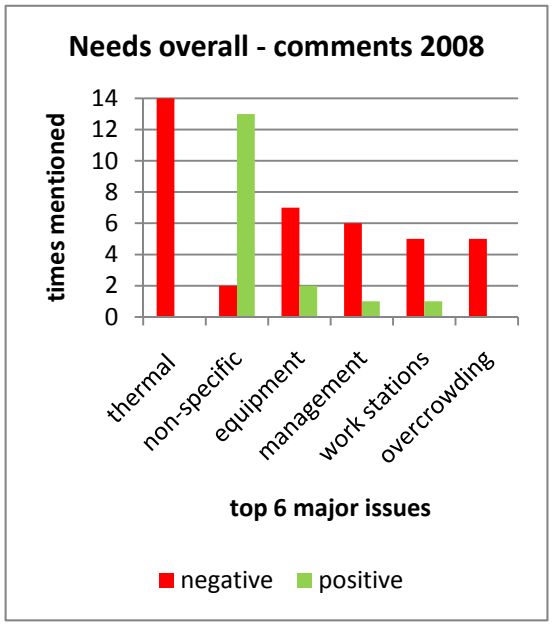


Figure 5.5 d

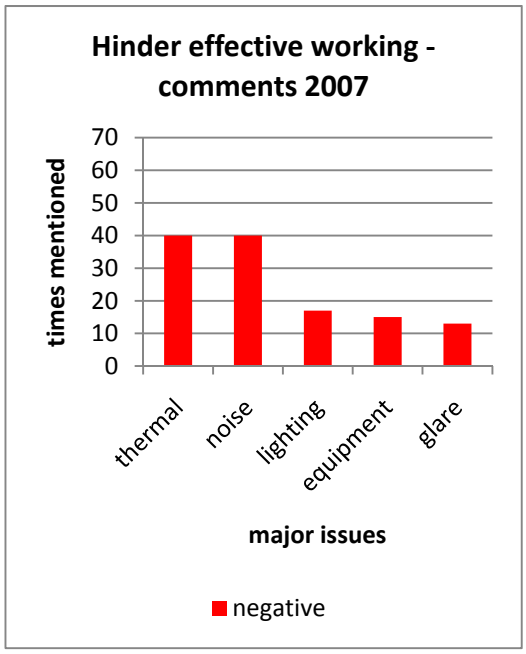


Figure 5.5e

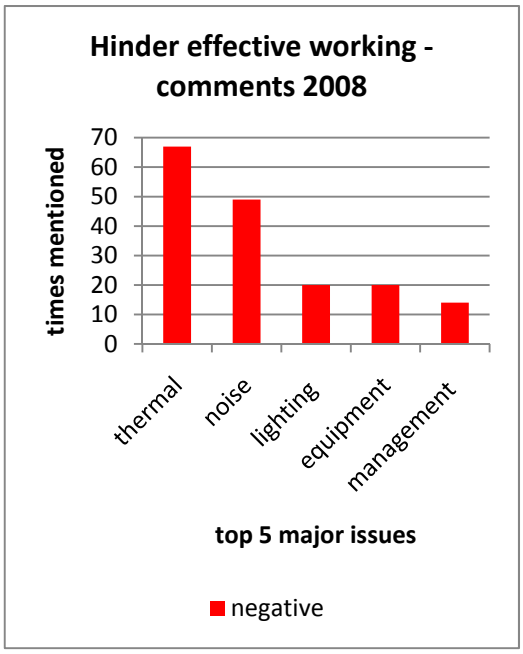


Figure 5.5f

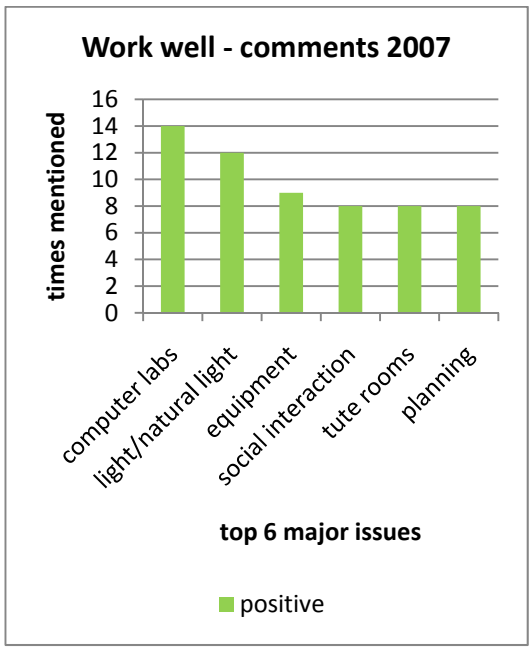


Figure 5.5g

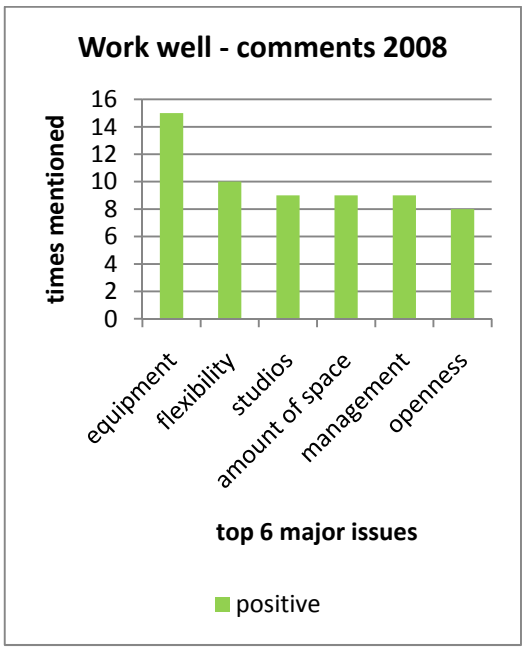


Figure 5.5h

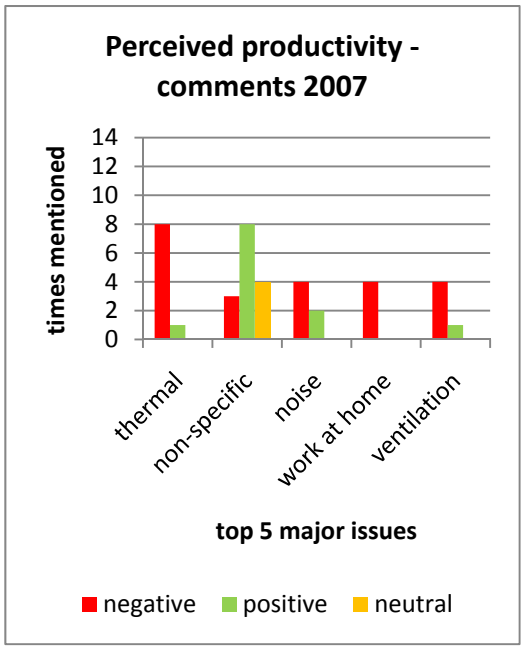


Figure 5.5i

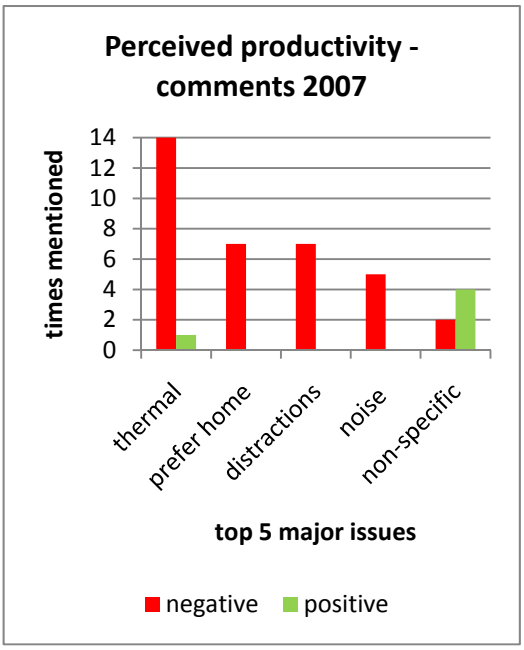


Figure 5.5j

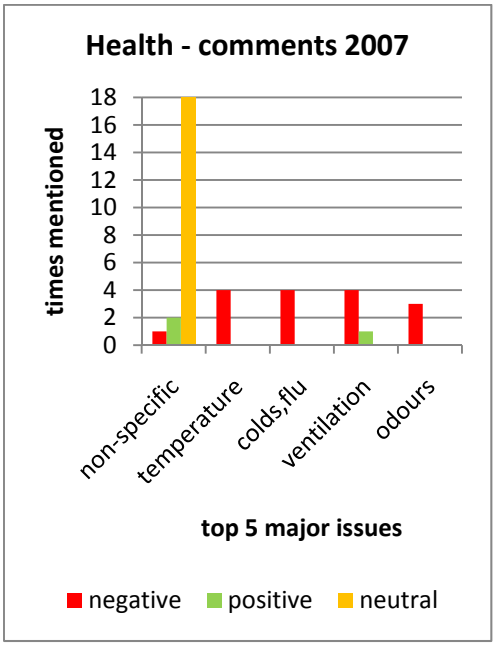


Figure 5.5k

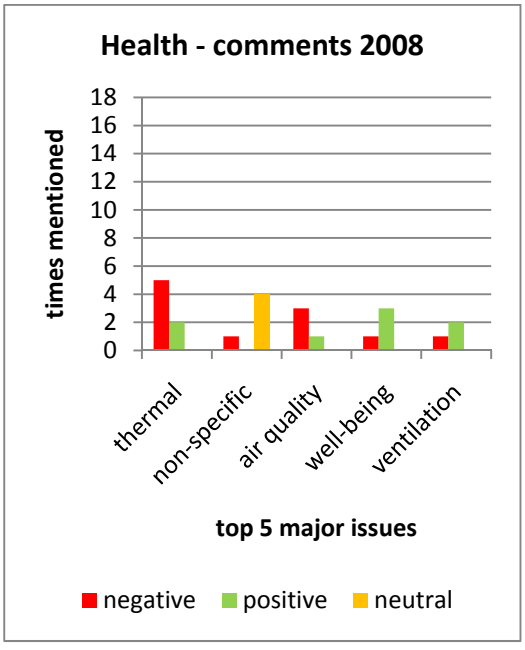


Figure 5.5l

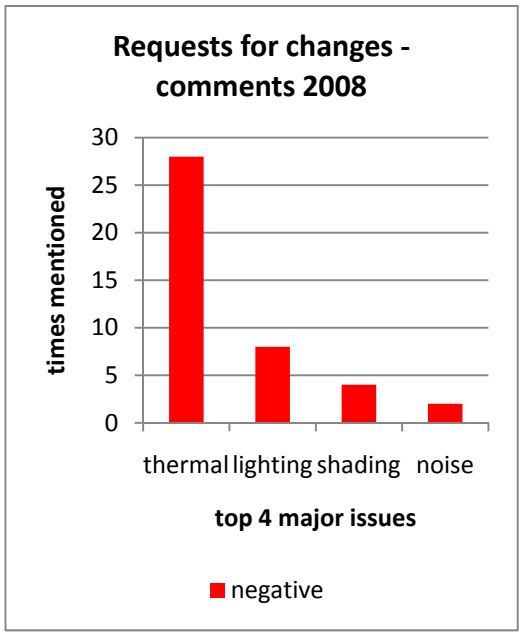


Figure 5.5m

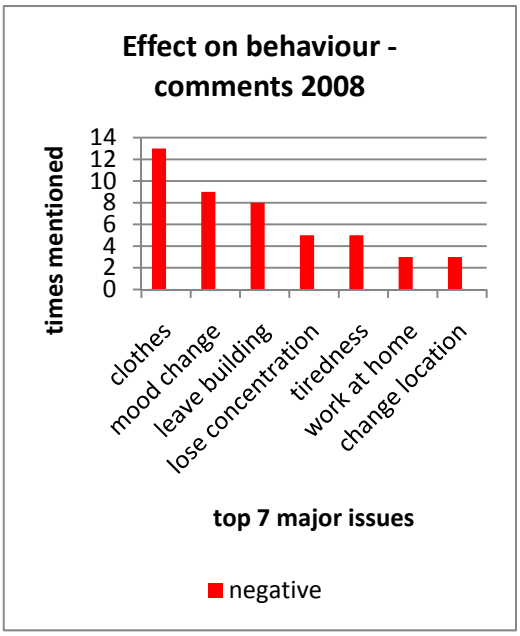


Figure 5.5n

5.6 Chapter summary

In this chapter, I have explained the rationale for the structure of the following chapters which present the results, their analysis and discussion. The thematic structure whereby results, analysis and discussion are synthesised is based on the major themes arising from the data: comfort, delight and forgiveness.

The chapter also describes the sources and nature of the data, numbers of participants for each type of data and background information about the participants. It gives an overview of the processes used to analyse the different types of data and includes charts of the major issues in the responses to the open-ended questions in the questionnaire. These charts were included here due to the diversity of issues raised in responses, making each chart relevant to a number of themes and therefore not easily categorised according to the chapter structure.

Chapter 6 Comfort: Results, Analysis, Discussion

6.1 Introduction

Although the definition of comfort in buildings can be broad and include both physical and psychological—and especially nurturing—dimensions, understandings of it in the literature are particular (de Dear, 2011, Humphreys, 2005, Leaman and Bordass, 2005, Luther and de Dear, 2003, Nicol, 2011, Strengers, 2008). In such contexts, comfort relates to temperature, ventilation, relative humidity, indoor air quality, lighting and noise. Such is the definition used here and by students in the 2007 focus group, who listed warmth, lighting, temperature, air quality, air circulation and sound when asked what contributed to indoor comfort.

Comfort is significant in the BUS data for the Inveresk building in part because of the number of questions about it (43 out of 71 and 78 questions respectively in the 2007 and 2008 questionnaires), and also because of the frequency with which it is mentioned in response to questions where comments are sought. As noted in earlier chapters, comfort is the essential purpose of shelter and its provision with minimal energy use is the major challenge for architects of sustainable buildings. Comfort therefore is a significant aspect of the occupant experience and a key objective of sustainable architecture. For these reasons, comfort is one of three themes around which this section of the thesis is structured.

Of the 39 rated-response questions relating to comfort and health, three questions were on temperature in winter; three on temperature in summer; five on air in winter; five on air in summer; five on lighting; six on noise; five

on control of heating, cooling, ventilation, lighting and noise; five on the importance of control; and one on comfort overall.

In addition to these rated questions, the questionnaire contained open-ended questions seeking comments about noise and its sources; lighting conditions; and overall comfort. Comments about comfort are also found in responses to questions about design overall, satisfaction of needs, hinder effective working, perceived productivity, health, requests for changes and effect on behaviour.

A summary, analysis and discussion of all responses relating to comfort follows, supported by relevant comments from focus groups and interviews.

Note that BUS graphics have been used to present the results for the rated-response questions. BUS have changed the direction of the vertical scale between the years 2007 and 2008 which makes comparison between the years slightly complicated.

6.2 Temperature

In the questionnaire, there were three variables relating to temperature in winter and three relating to temperature in summer. Participants were asked to rate temperature for winter and summer separately on the following scales:

Uncomfortable ….Comfortable
Too hot……...Too cold
Stable……..Varies

Figure 6.1 Temperature in winter ratings 2007 - red, 2008 - blue (BUS Graphics)

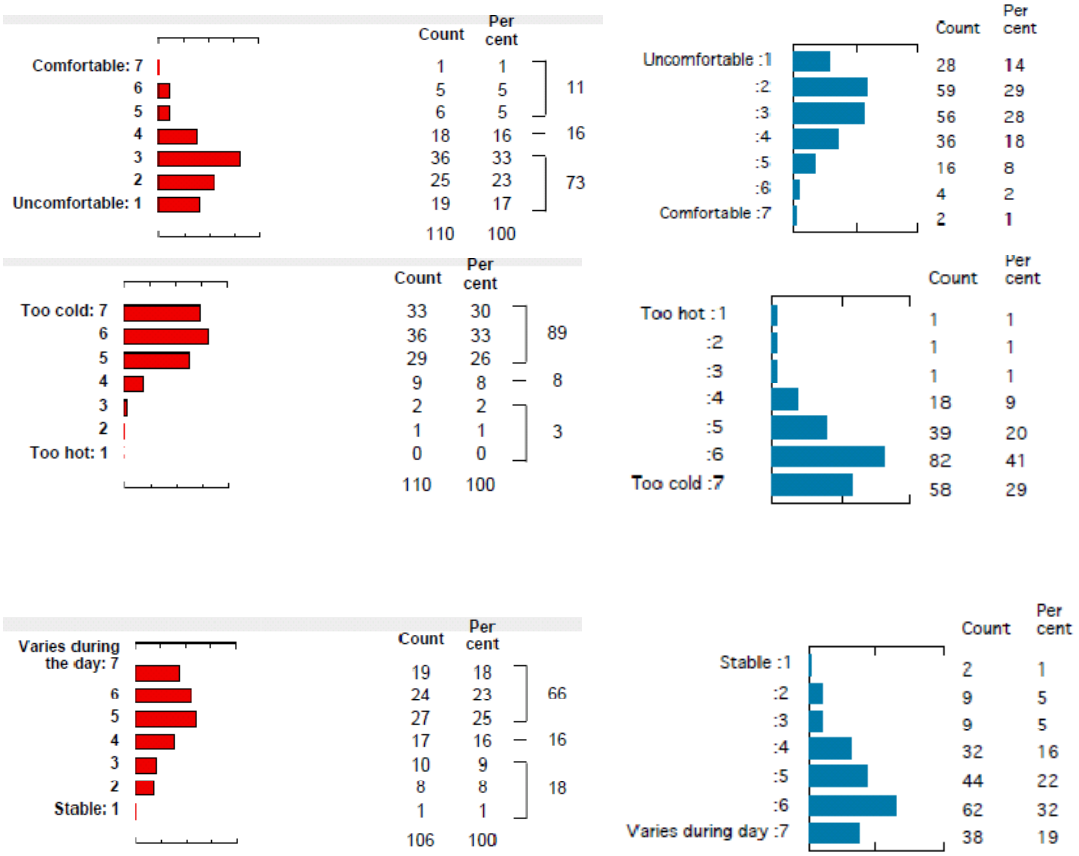
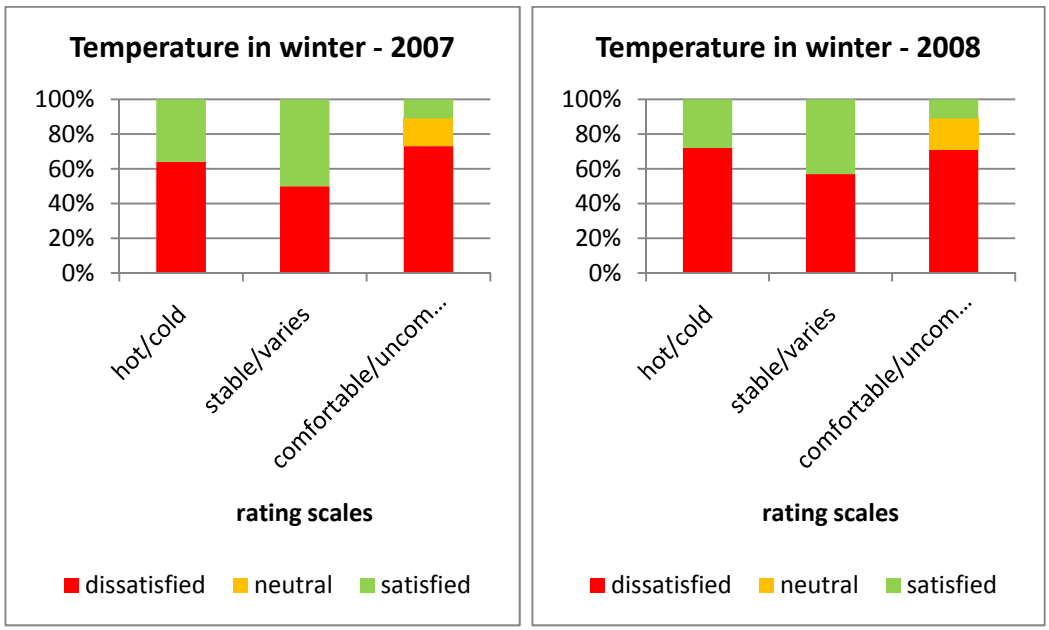
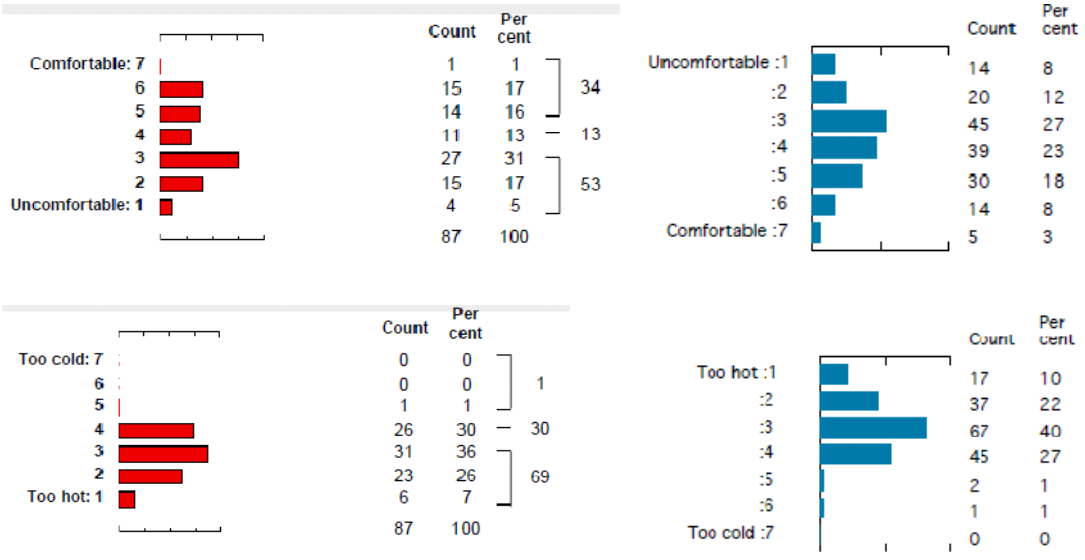


Figure 6.2 Satisfaction ratings for temperature in winter



For both 2007 and 2008, temperature in winter received very negative scores and was therefore a major issue. In 2007, 73 per cent of participants, n. 80/110, were dissatisfied with temperature overall in winter and rated it as uncomfortable; 64 per cent, n. 40/110, were dissatisfied with the warmth of the temperature; 89 per cent, n. 98/110, rated the building as too cold in winter; 50 per cent, n. 53/106, were dissatisfied with the stability of the temperature; and 66 per cent, n. 70/106, felt that temperature varied during the day. In 2008, 71 per cent of participants, n.143/201, were dissatisfied with temperature overall in winter and rated it as uncomfortable; 72 per cent, n. 142/200, were dissatisfied with the warmth of the building; 90 per cent, n. 179/200, rated it as too cold in winter; 57 per cent, n. 111/196, were dissatisfied with the stability of the temperature; and 73 per cent, n. 144/196, felt that temperature varied during the day. For both years, temperature in winter was considered uncomfortable, too cold and variable during the day. Figure 6.2 illustrates satisfaction levels for temperature in winter. The BUS traffic light rating for both years was red for all three variables relating to temperature in winter. This result means the scores for all variables relating to temperature in winter were outside the limits of both the scale midpoints and the benchmarks (Figure 5.3, page 101).

Figure 6.3 Temperature in summer ratings: 2007 – red, 2008 – blue (BUS graphics)



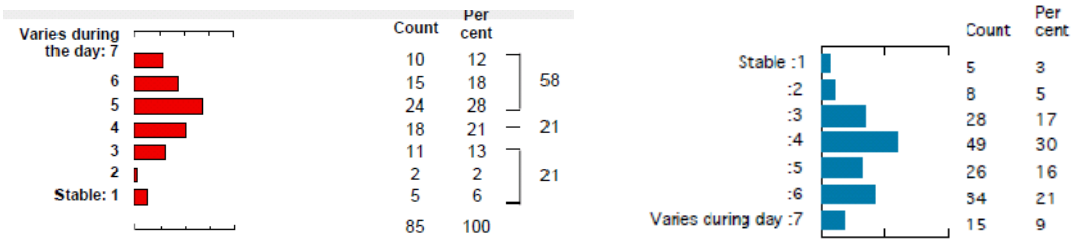
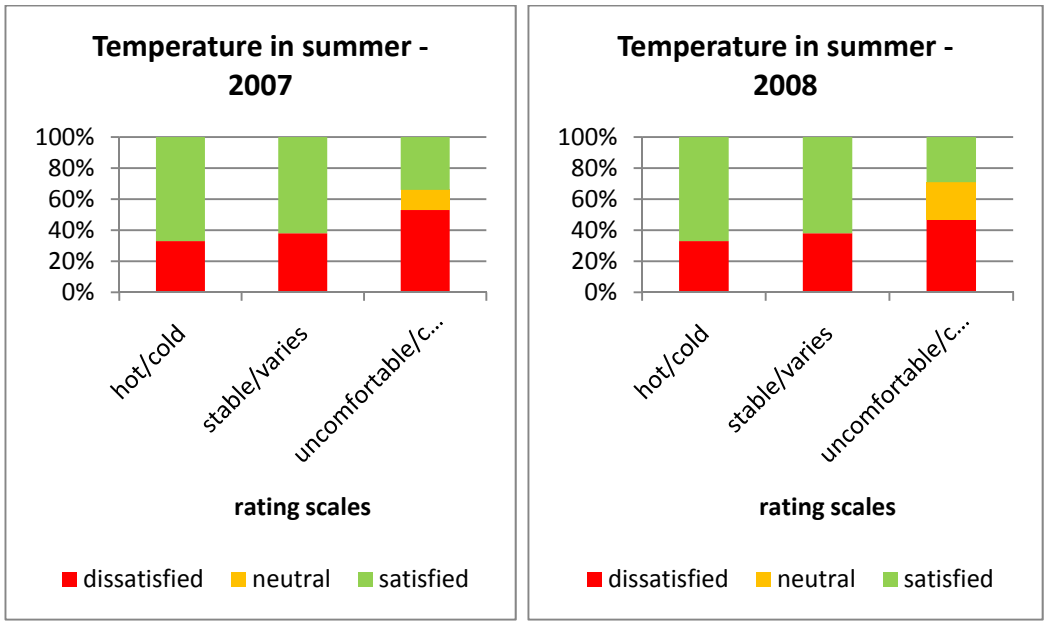


Figure 6.4 Satisfaction ratings for temperature in summer



Responses to temperature in summer did not engender such negative scores and it was not considered as significant an issue as temperature in winter. In 2007 and 2008, 53 per cent, n. 46/87, and 47 per cent, n. 79/167, respectively of participants were dissatisfied with temperature in the building in summer and rated it as uncomfortable. In 2007, 33 per cent of participants, n. 58/87, were dissatisfied with the warmth of the temperature in summer; 69 per cent,n. 60/87, rated the building as too hot; 38 per cent of participants were dissatisfied with the stability of the temperature; and 58 per cent, n. 49/85, felt the temperature varied during the day. In 2008, 33 per cent of participants, n. 55/169, were dissatisfied with the warmth of the temperature in summer; 72 per cent, n. 121/169, of participants rated the building as too

hot; 38 per cent, n.62/165, were dissatisfied with the stability of the temperature in summer; and 46 per cent, n. 75/165, felt the temperature varied during the day. For both years, temperature in summer was considered uncomfortable, too hot and variable during the day.

The BUS traffic light rating was red for temperature in summer: hot/cold, for both years; red for temperature overall in summer for 2008; amber for temperature overall in summer 2007; and amber for temperature in summer: stable/varies for both years (Figure 5.3, page 101).

Occupant perception of comfort is gauged from the rated-response questions in the questionnaire; from the comments in response to open-ended questions in the questionnaire; and from comments and statements made during interviews and focus groups. From the charts which graph the frequency of issues mentioned in comments in response to the questionnaire's open-ended questions (Figure 5.5, page 104 - 107), it can be seen that thermal comfort was the most significant issue across all variables. It was noteworthy in terms of the frequency with which it was mentioned compared to other issues and in terms of the range of variables where it was mentioned. Thermal comfort was negatively perceived in responses to questions about overall comfort, health, design and needs fulfilment, as well as hindrances to effective working, perceived productivity, requests for changes and effect on behaviour. In all of these variables, except overall design in 2007, thermal comfort was mentioned as a negative issue more than any other. In the form of five comments, thermal comfort did receive a small amount of positive mention in 'work well' in 2008. These comments generally related to the warmth of smaller enclosed spaces such as tutorial rooms and computer labs; for example:

> Heating in smaller rooms (Work well, 2008).
>
> Computer rooms HEATED (Work well, 2008).

The most frequently mentioned statements on thermal comfort related to winter temperatures generally; the thermal discomfort of the studios, especially those on the ground floor; thermal discomfort at night and weekends; the variation in temperature within the building, across the seasons and throughout the day and the impact of thermal discomfort on health and productivity.

For example, relating to winter temperatures:

> It is freezing cold inside the building (Design overall, 2007).
>
> Frosty morning desks in winter (Hinder effective working,2007).
>
> Very cold building (Hinder effective working, 2007).

The studios were considered the most thermally uncomfortable areas of the building according to the questionnaire comments. For example:

> Heating and cooling large spaces (Hinder effective working, 2007).
>
> Too hot/cold in studios (Hinder effective working, 2008).
>
> Too cold, especially on the ground floor (Overall comfort, 2007).
>
> Louvres don't really work during summer causing overheating. 3rd floor gets really hot during sometime of each day (Hinder effective working, 2008).

The dominant spatial type in School of Architecture and Design is the design studio, a large flexible open space where students can work on design projects as a year group, in small groups or individually. Large open spaces such as studios are always difficult to heat and cool. In the ground floor studios of this building, the difficulty is compounded by the huge volume produced by the three-storey height and by the large expanse of west-facing single glazing. The single glazing allows heat loss from the building in cold weather and heat gain from afternoon sun. In the 2007 focus group for staff, comments were made on the decision to keep the huge volume of the ground floor studios and on the impact this had on strategies for ecologically

sustainable development. One participant observed, 'If you were really sensible you wouldn't have that huge volume' (Staff focus group, 2007). However, it should be noted that the large area of single glazing was an existing feature of the building which was not able to be changed; for example, double glazing this large window was not possible due to budget constraints and shading could not be attached because of heritage constraints.

Many comments related to thermal discomfort experienced after hours.

> It gets very cold at the upper level (students work place) during the night (Design overall, 2008).
>
> Very cold in winter—unbearably of a night (Design overall, 2008).
>
> On late nights and weekends it is difficult to work here because of the temperatures and ineffective heating (Perceived productivity, 2008).

The School of Architecture and Design supports 24-hour access, 7 days a week for students because it encourages collegiality and a studio culture, and supports group work on design projects. However it is inefficient to heat or cool the entire building continuously, especially when it is not fully occupied. Heating is turned off at night and weekends but the building's 31 zones can be individually heated by occupants working after hours. The only zones not able to be heated after hours are the ground floor studios and the workshop (Fay, 2009, interview). This energy conserving strategy relies on occupants understanding the intent, being adaptable about where they work in the building and being able to move their work to different locations within the building. However not all occupants understand or support this (implicit) flexibility requirement, as is evident from the following comment in the student focus group.

> There was an email sent around saying downstairs studios weren't to be used after hours—we don't know what first and second years are supposed to do when it gets to 5pm! (Student focus group, 2007).

From responses to the rated-response questions, a majority of participants experienced variation in temperature throughout the day. In questionnaire comments, focus groups and interviews, temperature variation was identified as a problem, and was related to both spatial and temporal variation, with temporal variation occurring across the seasons as well as diurnally.

> At the middle of the day it is fine. Morning and afternoon are when the temperature is uncomfortable (Overall comfort, 2008).
>
> The building may be sustainable, but it is too cold in winter and too hot in summer (Overall comfort, 2008).
>
> During winter, heaters on during the day are too hot. After hours, heaters consistently fail. Too hot in the day, too cold at night and this in most work areas in the building (Overall comfort, 2008).
>
> Everyone wears two layers of wool for the cold areas of the building (Staff focus group, 2007).

The exception was one staff member who stated:

> I don't mind the varying temperature—it reminds me that I'm alive (Staff focus group, 2007).

The diurnal and seasonal variation can be in part attributed to the local climate, as one staff member explained:

> The differential temperature in Launceston is so great. It can be 2–18degrees C. The building doesn't respond quickly enough. In the afternoon in winter it can get quite warm (Staff focus group, 2007).

Solar altitude and azimuth vary significantly across the seasons in Launceston and the building's orientation with its long sides facing east and west exposes it to low angled morning and afternoon sun. Heritage and budget constraints limited options for overcoming this problem with the existing building, resulting in overheating in summer.

> Sun penetration into offices makes space very hot in summer and heating to offices seems inadequate in winter (Overall comfort, 2007).

Thermal discomfort in the building impacts on productivity and health, as the following comments demonstrate:

> … temperature variations/extremes can affect productivity (Perceived productivity, 2007).
>
> When the building is cold, you don't want to be here. When it's hot and stuffy, you just feel sleepy (Perceived productivity, 2007).
>
> Difficult to concentrate if lecture theatre is hot (Changed behaviour, 2008).

In the 2008 questionnaire results, improvements to thermal comfort were the most requested changes. For example:

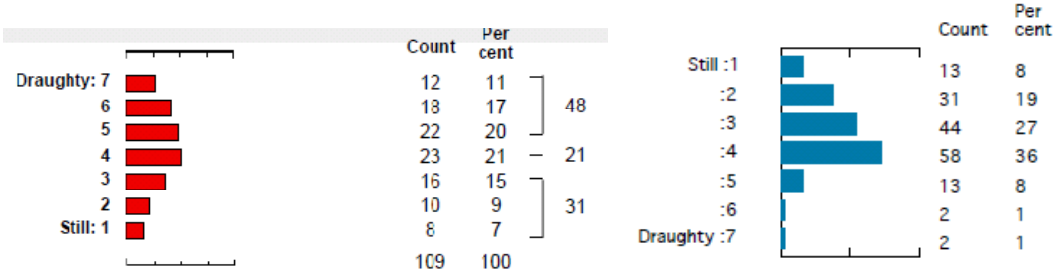
> Requested more heating in winter, especially after hours and weekends when the building is extremely cold (2008, Requests for changes).

6.3 Air

There were eight variables relating to air in the questionnaire. Participants were asked to rate air in winter and summer separately on the following scales:

> Still ….. ……..Draughty
> Dry……. Humid
> Fresh……Stuffy
> Odourless……Smelly

Figure 6. 5 Air in winter ratings: 2007 – red, 2008 – blue (BUS graphics)



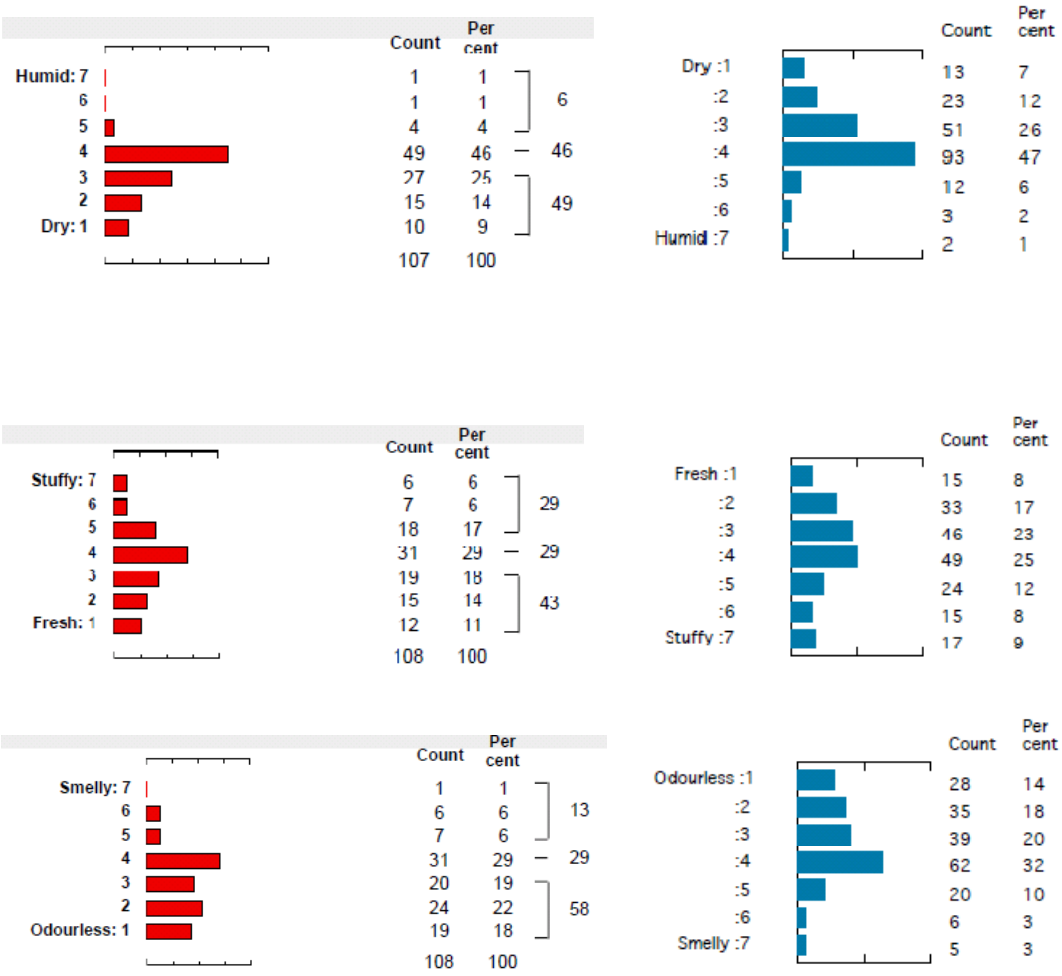
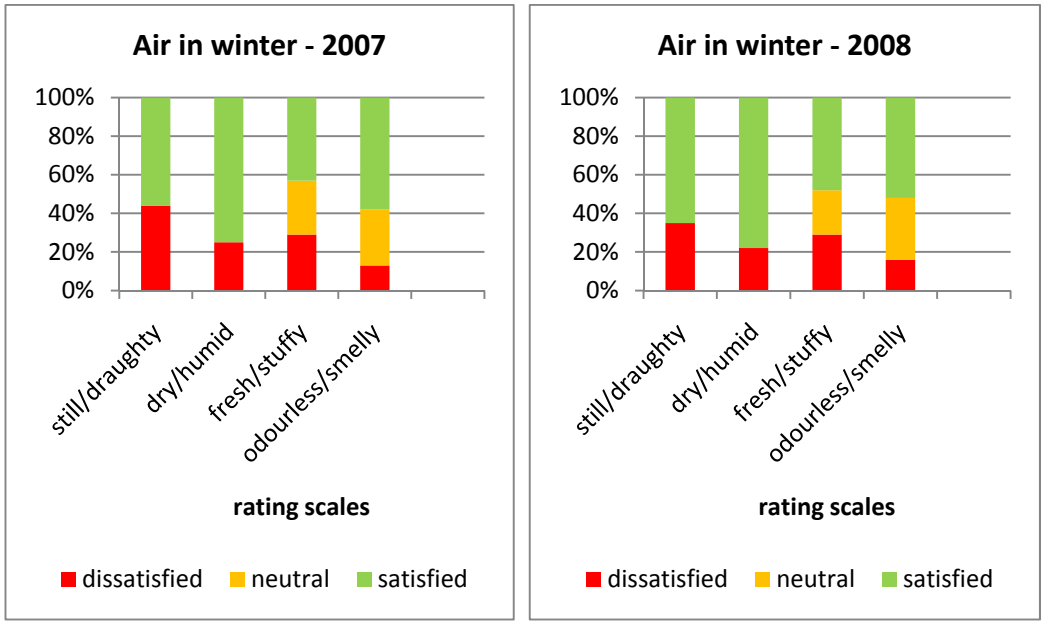


Figure 6.6 Satisfaction ratings for air in winter



For both 2007 and 2008, aspects of air in winter were significant issues. In 2007, 44 per cent of participants, n. 48/109, were dissatisfied with the amount of air movement in winter with 48 per cent, n. 53/109, considering it draughty, possibly too draughty. Some 25 per cent of participants were dissatisfied with the relative humidity of air in winter, with 49 per cent (n. 52/107) rating the air as dry. On the positive side, air in winter in 2007 was considered fresh (43 per cent satisfied, n. 56/108) and odourless (58 per cent satisfied, n. 63/108). Freshness and lack of odour are consistent with a draughty building. Air in winter overall was rated as unsatisfactory, with 63 per cent, n.68/108, dissatisfied.

In 2008, 35 per cent of participants, n. 66/199, were dissatisfied with the amount of air movement with 40 per cent, n. 80/199, rating the air as draughty and 22 per cent, n. 41/197 were dissatisfied with the relative humidity of the air in winter with 45 per cent, n. 87/197, rating it as dry. Forty-eight per cent, n. 94/199, of participants rated the air in winter as fresh and 52 per cent, n. 102/195, rated it as odourless. In spite of the reasonable scores for these specific variables, air in winter overall was rated as unsatisfactory with 64 per cent, n. 126/200, dissatisfied.

The BUS traffic light ratings for 2007 were red for air in winter overall and air in winter: dry/humid; amber/red for air in winter: still/draughty; and green for air in winter: fresh/stuffy and air in winter: odourless/smelly. In 2008, the ratings were red for air in winter overall; amber for air in winter: dry/humid and air in winter odourless/smelly; and green for air in winter: still/draughty and air in winter: fresh/stuffy (Figure 5.3, page 101).

Figure 6. 7 Air in summer ratings: 2007 – red, 2008 – blue (BUS graphics)

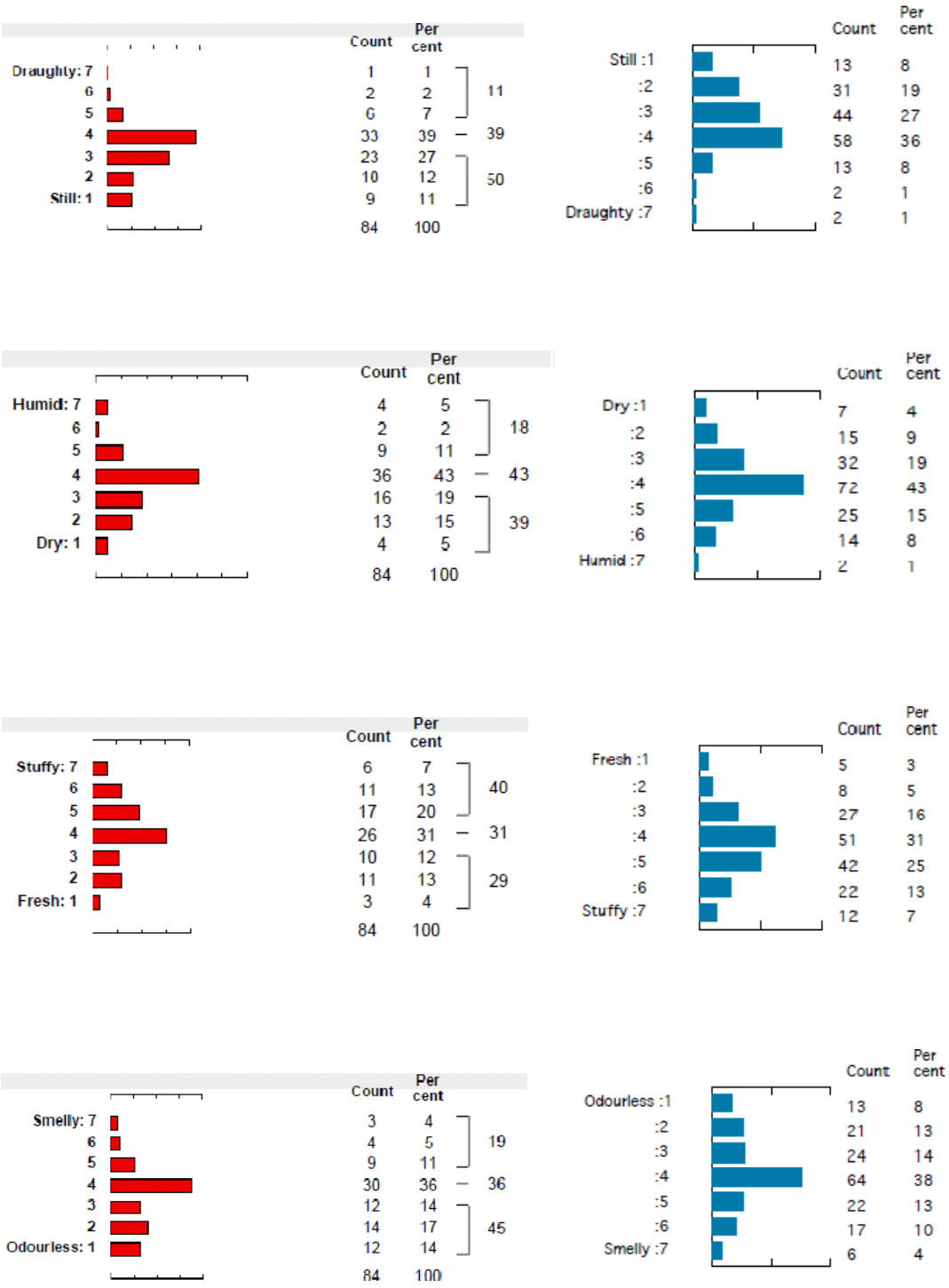
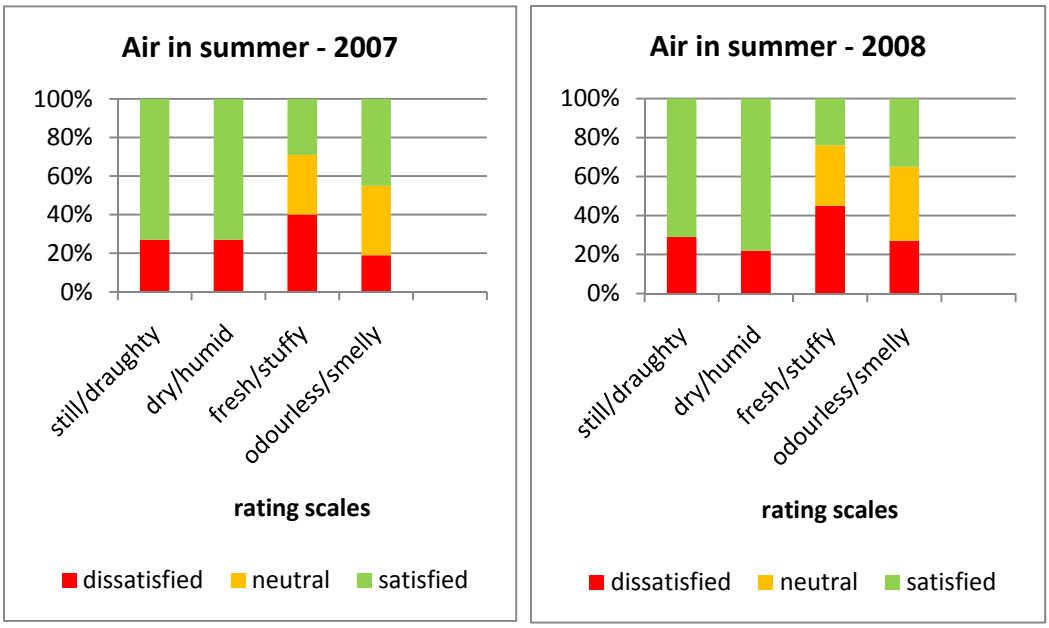


Figure 6.8 Satisfaction ratings for air in summer



For both 2007 and 2008, air in summer was not a major issue with the exception of the dry/humid variable. In 2007, 27 per cent of participants, n. 22/84, were dissatisfied with air movement with 50 per cent, n. 42/84, rating it as still. Twenty-seven per cent, n. 23/84, of participants were dissatisfied with the relative humidity of air in summer with 39 per cent, n.33/84, rating it as dry. Forty per cent, n. 34/84, considered the air in summer stuffy and 45 per cent, n. 38/84, considered it odourless. Air in summer overall was rated as unsatisfactory by 42 per cent, n. 35/84, of participants.

In 2008, 29 per cent of participants, n. 48/163, were dissatisfied with air movement with 54 per cent, n. 88/163, rating air as still. Only 22 per cent, n. 38/167, of participants were dissatisfied with the relative humidity of air in summer, with 32 per cent, n. 54/167, rating the air as dry. Forty-five per cent, n. 76/167, of participants rated the air as stuffy and 35 per cent, n. 58/167, considered it odourless. The BUS traffic light ratings for 2007 were red for air in summer: dry/humid; and amber for all other 2007 air in summer variables. In 2008, there were no red ratings. Air in summer: dry/humid was rated green. All other 2008 air in summer variables received amber ratings (Figure 5.3, page 101).

Air in summer: dry/humid is the only variable to demonstrate a significant difference between 2007 and 2008 in traffic light ratings. Whilst the actual responses show similar levels of satisfaction/dissatisfaction, the inclusion of the benchmark in the traffic light rating creates very different results for the two years. In 2007, the score was below the benchmark, resulting in a red rating; and in 2008, it was above, with a consequent green rating.

Consistent with the predominance of the amber rating, which indicates a lack of strong satisfaction or dissatisfaction, the issue of air received few strong or detailed comments in response to the questionnaire's open-ended questions. It was also only briefly discussed in focus groups and interviews.

There were some comments about draughts in winter. For example:

> When the building is cold and draughty (even with my coat and scarf) which it is in places, I feel like I could get sick from working in the building (Health, 2007).
>
> … the school is draughty, so you do go home and feel like you're getting a cold sometimes(Health, 2007).

Materials and finishes in the building were chosen to avoid or minimise off-gassing and this would contribute to the rating of air as odourless. However some comments on health mentioned toxic smells, and it is possible these came from activities in the workshop rather than the building itself.

> This is the first UTAS building that I've walked into that I didn't smell any off-gassing (Staff focus group, 2007).
>
> Odours from workshop—sometimes strong (Health, 2008).
>
> Lots of rooms smell of glue, toxic smells (Health, 2007).
>
> Computer lab odours, smells (Health, 2007).

The building's fresh air was appreciated by participants. The building has 100 per cent fresh air intake in its ventilation system and relies on natural ventilation for the open spaces. The fact that it is also a 'leaky' or draughty building would contribute to the freshness of the air and the lack of smells.

… it provides a lot of fresh air … (Building design overall, 2008).

Fresh air (Work well, 2008).

Leaky air (Building design overall, 2008).

It's leaky on the east and west elevations and if you're sitting next to a window it's draughty and you can feel cold. Therefore you don't sit next to windows (Fay interview, 2009).

The building breathes—it's not sealed. Some offices have better cross ventilation but this is a disadvantage in winter. The offices are draughty in winter (Staff focus group, 2007).

However the lack of fresh air and poor ventilation in enclosed spaces such as offices, tutorial rooms, lecture theatres and computer labs was commented on and formed the majority of negative comments about air:

Ventilation—not usually stuffy except for computer labs (Work well, 2007).

The computer room has really poor ventilation (Hinder effective working, 2007).

Some spaces (tutorial rooms) poorly ventilated (Facilities meeting needs, 2007).

Not enough ventilation in most rooms (i.e. lecture theatre and computer lab) (Hinder effective working, 2008).

Needs better ventilation in offices (Facilities meeting needs, 2008).

6.4 Conditions overall in winter and summer (includes temperature and air)

Figure 6. 9 Conditions overall in winter ratings: 2007 - red, 2008 – blue (BUS graphics)

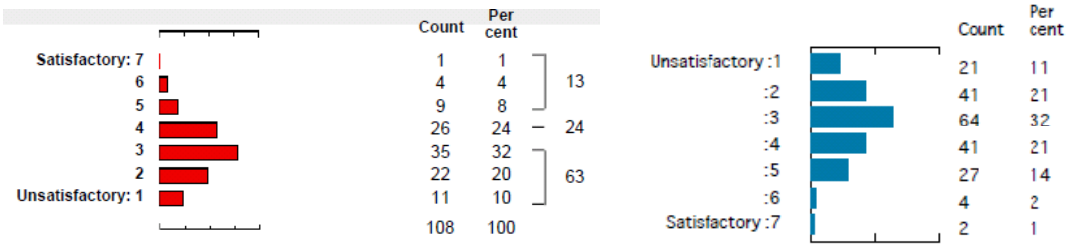


Figure 6.10 Conditions overall in summer: 2007 – red, 2008 – blue

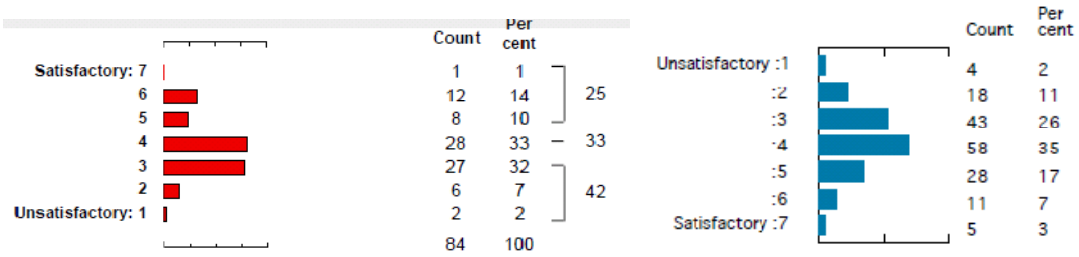
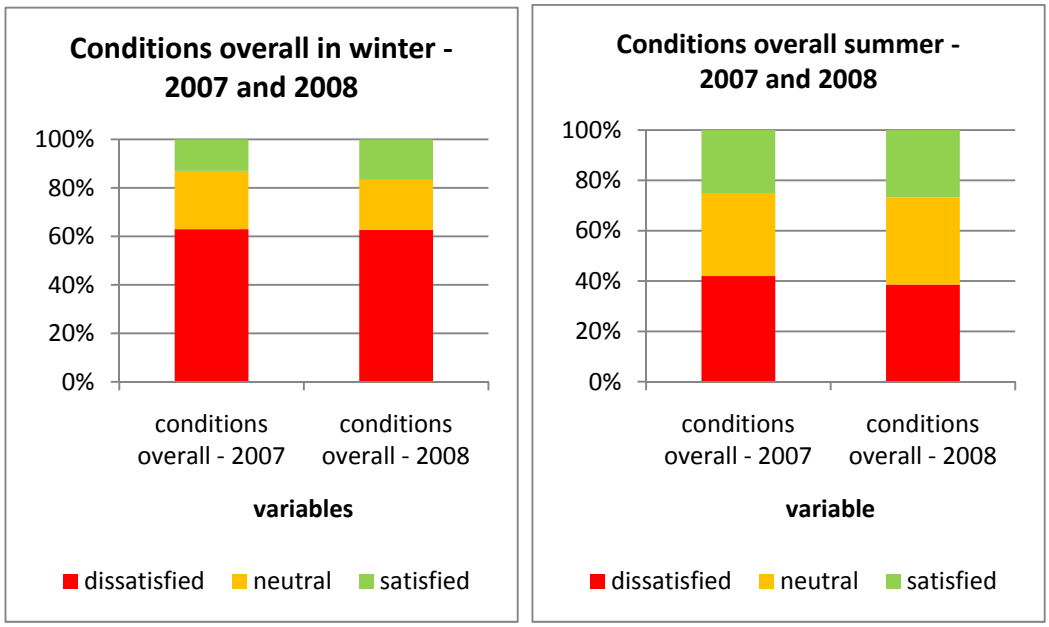


Figure 6.11 Satisfaction ratings for conditions overall in winter and summer



In the BUS, this question is located in the section with questions on temperature and air and asks participants to rate 'Conditions in winter' and 'Conditions in summer' on a scale from unsatisfactory overall to satisfactory overall. I have assumed that participants would interpret the word 'conditions' as meaning the combination of temperature and air which is equivalent to thermal comfort and indoor air quality.

Conditions overall in winter in both 2007and 2008, were rated as very unsatisfactory with 63 per cent, n. 68/108, and 64 per cent, n.126/200, respectively dissatisfied. Conditions overall in summer were rated as slightly

unsatisfactory in both 2007 and 2008, with 42 per cent, n. 35/84, and 39 per cent, n. 65/167, respectively dissatisfied.

The BUS traffic light rating for conditions overall in winter were red for both 2007 and 2008 and for conditions overall in summer were amber for both 2007 and 2008 (Figure 5.3, page 101).

According to Professor Fay, the strategy for thermal comfort was to provide cost effective, environmentally sustainable strategies such as radiant heating, which heats people not air, and natural ventilation for cooling. The other important strategy is that occupants have been expected to adapt by wearing appropriate clothing, choosing appropriate work areas and being more active. Fay feels that these strategies have provided acceptable comfort for most of the year, but accepts that very hot and very cold days are uncomfortable. This acceptance of some days of discomfort has been necessary to avoid the use of air conditioning. Air conditioning has been used only in the two computer labs due to the heat generated by the equipment (Fay, 2009, interview.).

Professor Fay was disappointed that there was not a significant change in the questionnaire results for thermal comfort between 2007 and 2008. He noted that there were a number of teething problems with the heating and cooling systems during 2007 which were rectified before the 2008 survey. Other improvements had also been carried out, including installation of carpet and radiant heaters in the ground floor studios and sealing gaps around the windows (ibid). One of the early problems was that the louvres in the roof lights were not opening and hot air could not escape, so 'the building just got hotter and hotter' (Norrie, pers. comm.). This spike in temperature occurred during one of the hottest summers in Launceston but was rectified before the 2008 survey. In the comments received in the 2008 questionnaire, there was little acknowledgement that the changes had been effective in improving

thermal comfort. For example, from the comments on factors that hinder effective working:

> Louvres don't really work during summer, causing overheating. 3rd floor gets really hot during sometime of each day.

And from comments on overall comfort:

> During winter, heaters on during the day are too hot. After hours heaters consistently fail. Too hot in the day, too cold at night and this in most work areas in the building.

However some 2008 questionnaire comments on comfort overall were positive about the improvements:

> The building is very cold but my office has been equipped with an extra heater so it is fine now.
>
> It's improving.

Students in the 2008 focus group were also positive about some improvements:

> Carpet has definitely helped to make the place feel warmer.

In summary, dissatisfaction with thermal comfort is a significant issue in the building, with strong dissatisfaction being expressed with internal temperature in the rated-response questions. Negative comments about temperature also featured prominently in response to open-ended questions on design overall, needs overall, hinder effective working, perceived productivity, health and requests for changes. Although air contributes to thermal comfort, the level of satisfaction in expressed in rated –response questions was higher than for temperature. In the open-ended questions, ventilation was mentioned as having both a negative and positive impact on health.

6.5 Noise

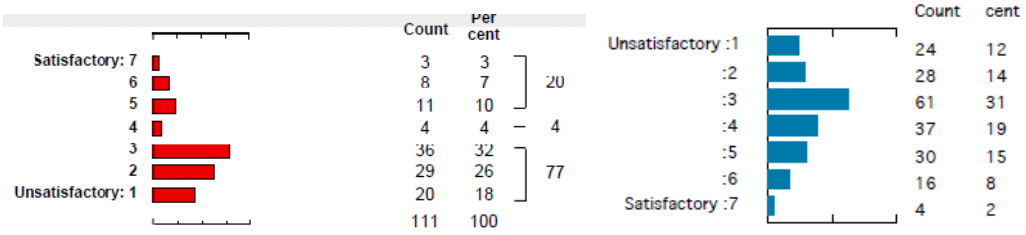
There were six rated-response questions about noise and its sources in the questionnaire and space to write comments about it. Participants were asked to rate noise as follows:

Noise overall	Unsatisfactory….Satisfactory
Noise from colleagues	Too little……Too much
Noise from other people	Too little……Too much
Other noise from inside	Too little……Too much
Noise from outside	Too little……Too much
Unwanted interruptions	Not at all……Very frequently

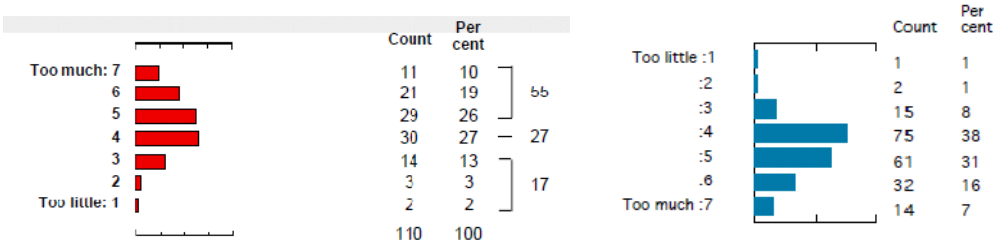
Apart from noise overall and unwanted interruptions, most noise variables have a centred rating scale. This finding supports the concept that some noise contributes to the vitality of a building and its 'sense of buzz' (Fay, pers. comm.). That buzz is a necessary component of the interaction associated with learning and team work; still allows for aural privacy for small groups; and contributes to spatial orientation in the building. The importance of ambient noise in the indoor environment has been recognized with the use of muzak and white noise in sealed, air conditioned, open plan offices.

Figure 6.12 Noise ratings: 2007 – red, 2008 – blue (BUS graphics)

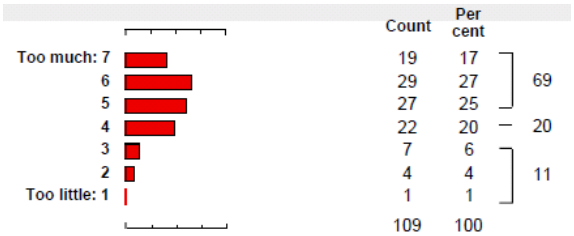
Noise overall



Noise from colleagues

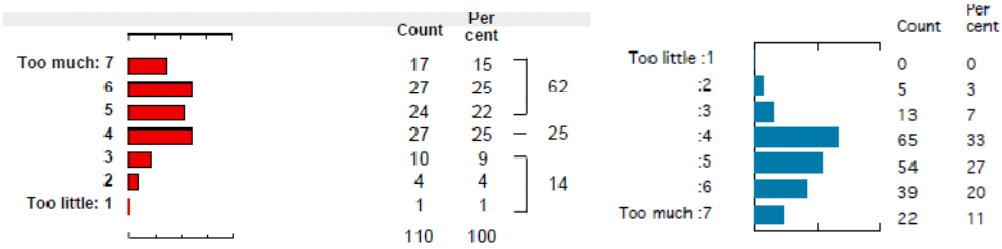


Noise from other people

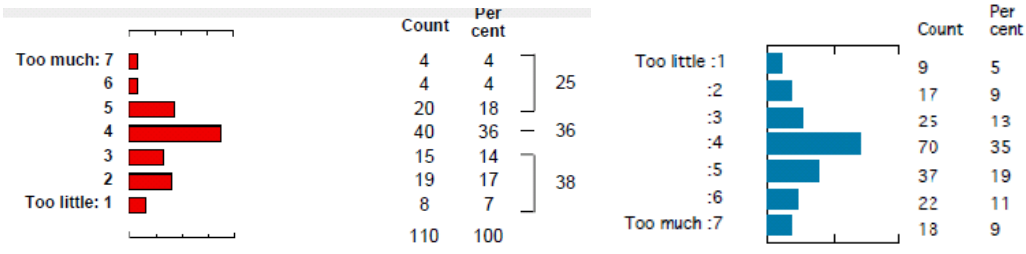


BUS graph for 2008 not supplied.

Other noise from inside



Noise from outside



Unwanted interruptions

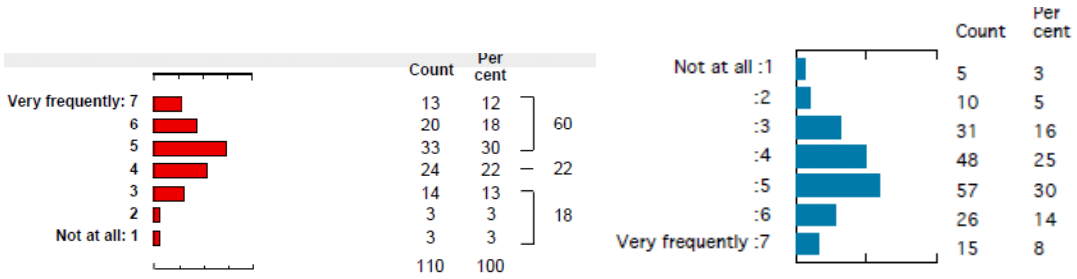
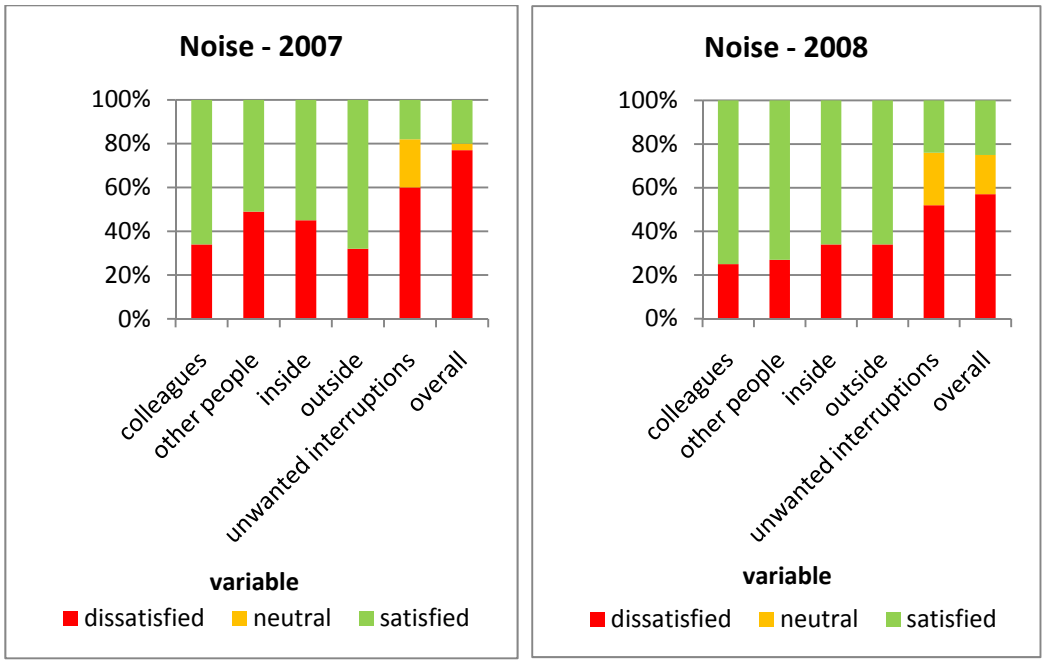


Figure 6.13 Satisfaction ratings for noise



In 2007, 34 per cent of participants, n. 38/110, were dissatisfied with the amount of noise from colleagues with 29 per cent, n. 32/110, considering there was too much noise and interestingly 5 per cent considering there was too little. Some 49 per cent, n. 53/109, of participants were dissatisfied with the amount of noise from other people with 44 per cent, n. 48/109, considering there was too much noise and 5 per cent considering there was too little. Of participants, 44 per cent, n. 49/110, were dissatisfied with the amount of other noise from inside with 40 per cent, n. 44/110, considering there was too much noise and 5 per cent considering there was too little.

Some 32 per cent, n. 35/110, were dissatisfied with the amount of noise from outside with 24 per cent, n. 27/110, considering there was too little noise from outside and 24 per cent considering there was too little; 60 per cent, n. 66/110, of participants considered there were frequent unwanted interruptions and 6 per cent considered there were none. Noise overall was considered unsatisfactory, with 77 per cent, n. 85/111, dissatisfied.

In 2008, 25 per cent of participants, n. 49/200, were dissatisfied with the amount of noise from colleagues with 23 per cent, n. 46/200, considering there was too much noise and 2 per cent considering there was too little. Some 27 per cent were dissatisfied with the amount of noise from other people[1]; 34 per cent, n. 66/198, were dissatisfied with the amount of other noise from inside; and 31 per cent, n. 61/198, considered there was too much noise. 3 per cent thought there was too little noise from inside. Of participants, 34 per cent were dissatisfied with the amount of noise from outside with 20 per cent, n. 40/198, considering there was too much noise and 14 per cent, n. 26/198, considering there was too little noise. Some 52 per cent, n. 98/198, of participants considered there were frequent unwanted interruptions and 8 per cent considered there were none. Noise overall was considered unsatisfactory with 57 per cent, n.113/200, dissatisfied.

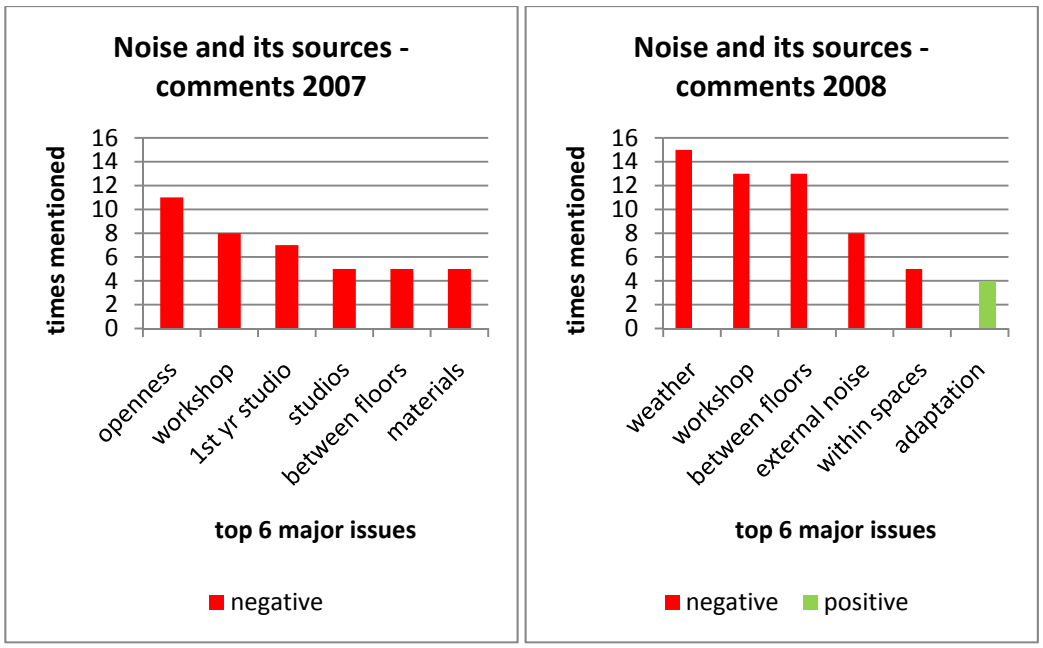
The BUS traffic light ratings for noise for both 2007 and 2008 were red for all noise variables; this indicates the significance of problems with noise in the building (Figure 5.3, page 101).

With the exception of noise from other people and noise overall, the results for both years are similar. The improved rating for noise overall in 2008 may be attributed to improvements such as the installation of carpet in the

[1]Full details for this variable were not provided by BUS

ground floor studios, sealing around roof lights in the top floor studio and better management of workshop operations. For all variables too much noise rather than too little noise was the problem, except in the case of noise from outside in 2007. In 2008 a significant number of participants thought there was too little noise from outside; this finding may be attributed to the fact that outside noise allows occupants to connect with the external environment and that much of this noise (for example, weather noise) would be associated with natural processes. Some of the comments indicated an appreciation of weather noise (see example below). Recall here that connection with the natural environment is known to contribute to restoration and well-being (Kaplan, 1998).

Figure 6.14 Major issues in responses to open-ended question on noise



Comments in response to the open-ended questions in the questionnaire and comments from focus groups and interviews provided more detail on the extent of noise, its sources and the impact of noise. The openness of the building; hard surfaces, especially on floors; circulation areas; noise from the workshop; noise from weather; ambient noise from building services; and the impact of noise on teaching and learning were commented on.

The openness of the building and the hard surfaces allow noise to be reflected and carried throughout the building. This problem is pronounced in the studios, which have no separation from noise sources such as the circulation areas where noise is generated by people moving through the building.

> The studio area is just too large and exposed. Sound could reach almost anywhere (Noise and its sources, 2008).
>
> It's great having the openness between the studios and circulation, but sound-wise it's terrible (Student focus group, 2007).
>
> Excessive noise within multi-storey studio space (Hinder effective working, 2007).
>
> Open plan learning spaces without anything that attempts to absorb sound makes the whole building loud (Noise and its sources, 2007).
>
> Big open space + circulation = too much noise (Noise and its sources, 2007).
>
> Large open atrium space, hard surfaces, no control over ambient noise (Noise and its sources, 2007).
>
> In the 4th year studio the acoustics are very bad. There is noise from the computer lab below and the plant room. The noise from services in the building is frustrating in the lecture theatre (Noise and its sources, 2007).
>
> In the 4th year studio, noise from workshop machinery and computer labs below mean you can't hear lectures in the studio (Student focus group, 2007).
>
> You can't hear anything in the 2nd year studio—first years make a lot of noise (Student focus group, 2007).

The design decision to retain the industrial aesthetic of the existing building and create a robust building has resulted in many hard surfaces, unadorned by soft, sound-absorbing finishes. Given the tight budget, this approach was

cost-effective; nevertheless noise generated by the movement of people and furniture is transmitted throughout the building and may be disruptive.

> Noises caused by timber floor, staircase and workshop cause nuisance (Overall comfort, 2007).
>
> Shoes, high heels especially from floor above (Noise and its sources, 2007).
>
> Background noise is quite OK now. Moving of furniture and students (on floor above) is very annoying (Noise and its sources, 2007).
>
> We measured the sound level of ten people standing up from their chairs at once in that studio and it was just a bit less than a jet plane taking off. That's what drives people mad in the offices downstairs (Staff focus group, 2007).
>
> Carpet has definitely helped to reduce noise and make the place feel warmer (Student focus group, 2008).
>
> Walls have ears—you have to understand that. In the male WC you can hear everything being said in the tute room next door—we used to have staff meetings there, but had to move them (Staff focus group, 2007).
>
> The walls between offices must be quite thin because in my office I can hear everything that's going on in adjacent offices very clearly and sometimes this makes it a bit hard to concentrate (Noise and its sources, 2008).

Some students expressed a preference for the smaller rooms which are more enclosed and carpeted. For example:

> There are 5 rooms I like best. The tute rooms and the rooms in the hub—they're the only spaces that are completely isolated from noise (Student focus group, 2008).

Noise from outside was mentioned as a source of disturbance. Such noise included crowd sounds from an adjacent stadium, construction noise, and weather. Weather has the most impact, with wind rattling the metal cladding on the building and rain drumming on the metal roof. Weather noises are most problematic in the top floor studios, but carry through the building.

From my own observations, rain during the 2007 student focus group held in a seminar room on the top floor made hearing the discussion difficult and voices needed to be raised; this was noticeable at the time and later when listening to recordings of the session. Comments about weather noise were made in response to open-ended questions in the questionnaire and also in the focus groups and interviews.

> Rain's a problem in the studio—you can't hear a thing (Student focus group, 2007).

> You can't hear if it rains, the workshop noise fills the building, the noise from the top level to lab travels (Noise and its sources, 2008).

Some of the staff reacted differently from their peers or students in relation to the sound of rain:

> Yesterday it rained … It was absolutely beautiful because the sound of the rain resonating through the building was just gorgeous … (Staff focus group, 2007).

The major source of loud noise within the building is the workshop, which is separated from the ground floor studios by a glass wall. The central and visible location for the workshop responds to the school's requirement that the building express its attributes, disciplinary foci and values. One of these is the 'learning by making' program, which uses the workshop for model making, construction of full scale small buildings and experimental building. The conflicting requirements for a visible workshop and an environment for teaching and learning resulted in an acoustic glass wall separating the workshop from teaching spaces.

> The appropriateness of a glass wall to the workshop was raised at design consultation meetings, but we were told that it would be designed to minimize noise transmission (Student focus group, 2007).

> $600,000 on that glass wall and it's not sound proof! (Student focus group, 2007).

> The workshop should not be in this building. There doesn't need to be a visual connection to the workshop (Student focus group, 2007).

Staff expressed concern about noise from the workshop:

> The router is quarantined, but noise generated by hand tools, circular saw and nail guns were all audible upstairs in the computer lab and the 4th year studio and is one of the reasons the 4th year studio is not used much (Staff focus group, 2007).

Ambient noise was identified as a problem in comments responding to open-ended questions. This was generally related to noise from building services.

> Lots of ambient sound (Hinder effective working, 2007).

> Mechanical services noises that make hearing hard (Hinder effective working, 2007).

> Walls between services and served spaces (lecture room, seminar room, tutorial, computer labs) are thin and provide little in the way of sound insulation (Noise and its sources, 2007).

> Too much noise from building climate control mechanism and low frequency lighting fixture especially in lecture (theatre) when dimmed and in normal setting (Noise and its sources, 2008).

The significant impact that noise had on effective teaching and learning was commented on by students and staff in focus groups, interviews and comments in the questionnaire responses.

> Acoustics make it very difficult to concentrate on research or teaching (Hinder effective working, 2007).

> Sound isolation very poor – too noisy to teach groups in studio. Great when it's raining though! (Hinder effective working, 2007).

> In the 4th year studio last year, we would have whole class discussions and if something was going on in the computer lab or workshop it was just impossible to hear anything. The whole of 4th year just stopped. Now the 5th year studio is (used as the) teaching space. (Student focus group, 2008).

> It is too noisy for tutorials in our 2nd year studio (Facilities meeting needs, 2007).
>
> We did some experiments in the top studio. With two people six metres apart, you couldn't hear what was being said – but that makes it great for small tute groups. So sound dissipation is both positive and negative (Staff focus group, 2007).
>
> I become reclusive and keep the door shut - NOISE is a huge issue (Changed behaviour, 2008).
>
> The 3rd year studio is impossible to use for tutorials. If students come out of the lecture theatre and tute rooms en masse, you can't hear what is being said in the studio (Staff interview, 2007).
>
> If you have the door open (in the tute rooms), noise from outside the room interrupts the class (Student focus group, 2007).

Noise and thermal comfort were rated as the two most significant issues with the building; in rated-responses to the questionnaire, these variables were consistently given the red traffic light rating in the BUS results (Figure 5.3, page 101). Negative comments about noise also featured prominently in comments on overall comfort (2007), design overall (2007 and 2008), needs overall (2007 and 2008), hinder effective working (2007 and 2008) and perceived productivity (2007 and 2008).

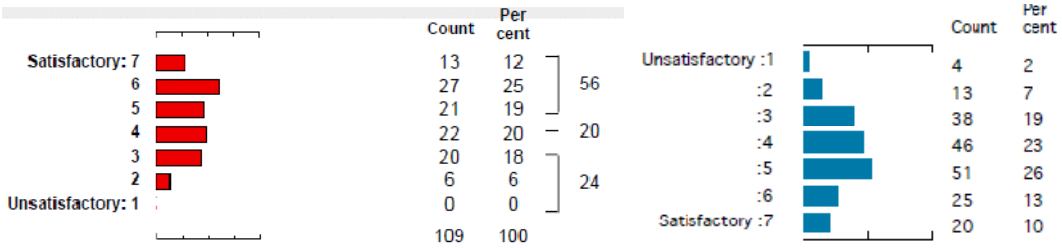
6.6 Lighting

The questionnaire asked participants to rate lighting as follows:

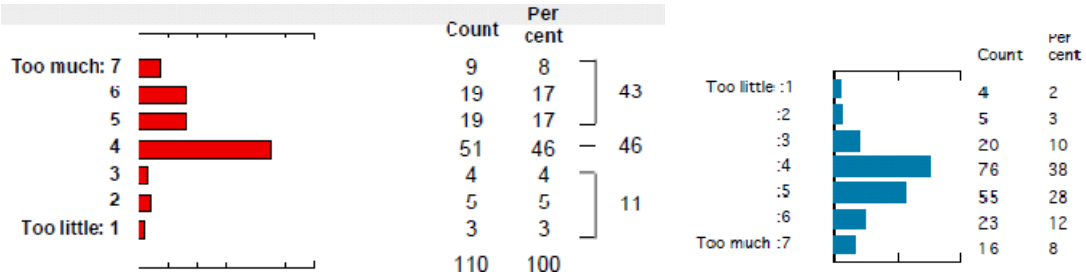
Lighting overall	Unsatisfactory….. Satisfactory
Natural light	Too little…….Too much
Glare from sun and sky	None…….. Too much
Artificial light	Too little…….Too much
Glare from lights	None……...Too much

Figure 6. 15 Lighting ratings: 2007 – red, 2008 – blue (BUS graphics)

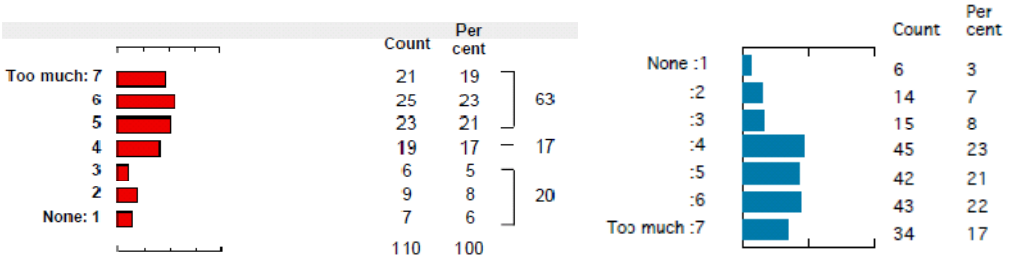
Lighting overall



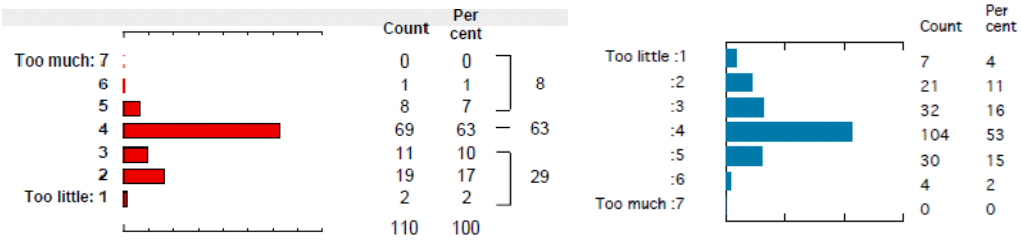
Natural light



Glare from sun and sky



Artificial light



Glare from lights

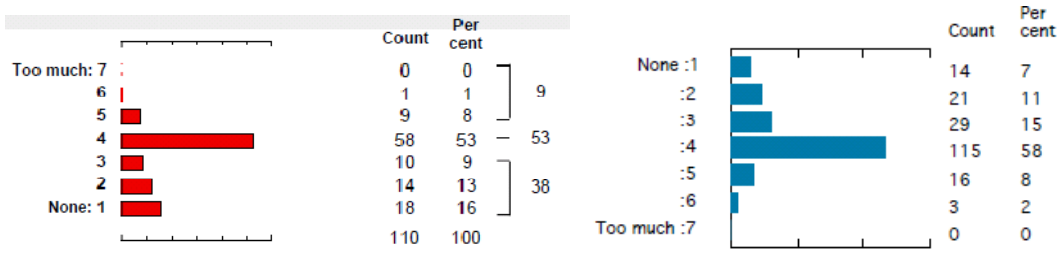
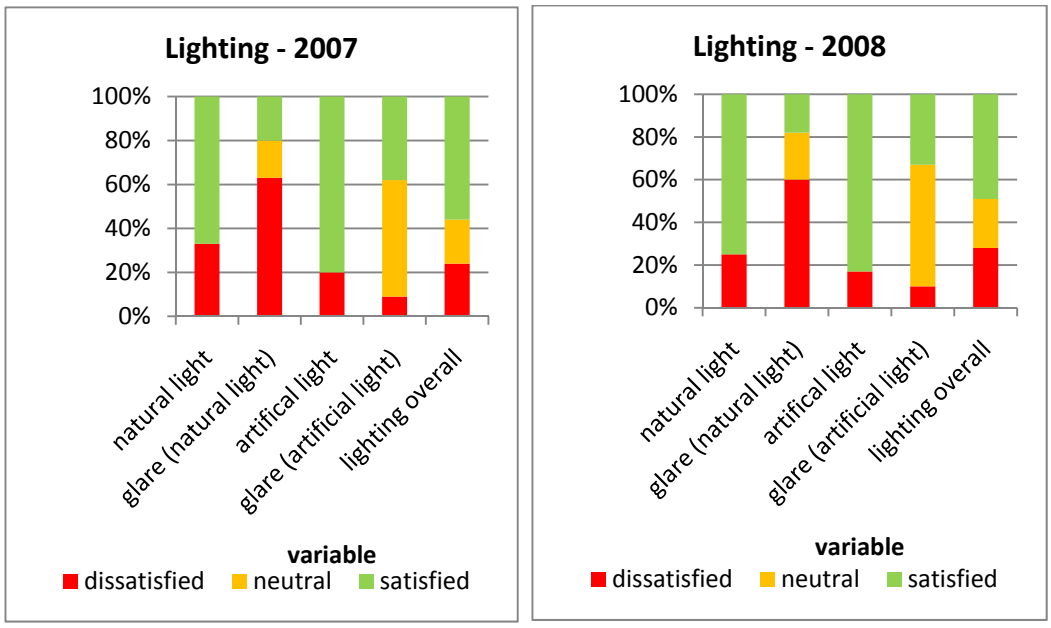


Figure 6.16 Satisfaction ratings for lighting



In 2007, 33 per cent of participants, n. 36/110, were dissatisfied with the amount of natural light with 25 per cent, n. 28/110, considering there was too much; and 63 per cent, n. 69/110, of participants felt there was too much glare from sun and sky. Of participants 20 per cent, n. 22/110, were dissatisfied with the amount of artificial light with 19 per cent, n. 21/110, considering there was too little; and 38 per cent, n. 42/110, considered there was little or no glare from artificial lights. Lighting overall was rated as satisfactory by 56 per cent, n. 61/109, of participants.

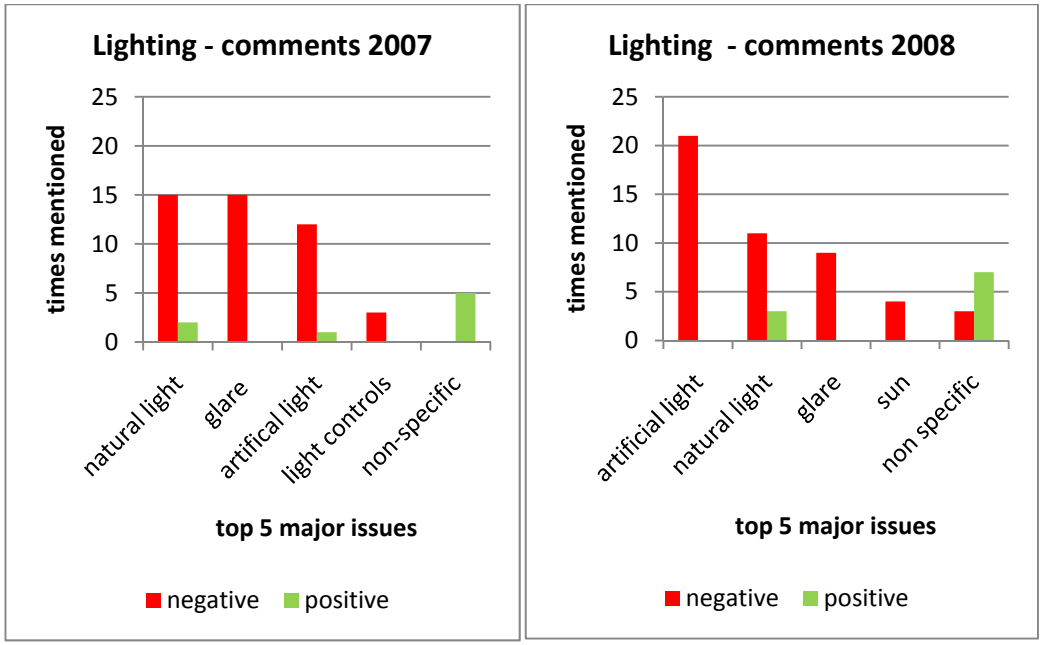
In 2008, 24 per cent of participants, n. 48/199, were dissatisfied with the amount of natural light with 20 per cent considering there was too much; 60 per cent,n. 119/199, felt there was too much glare from sun and sky. Some 17 per cent, n. 32/198, of participants were dissatisfied with the amount of artificial light with 15 per cent, n. 28/198, considering there was too little; and 33 per cent, n. 64/198, considered there was little or no glare from artificial lights. Lighting overall was rated as satisfactory by 49 per cent, n. 96/197, of participants.

Traffic light ratings were red for glare from sun and sky in both 2007 and2008, amount of natural light (too much), and artificial light (too little) in 2008; amber/red for the amount of natural light (too much) and artificial light (too little) in 2007; amber for lighting overall for both years, glare from artificial light in 2008 and green for glare from artificial light in 2007 (Figure 5.3, page 101). The only lighting variable with a difference in traffic light rating between 2007 and 2008 was glare from artificial lights. The slightly better score in 2007 was significantly lower than the benchmark mean, resulting in the green rating; whilst the 2008 score was closer to the benchmark mean, resulting in an amber rating.
Although some of the variables (natural light, glare from sun and sky and artificial light) were rated very negatively, lighting overall was given a more positive score. There appears to be tolerance/forgiveness of inadequate lighting conditions.

There was little mention of lighting in the focus groups and interviews. Most of the comments about lighting were made in the questionnaire. Comments about lighting were made in response to the open-ended question about lighting conditions and also to other more general questions such as design overall, facilities meeting needs, meeting rooms, hinder effective working,

work well, overall comfort, health, perceived productivity, requests for changes and changed behaviour.

Figure 6.17 Major issues in responses to open-ended question on lighting



Glare from sun and sky, natural lighting and poor artificial lighting were the major issues in the questionnaire comments. The amount of natural light was considered excessive by the majority of respondents commenting on lighting conditions, but other participants enjoyed it. The problem of glare is related to the orientation of the existing building, which exposes occupants to penetrating, low-angled morning and afternoon sun and the heritage constraints which prevented installation of sun-shading on the façade. This problem is pronounced in the ground floor studios because of the extensive areas of west-facing glazing. Offices are fitted with blinds, but these reduce cross ventilation and darken the room when drawn. Associated with sun penetration causing glare is the amount of direct sun, about which some participants claimed concern in relation to sunburn and skin cancer.

> Excellent daylighting (Work well, 2007).
>
> Day light at loft level is excellent (Perceived productivity, 2008).

> There is way too much sunlight into studio. In summer we wore sunglasses to see our paper (Lighting, 2007).
>
> Studio space—unsuitable light, need to wear sunglasses at some times and then too dark other times (Hinder effective working, 2007).
>
> Bright and glare from double height glazed curtain wall (Hinder effective working, 2007).
>
> Western wall gives off a LOT of glare (Lighting , 2007).
>
> It's very glarey about 2–3ish (Design overall, 2007).
>
> Sometimes when it's really glarey I get headaches (Perceived productivity, 2007).
>
> I like the natural light and open areas. However, I have to be careful about glare as I suffer from migraine (Health, 2008).
>
> Glare in the building's a problem because of my eyesight (Hinder effective working, 2007).
>
> Window opening very large—can be too glarey or sunny, need to close blind then so dark, need to put light on! (Lighting, 2007).
>
> Shading required—4 hours in sun in summer—skin CANCER (Lighting, 2008).
>
> …. It gets glarey in summer—actually leads to sunburn! (Lighting, 2008).

Participants were critical of the enclosed areas of the building which received either no or minimal amounts of natural light.

> Internal rooms unpleasant due to lack of natural light (Meeting rooms, 2008).
>
> Lighting—not enough in the meeting room space (Hinder effective working, 2007).
>
> Corridors very dark in winter when natural light is low (Lighting, 2007).

In addition, large spaces, and particularly the ground floor studios with the void above, are difficult to light effectively at night. Task lighting in the top floor studios has been successful in addressing this problem, but may also be the cause of the glare which was rated more negatively in 2008 than in 2007.

At night the artificial light is too dark for drawing (Lighting, 2007).

Hard to light studio are at night as there are very high ceilings (Lighting, 2008).

Lighting at night in the large studios is poor (Hinder effective working, 2007).

At night hard to see as lights are above and cast shadow (Lighting, 2008).

Poor lighting in studio at night, hurts your eyes (Hinder effective working, 2007).

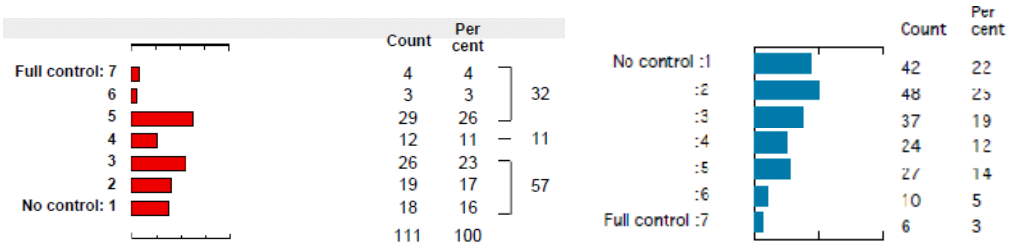
The task lighting in the 3rd and 4th year studios is a great idea at night. During the day most people prefer to be near a window for better light (Lighting, 2007).In summary, lighting was rated as a concern for participants, but was not considered as significant an issue as thermal comfort and noise.

6.7 Personal control over indoor environmental conditions

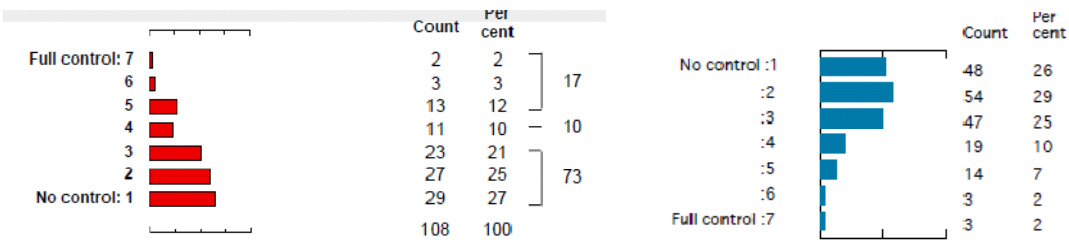
6.7.1 Control over heating, cooling, ventilation

Figure 6.18 Personal control ratings: 2007 – red, 2008 – blue (BUS graphics)

Heating



Cooling



Ventilation

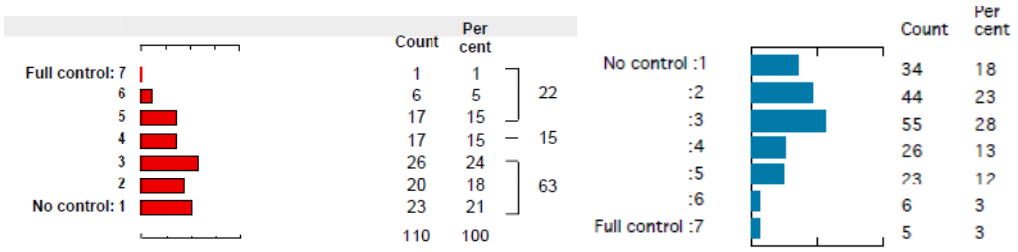
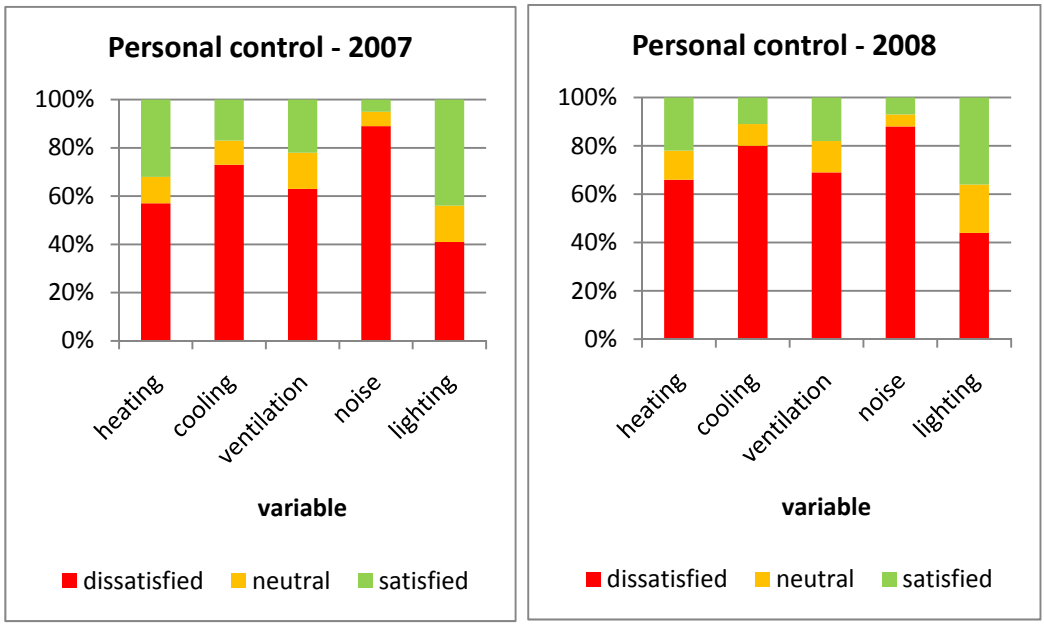


Figure 6.19 Satisfaction ratings for personal control



The majority of participants felt they had little or no control over heating, cooling and ventilation in the building. In 2007, 57 per cent of participants, n. 63/111, felt they had little or no control over heating, 73 per cent, n. 79/108, felt this about cooling and 63 per cent, n. 69/110, about ventilation. However only 39 per cent of participants felt that control over heating was important, 27 per cent felt control over cooling was important and 32 per cent felt control over ventilation was important.

In 2008, 66 per cent, n. 127/194, of participants felt they had little or no control over heating, 80 per cent, n.149/188, of participants felt the same about cooling and 69 per cent, n.133/193, about ventilation. However only 27 per cent of participants felt that control of heating was important, 17 per cent felt that control of cooling was important and 18 per cent felt that control of ventilation was important.

Figure 6.16 shows the satisfaction ratings for personal control of heating, cooling and ventilation. All BUS traffic light ratings for control of heating, lighting and ventilation for both 2007 and 2008 were amber (Figure 5.3, page 101).

Professor Fay admits that he could not be sure that all students understand the building controls.

> We need a user guide to the building with plans of floors, location of switches, how to operate the services and how to access rooms (Fay interview, 2009).

The staff interviewed in 2007 felt that occupant control of the heating and cooling is important for comfort and that it could be something that students learn from. In 2007, staff made the following comments:

> We haven't had a workshop on how to operate the systems. We've got a machine that no-one's given us operating instructions for.
>
> The uni administers and controls who can adjust the sensors. Ideally you would have readouts and occupants could adjust the controls … and then students could learn from it.
>
> It took one and a half months to find out where the switches were and it came from a Honeywell[2] person who was very reluctant to divulge the information.
>
> The louvers in the roof have two switches, one upstairs and downstairs. They're enticing buttons and when students get frustrated at the lack of heating, they think pressing the button might help—it actually opens the louvers and cools the building.

[2]Honeywell is the manufacturer and installer of heating, cooling and air-conditioning systems.

> The tute rooms have very long heaters. I think the students turn them on high at night and don't turn them off when leaving. It's very hot next morning.

Students in the 2007 focus group admitted they were uncertain about operating controls:

> We don't know how to operate the vents.
>
> There's a sign at the bottom of the stairs "This button will not make you hot."
>
> There's a button and someone accidently presses it every now and again and we all go AAAAH!

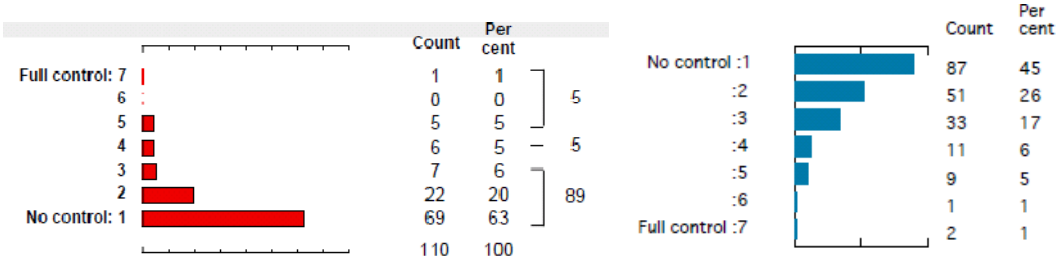
Some students in the 2007 focus group knew how to operate the louvres but were critical of the fact that the switches are not obviously related to the mechanisms they control.

> The two sets of louvres are controlled by switches—one side upstairs and one side downstairs. You have to call out from downstairs to see if the louvres are working.

Poor ratings for control over heating, cooling and ventilation have been explained by a lack of understanding about controls, but the term 'control' may not have been fully understood by participants. According to Leaman and Bordass (2005) control can also include simple adjustments to equipment, furniture and fittings such as blinds. This type of control may be thought of as a form of adaptation and is discussed in the next section. It is difficult to understand why more participants did not feel control of heating, cooling and ventilation was important. I suggest that it is due to their inexperience of, and lack of knowledge about, other medium to large scale sustainable buildings where occupant control is a feature.

6.7.2 Control over noise

Figure 6.20 Control over noise ratings (BUS graphics)



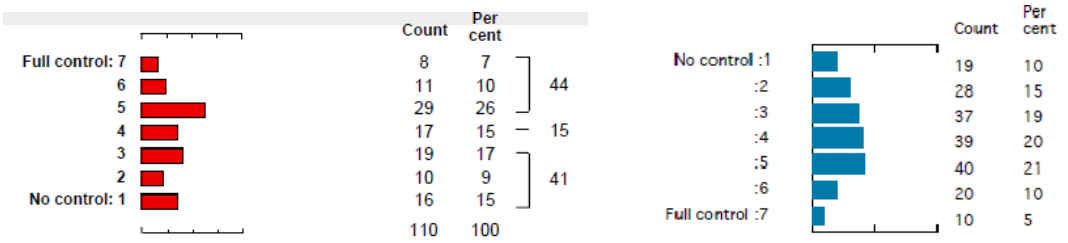
The majority of participants felt they had no control over noise in the building. Perceived control was rated significantly lower than both the benchmark limit and the scale midpoint for both 2007 and 2008. In 2007, 63 per cent of participants, n. 69/110, rated their degree of control as none, and in 2008, 45 per cent, n.87/194, also rated their control of noise as none; whilst 89 per cent, n. 98/110, and 88 per cent, n. 171/194, in 2007 and 2008 respectively were dissatisfied with the amount of control. However only 31 per cent of participants in 2007 and 15 per cent of participants in 2008 felt control over noise was important.

Figure 6.16 shows the satisfaction rating for personal control over noise. The BUS traffic light rating for control of noise was red for both years (Figure 5.3, page 101).

It is difficult to understand why the importance of control was not rated more positively, given the poor ratings for noise in the building and control of noise; and the significant impact noise was seen to have on effective working and productivity.

6.7.3 Control over lighting

Figure 6.21 Control over lighting ratings: 2007 - red, 2008 – blue (BUS graphics)



In 2007, 41 per cent of participants, n. 45/110, felt they lacked control over lighting, and in 2008, 44 per cent, n. 84/191, also felt they lacked control over lighting (Figure 6.16). In 2007, 32 per cent of participants felt control over lighting was important, but in 2008, only 23 per cent felt control over lighting was important. Figure 6.9 shows the satisfaction rating for personal control over lighting. The BUS traffic light rating for control over lighting was amber for both years (Figure 5.3, page 101).

Given that most lights are sensor operated, the only controls for natural light are the blinds on office windows and only task lighting has individual control, the participant response to the degree of control is understandable. However the low positive response to the importance of control over lighting is difficult to understand.

6.8 Adaptation

Although there was no question about adaptation in the questionnaire, adaptive measures to alleviate discomfort and achieve comfort were mentioned in the comments responding to open-ended questions, and in the focus groups and interviews. Adaptation is an important aspect of comfort and some aspects of adaptation can be considered as means of control over indoor environments. Adaptation to achieve comfort occurs at both personal and building scales. Examples of personal adaptation mentioned in

comments or observed on my visits to the building include wearing more or less clothing, wearing sun glasses, using equipment such as a beach umbrella for shade, ensuring the use of task lighting or personal heaters, placing cardboard on office windows, closing blinds, opening windows, opening louvres, or using headphones to block out noise. Professor Fay, who personally found all parts of the building comfortable, has explained that he is prepared to adapt to the conditions by wearing appropriate clothing. He gave the example of students wearing shorts and T shirts in winter in the building. He also spoke of the need to adapt to the building's acoustics by modulating voices (Fay, 2009, interview).

Plate 6.1 Adaptive behaviour: 2007 (left), 2008 (right). Author's photos.

Comments illustrating adaptation on a personal scale include:

> Good when you have layers on and shade provided (Comfort overall, 2007).
>
> Put on jacket inside in winter (Changed behaviour, 2008).
>
> More/less clothing (Changed behaviour, 2008).
>
> Headphones and warm clothes in winter (Changed behaviour, 2008).
>
> Sunglasses need to be worn in 2nd year studio in summer (Design overall, 2007).
>
> You dress for the climate, so when you enter the building, it shouldn't be a complete shock (Student focus group, 2007).

> The blinds are not good. Staff use cardboard on the windows. But this adaptation adds to the identity of the building (Staff focus group, 2007).
>
> Headphones are needed at times (Perceived productivity, 2008).

Adaptation can also involve moving from one space to another to suit context; for example, using the enclosed tutorial rooms or computer labs at night because they are warmer than colder open studio spaces. The building's flexibility in terms of spatial variety facilitates adaptation. The range of temperatures existing at one time within the building was identified as a problem in that occupants dress for one situation and then experience different temperatures in different parts of the building. However, it could also be seen as an advantage in that not everyone has the same comfort experience and the variety allows occupants to find a comfortable place somewhere in the building.

> Lots of students are using the learning hub during the day as offices. They like it because it's quiet. Others like those two tute rooms upstairs. Others make a little community in front of the window. D___ likes to sit in the corridor. People find space that suits them (Staff focus group, 2007).
>
> Group rooms in learning hub are great for getting away and working quietly (Work well, 2007).
>
> Keeping warm sometimes necessitates moving spaces (Facilities meeting needs, 2007).
>
> Move to smaller, easier to heat rooms when cold (Changed behaviour, 2008).
>
> Have to move frequently to avoid sun in studio in summer (Changed behaviour, 2008).
>
> Move around more often to seek fresh air (Changed behaviour, 2008).
>
> A lot of students spend most of their time in the computer labs and actually set up their workspace there. It's a nicer place to be. It's warmer (Student focus group, 2007).

> Most of us set up in the 3rd year area. The 3rd year studio has lots of light, that's why we use it (Student focus group, 2007).
>
> In the 4th year studio last year, we would have whole class discussions and if something was going on in the computer lab or workshop it was just impossible to hear anything. The whole of 4th year just stopped. Now the 5th year studio is (used as a) teaching space (Student focus group, 2008).

Adaptation also occurs at the building scale to improve comfort. Changes between the 2007 and 2008 surveys included installing carpeting on the ground floor which reduced noise and increased thermal comfort; installing radiant heaters in the ground floor studios; replacing window glass; sealing around windows; and partially glazing internal walls on the second floor to allow natural light into the CSAW area. Professor Fay and staff spoke of plans to build a mezzanine floor over part of the ground floor studios to accommodate increased numbers of students. This change would have the advantage of reducing the large space to reduce heat loss and provide shade to the ground floor studios; providing a location for fixing radiant heaters close to work areas in the ground floor studios; and reducing the transmission of noise throughout the building.

The ability of the building to be adapted provides opportunities for students to learn.

> We have the capacity to understand how the building works and adapt it. It's a great learn, it makes great projects for the future. One of the values of the building is that it can be adapted. Tinkering with the building is really exciting (Staff focus group, 2007).
>
> I think as we learn to use the building better, more spaces will work well (Work well, 2007).

While adaptation was practiced by many occupants of the building, a number of participants felt it was an inconvenience and that it should not be necessary.

> We are told to dress for winter, but there's nothing else I can put on! (Student focus group, 2007).
>
> You need to be comfortable to work effectively. Putting on three jumpers isn't acceptable (Facilities meeting needs, 2007).
>
> Can move around building to get most comfortable space. Would be nice not to have to move! (Perceived productivity, 2008).

Professor Fay attributed an apparent unwillingness to be adaptive to what he sees as narrow comfort expectations, these having developed in people by their being accustomed to buildings which are centrally heated day and night. Only a few decades ago, it was uncommon for houses to be centrally heated, whereas now either central heating or extensive gas or heat pump heating are standard and would be considered normal by many students too young to have experienced otherwise. Fay believes that in a resource-constrained world people need to look at what can be done to tolerate temperature variations and still be comfortable. This need to extend comfort expectations in order to achieve the broader goals of sustainability is also supported in the literature (Chappells and Shove, 2005, Strengers, 2008,)

6.9 Comfort overall

The BUS asks participants to rate the overall comfort of the building environment 'all things considered'. Figure 6.10 illustrates the response.

Figure 6. 22 Comfort overall ratings: 2007 – red, 2008 – blue (BUS graphics)

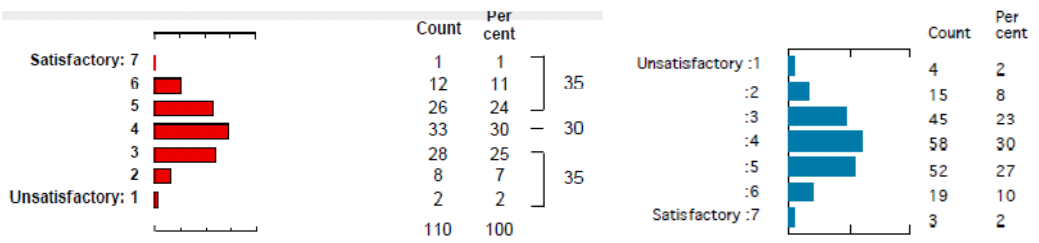


Figure 6.23 Satisfaction ratings for comfort overall

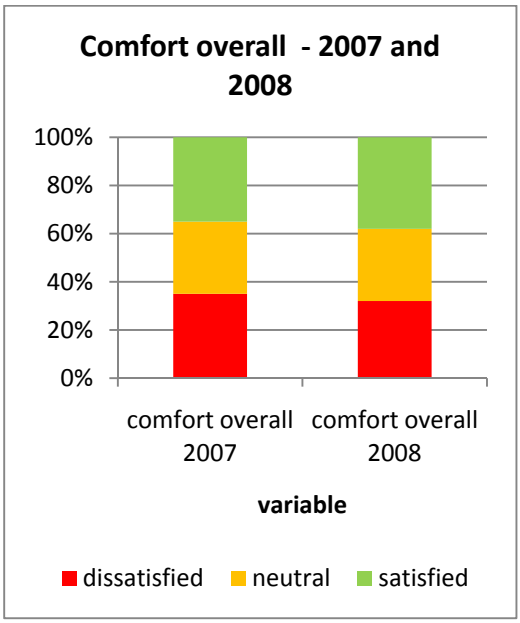
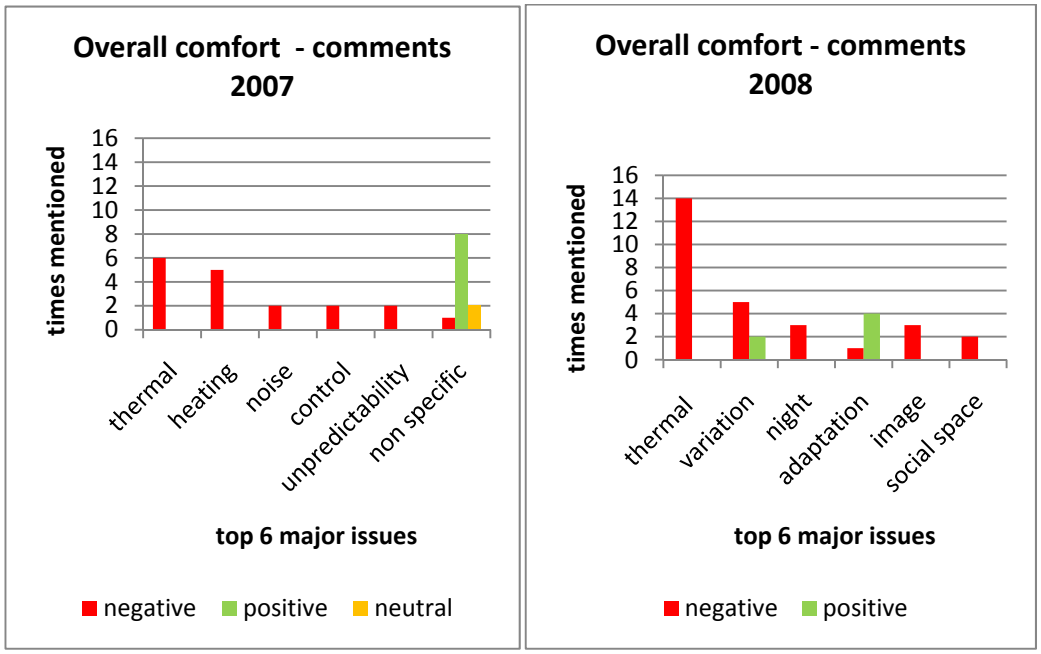


Figure 6.24 Major issues in responses to open-ended question on overall comfort



In 2007, the score was significantly lower than the benchmark limit but no different from the scale midpoint, with equal satisfaction and dissatisfaction of 35 per cent, n. 38/110. In 2008, the score was below the benchmark limit but close to the scale midpoint, with 39 per cent satisfaction, n.74/196, and 33 per cent dissatisfaction, n. 64/196. In summary, the participants rated the

overall comfort of the building as predominantly neutral and neither strongly positive nor strongly negative. This result is a more positive response than the very negative ratings for the specific comfort variables, especially those of temperature and noise.

The rating for comfort overall does not reflect the negative ratings for the specific comfort variables, the frequency of negative statements about thermal comfort and noise in the questionnaire comments and the amount of negative discussion about thermal comfort and noise issues in the focus groups and interviews.

Such apparent inconsistency may be explained by several factors. First, overall evaluations are subjective and multi-dimensional, involving participants balancing a number of positive and negative aspects of the environment. There are likely to be other aspects affecting their overall evaluation besides the specific variables previously rated. Research has shown that dissatisfaction with specific comfort variables does not necessarily lead to dissatisfaction with the overall comfort of the environment (Humphreys, 2005).

Second is the fact that the rated-response questions on temperature and air only ask about the two climatic extremes of winter and summer. The academic year runs from February to October with a six week winter semester/non-teaching period in June and July; the majority of occupants (students) are only in the building during the main semesters from February to end May and from mid-July to late October. Although these periods include both the hottest and coldest months—February and July respectively—much of the academic year includes the temperate periods of autumn and spring. Although the more specific questions focus on the climatic extremes, the rating of comfort overall would take the whole academic year into account.

Some of the focus group discussion, which was held in spring, illustrated this reckoning:

> At this time of year, the building is quite pleasant to work in. In the fifth year studio, you can open a window and there's a nice breeze and its good light. Today is quite nice, there's no rain so you can hear everything (Student focus group, 2008).

Third, having perceived control over environmental conditions is known to improve occupant perception of comfort (Leaman and Bordass, 2005). While not strongly positive, the degree of control over all environmental conditions except noise was rated as reasonable by participants. There is also evidence of adaptation which may be considered a form of control to alleviate discomfort.

Fourth, comfort is a condition of mind in which aesthetics, materials and finishes are known to affect perception of comfort (Ohta et al., 2008, Rohles, 2007) and I propose that aesthetics, design and image were influential in participants' overall comfort evaluations.

Fifth, forgiveness is common, suggesting tolerance of discomfort and satisfaction with comfort overall, especially in sustainable buildings (Baird, 2010, Leaman and Bordass, 2005). These data demonstrate support for the concept of forgiveness, which is discussed in detail in a following chapter.

The BUS Comfort Index is calculated from the scores for the following questionnaire variables: comfort overall, temperature in winter overall, temperature in summer overall, air in winter overall, air in summer overall, noise overall and lighting overall. The formula for calculating the Comfort Index uses the Z scores for these variables. Z scores are derived from (actual score-benchmark) / (benchmark standard deviation) and are standardized scores with mean = 0 and standard deviation = 1, and are used to give equal weighting to the variables. The formula is:

(Z comfort + Z light + Z noise + Z temp winter + Z temp summer + Z air winter + Z air summer)

7

Values range from -3 to +3 (Baird, 2010). The Comfort Index for this building was -0.95 in 2007 and -1.09 in 2008, both well below the scale midpoint of 0.

The lack of correlation between the Comfort Index and comfort overall may be explained by the dependence of the Comfort Index on the scores for specific comfort variables (in this case mostly poor scores), whereas comfort overall is a subjective evaluation which is likely to include a range of other aspects besides the specific comfort variables.

6.10 Chapter summary

Table 5.3 (page 101) summarises participants' responses to the rated-response questions dealing with comfort, using the BUS traffic light rating. It can be seen that temperature in winter and noise are considered the most significant issues with the building. Comments in the questionnaire responses and in interviews and focus groups reinforce this (see Figure 5.5). Specifically the building is considered too cold in winter, too hot in summer and too noisy. Participants considered there was too much glare from sun and sky, too much natural light and too little artificial lighting. They considered they had little or no control over noise, but some control over heating, cooling, lighting and ventilation. The operation of the controls was not well understood and there is a need for greater awareness of the design intent of the building and how to operate it.

There is evidence of adaptive comfort. Participants are adjusting their clothing, using accessories, using blinds and other shading devices and moving to more comfortable spaces. Adaptation is also taking the form of

making incremental changes to the building and this is being used as a learning opportunity for the students.

The BUS Comfort Index, based on the scores for the specific comfort variables, was relatively low. However comfort overall, which is a subjective evaluation, was rated more positively in spite of the low scores for many of the comfort variables and the negative comments about comfort. This finding supports the concept of forgiveness, which describes tolerance of discomfort, and is characteristic of sustainable buildings.

Chapter 7 Delight

7.1 Introduction

In this chapter data that provide evidence for occupant satisfaction with the building are presented, analysed and discussed. The Oxford Dictionary defines *satisfaction* as 'fulfilment of one's wishes, expectations or needs or the pleasure derived from this' and *delight* as a 'cause or source of great pleasure'. Delight, here meaning the pleasure derived from satisfaction in occupying the building, is one of three main themes of this research, and the focus of this chapter.

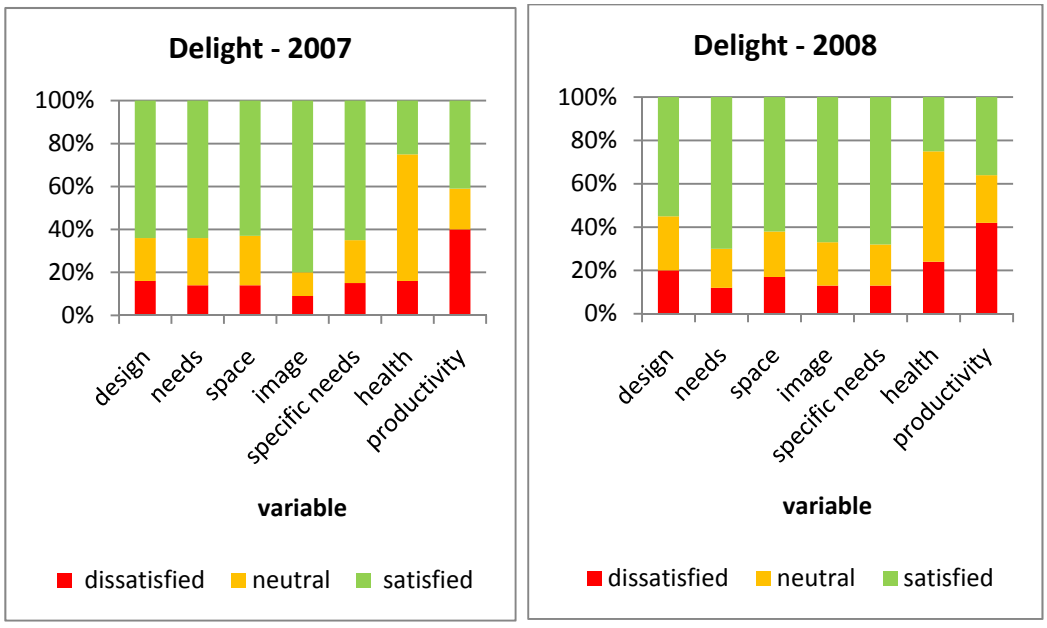
The purpose of the chapter is to understand participant satisfaction with the building, especially in light of contrary evidence discussed in Chapter 6. The overview of results in Table 5.3 (page101) shows a clustering of positive scores for several variables: design overall, image, effective use of space and facilities meeting needs in the building as a whole and for participants' specific work requirements. What causes such positive scores and consequently what causes delight with the building? Is it possible that this 'affect' is focused on the image of the building and its spatial and aesthetic qualities more than on quantifiable comfort characteristics such as temperature, relative humidity, air movement, lux and decibel levels? Further, in anticipation of the chapter to follow, what might these tensions reveal about the capacity to forgive and how is this relevant to sustainable architecture?

This chapter covers those sections of the questionnaire relating to overall evaluation of the building and its ability to provide an appropriate work

environment for learning and teaching. Consideration of productivity and health is included here as well because these variables can be considered indicators of overall satisfaction with a building, and are included in the BUS formula for calculating the Satisfaction Index. The relevant sections of the questionnaire contained a total of 11 questions, considerably less than the 43 questions on comfort. This chapter therefore is not as lengthy as the previous one and is structured around the variables in the questionnaire and uses the same terms. Comments made in response to open-ended questions and during focus groups and interviews are used to exemplify the results from rated-response questions. In order to understand the positive ratings, this chapter focuses on positive comments in responses to open-ended questions and from focus groups and interviews.

As an introduction to the following sections, Table 7.1 shows the satisfaction ratings for the delight variables which are analysed and discussed in more detail below.

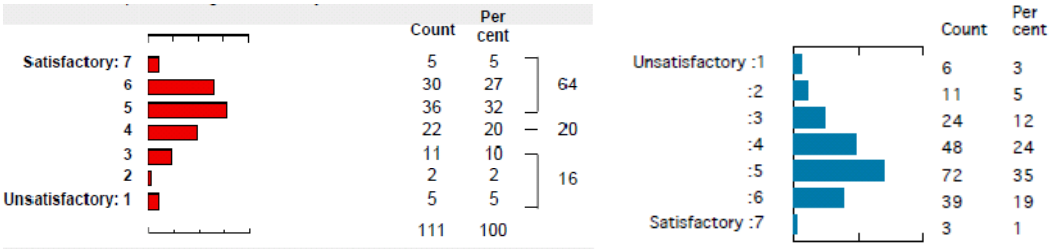
Figure 7.1 Satisfaction ratings for building overall variables



As for the previous chapter, note that the BUS graphics used to present the results for the rated-response questions have opposing vertical scale directions between the years 2007 and 2008 which makes comparison between the years slightly complicated.

7.2 Design overall

Figure 7.2 Design overall ratings: 2007 – red, 2008 – blue (BUS graphics)



The questionnaire asked participants to rate the building design, 'all things considered'. This broad question is effectively an overall rating of how successfully the building design meets all of the occupant needs. It is thus a significant question in that it is a measure of overall satisfaction with the architecture.

In the 2007 questionnaire, design overall was rated very positively with 64 per cent of participants, n. 71/111, satisfied and only 16 per cent, n.18/111, dissatisfied. In 2008, 55 per cent were satisfied and 20 per cent dissatisfied (Figure 7.1). The BUS traffic light rating was green for 2007 and amber for 2008 (Figure 5.3, page 101). This difference is partly attributable to a lower benchmark in 2007, but the score is better in 2007. This is possibly associated with the excitement of moving into a new building on a new campus both of which were very different to the previous situation.

The question about design overall provided space for comments. Figure 5.5 shows the major issues in these comments. In spite of the positive result in the rated-response question, the majority of comments were negative. As

mentioned by Baird (2010), negativity in comments appears to be a common trend. In 2007, 66 of the 112 participants wrote comments. The comments covered a range of issues, indicating that those who wrote comments did consider 'all things', including comfort. Of these 66 comments, the majority (34) were negative, compared to 15 containing both negative and positive statements and 17 which were positive statements. The most common negative comments, occurring in 26 responses, dealt with issues of comfort: temperature, noise, lighting and glare. Criticism of comfort levels also featured prominently in the comments containing both negative and positive statements. Another issue which featured in a number of negative comments was the lack of social spaces. The positive comments were varied and included issues such as the building as an opportunity for learning about sustainable design, inspiration, spatial quality, flexibility and retrofitting.

In 2008, 107 of the 203 participants wrote comments. Of the 107 comments, the majority (67) were negative, compared to 26 containing neutral or both negative and positive statements and 14 which were positive statements. Refer to Figure 5.5a and 5.5b, page 104 for charts of the most common issues in the comments for this variable. The most frequently mentioned issue, occurring significantly more times than any other, was thermal comfort; this was mentioned in 66 comments and was always negative, mostly relating to the building being too hot in summer and too cold in winter. The second most frequently mentioned issue was noise, occurring in 16 comments and always negative; comments on this matter were non-specific and lacked detail. These comments about comfort have been discussed in the previous chapter. Positive statements from the comments are discussed in detail below, augmented by comments made during focus groups and interviews. The most frequently mentioned positive statement was about design generally and was not specific, for example:

> Good design (Design overall, 2007).

> Good spaces—pleasing generally, but fails in certain areas (Design overall, 2007).
>
> I think they've done a great job, it's a really ambitious piece of work (Staff focus group, 2007).

Image was also frequently mentioned in a positive way. Image is discussed in detail in the next section. However the comments which relate to the educational purpose of the building and its ability to inspire and facilitate learning and teaching are most relevant to the role of design and are briefly discussed here. For some participants, the building was 'speaking' of meaningful ideas and values which contributed to their intellectual stimulation, mental health and happiness and enhanced their sense of delight with the building. Examples are:

> Very inspiring place to work in (Design overall, 2007).
>
> It is a really impressive refit that everyone is proud of attending (Design overall, 2007).
>
> I really enjoy working in the building. I think it provides many working opportunities and keeps me at school for large hours (Design overall, 2007).
>
> Well thought out. Interesting elements to inspire design (Design overall, 2007).
>
> Good example of what education facilities can be. Could be improved (Design overall, 2008).
>
> Evocative, lively, student feel, issues with noise main concern (Design overall, 2008).

A sense of aesthetics was mentioned in some comments. Some of these comments indicate that their experience of the building lifted their spirits and engendered delight. The use of natural materials was mentioned in a number of comments and this has been shown to improve perception of comfort (Ohta et al, 2008; Rohles, 2007). Examples of comments about aesthetics are:

> Great design visually (Design overall, 2007).

> Aesthetics-wise good, comfort-wise poor (Design overall, 2007).
>
> The articulation of the infill by Six Degrees is really beautiful (Staff focus group, 2007).
>
> The light changes in the studio—it's quite nice (Student focus group, 2007).
>
> Colours are really good, all the natural materials (Staff focus group, 2007).
>
> Circulation is pine timber construction and finishes look good. (Design overall, 2007).
>
> Timber rules! (Design overall, 2007).

The openness of the building, especially in terms of its contribution to social interaction and sense of community was mentioned in a number of comments. This response supports the idea that buildings need to be vessels that support the basic human desire for social interaction, leading to happiness (Bradley, 2008). The implications of open planning for noise transmission was also mentioned, in a manner that indicated a degree of tolerance. Examples of comments about the link between open planning and social interaction as well as noise are:

> Open, good circulation, sense of history of site (Design overall, 2008).
>
> Very good community space with mezzanine and openness (Design overall, 2008).
>
> Very open and a great place to work (Design overall, 2008).
>
> Love the open interconnected space (Design overall, 2008).
>
> It's good that it has created an open space, but the noise that can be created at some stages is an issue (Design overall, 2007).

Sustainability, both environmental and social, was mentioned in only a few comments. I assume the low number of comments on this issue is because there were no questions specifically about sustainability. However, it is likely that many of the occupants would embrace the environmental values which are a focus of the educational programme in the School of Architecture and

Design. Research indicates that those with environmental values are more satisfied with sustainable buildings than those who do not share these values (Deuble and de Dear, 2010). Examples of the few comments on sustainability are:

> Exciting and functional. Healthy interior (Design overall, 2007).
>
> Good design, ESD strategies but thermal and glare and leaking (Design overall, 2007).
>
> Sustainable design in a way to encourage group discussion (Design overall, 2007).

The flexibility of the spaces, the ability of the building to be adapted and the fact that the completed building remains an evolving project were mentioned. These are important aspects of sustainable architecture in that the building can be continually improved to suit changing requirements. These aspects contributed to participant satisfaction with design overall and were appreciated by staff as a learning opportunity for students.

> Very usable. Space is multi-purpose (Design overall, 2007).
>
> Building works well and ever evolving (Design overall, 2008).
>
> The malleability both here and outside, I think is fantastic (Staff interviews, 2007).

Some comments in response to the open-ended question on design overall contained positive overall observations about design, but were tempered with negative statements about comfort. In 2008, negative comments on Design overall were expressed in a manner that downplayed the severity of discomfort: for example people wrote: *'just* a little *cold'*, *'only a few issues'*, *'some* temperature *issues'* (my emphasis). These comments are interesting in that they illustrate forgiveness. Overall design was considered positive, despite discomfort. For example:

> Good design, but does not perform comfortably very well (Design overall, 2008).

Good design, too cold (Design overall, 2008).

Interesting design, just a little cold in winter and too hot in summer (Design overall, 2008).

Generally good. Heating and cooling issues (Design overall, 2008).

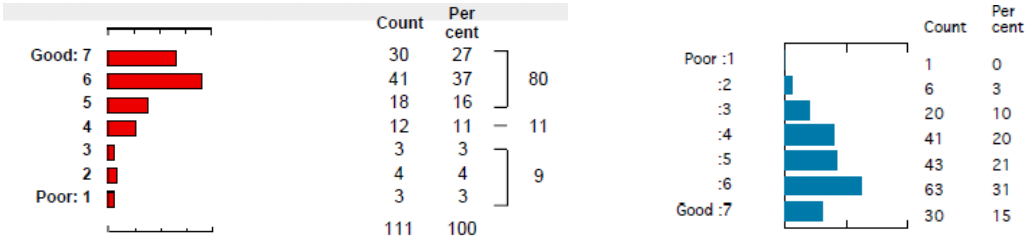
Nice design, only a few issues with volumes of spaces. Noisy and can be cold (Design overall, 2008).

Socially encouraging, plenty of types of work spaces, some temperature issues (Design overall, 2008).

Evocative, lively, student feel, issues with noise main concern (Design overall, 2008).

7.3 Image

Figure 7. 3 Image ratings: 2007 – red, 2008 – blue (BUS graphics)



In 2007, the highest scoring response of all questions in the survey was that pertaining to the image that the building as a whole presents to visitors. Some 80 per cent of participants, n. 89/111, rated were satisfied with the image of the building and only 9 per cent, n. 10/111, were dissatisfied. In 2008, image was again rated highly with 67 per cent of participants, n. 136/ 204, satisfied and 13 per cent, n.27/204, dissatisfied (Figure 7.1). The BUS traffic light rating was green for 2007 and amber for 2008 (Figure 5.3, page 101). The difference is due to the exceptionally high score in 2007 which was significantly higher than the benchmark median; whilst the slightly lower score in 2008 was not so significantly better than the benchmark. The exceptionally high score in 2007 is possibly associated with the excitement of moving into a new building on a new campus both of which were very

different to the previous situation. There was no open-ended question about image in the questionnaire. However comments about image were made in response to questions on design overall. There was also much discussion about image in the focus groups and interviews.

The rated-response question about image specifically states that it is the image that the building presents to *visitors*; while this is important in giving the school an identity for links to the broader community and within the university, the image the building presents to *occupants* is equally important. Image is important to the school community in reinforcing a sense of place, expressing the values of the school, strengthening the community of students and staff and contributing to the sense of identity of occupants and the school (Heschong, 1979, Mackay, 2010, Pallasmaa, 2005). Comments made about image related to the image for both visitors and occupants.

Image, then, is one of the ways in which a building speaks. It is communicated through all aspects of the building, including form, spatial character, layout, design details, materials, colours, lighting, views, sound and the activity the building houses. Image is experienced with all the senses (Pallasmaa, 2005, Rasmussen, 1959).

Professor Fay commented on the image of the building and made a series of observations about what it expresses. He stated that the building speaks of the excitement of architecture, the vibrancy of staff and students working together, sustainability (environmental, social, and economic) and the school's strengths (learning by making, design computing and sustainability). Image expresses excitement and vitality via the drama of spaces, funky details and openness—the last of which allows activity to be seen and heard throughout the building. Image expresses environmental sustainability by the obvious recycling of an industrial building, visibility of various ESD systems, use of natural unfinished materials and robust,

enduring character. Image expresses economic and social sustainability through its accessibility, and its low tech, affordable character which can be achieved by all (as opposed to a high tech, slick building for the wealthy). On such terms, Professor Fay felt that the building was very successful in expressing the school's values and strengths.

Comments in response to the question on design overall yielded some general statements about image. These statements express excitement, stimulation and delight. For example:

> Cool design … (Design overall, 2007).
>
> Great design visually (Design overall, 2007).
>
> Good form and feel (Design overall, 2008).
>
> Clean, interesting (Design overall, 2008).

The function that image has in contributing to school's identity was mentioned by students and staff in focus groups and interviews. There is a real sense of pride in being associated with the building and this reinforces a positive sense of self and delight. Participants spoke of showing the building to their friends and reported that they enjoyed the response. For example:

> Coming here as a first year …from a high school which looked like a government housing estate …was just fantastic and it just looked so sharp. We can take a reasonable amount of pride in coming here cos' it's an aesthetically fantastic building (Student focus group, 2007).
>
> I brought my mates up from Hobart. They're studying at UTAS there and they were really taken aback by how visually stunning the building was. They thought it was awesome compared to their campus (Student focus group, 2007).
>
> I've got friends in Sydney who say: 'Oh yeah, you guys have got that hot new building!' (Student focus group, 2007).
>
> Visitors are really impressed. They're interested in the history of the building (Staff interview, 2007).

This sense of pride extends beyond individuals and contributes to the sense of identity of the school and—some would argue—to the whole university. The fact that then Vice Chancellor Daryl Le Grew used it for official functions indicates that the building speaks of values that he wishes to be communicated about the university.

> Gives architecture students a new identity (Design overall, 2008).
>
> Image gives recognition. It's a positive thing for the school (Student focus group, 2007).
>
> It's so unlike other buildings in uni. It really gives us an identity (Staff focus group, 2007).
>
> The lecture theatre is lovely to give a lecture in. I think visitors would find it quite positive (Staff focus group, 2007).
>
> The sky lounge gets used for UTAS cocktail parties. The VC had all the deans up there, so they obviously think it's good (Staff focus group, 2007).

Expressing aspects of the culture of the school through the building's image also contributes to a sense of identity among occupants and was commented upon by staff and students in focus groups and interviews: (check these changes with original)

> I think it does express the culture of the school in that all the materials are soft and we can put screws in or change the face of the surfaces (Staff focus group, 2007).
>
> It expresses the culture of the school. Other schools might not operate in here so well. It's a small school with a good working relationship amongst staff. We have similar agendas, we're more practical, less bureaucratic. The building is a real expression of that (Staff focus group, 2007).
>
> It expresses the school's learning by making – that's what the school is known for internationally (Student focus group, 2007).

The contribution of the spatial qualities and large volumes to a bold and impressive image were mentioned:

> Spatially it's so luxurious and because of that and the wonderful long plywood wall, the building has an image and character that is all so incredibly powerful. The first 6 months people were afraid to do anything because it had such a big bold personality. But I think we're all used to it now (Staff focus group, 2007).
>
> I take groups of school kids up to the sky lounge and they just stand there, so impressed by the scale of the space (Staff focus group, 2007).
>
> The big volumes are impressive and overwhelming. There is a wow factor (Staff focus group, 2007).

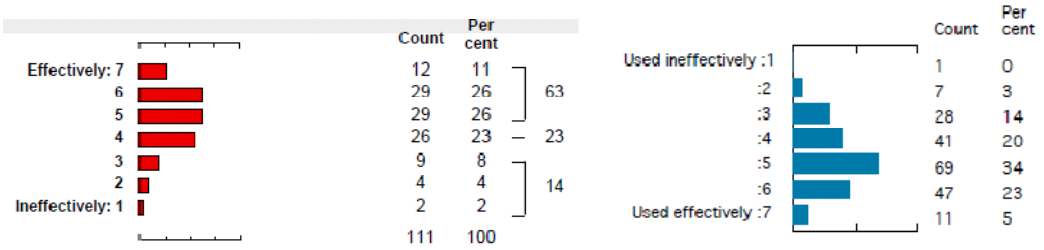
Nevertheless, criticisms of the dramatic spaces exist, with its being seen by some as superficial, inauthentic and contrary to the real values of the school:

> It's kind of ironic that we're supposed to be this ESD school and yet we fetishize space over ESD strategies. It looks good in the photographs! (Staff focus group, 2007).
>
> We're not designing things to be really amazing. We're designing buildings to be experienced (Student focus group, 2007).

In summary, the image of the building communicates the values and culture of the school and the university to visitors and occupants. The very positive ratings for image indicate great resonance between the values communicated by the building and those of the participants. Resonance of values between building and occupant engenders a sense of pride in occupants which reinforces a positive sense of self (Heschong, 1979, Mackay, 2010, Pallasmaa, 2005).The environmental values communicated by the sustainable building are likely to inspire satisfaction with the building in occupants sharing those values (Deuble and de Dear, 2010). The image of the building therefore contributes significantly to the satisfaction and delight experienced by occupants of the building.

7.4 Effective use of space

Figure 7. 4 Use of space ratings: 2007 – red, 2008 – blue (BUS graphics)



Participants were asked to rate the effectiveness of the use of space in the building as a whole. In 2007, 63 per cent of participants, n. 70/111, were satisfied and only 14 per cent, n.15/111, were dissatisfied. In 2008, 62 per cent, n.127/204, were satisfied and 17 per cent, n. 36/204, dissatisfied (Figure 7.1).

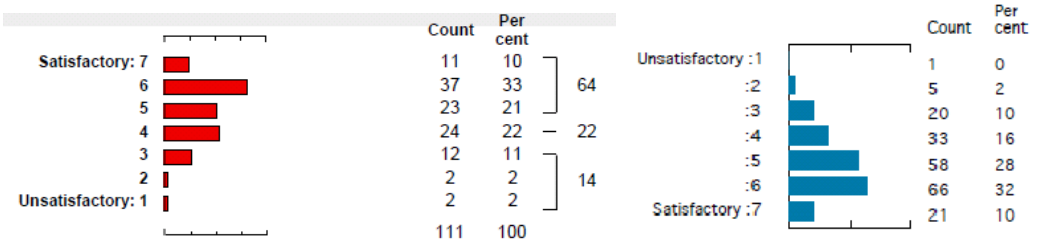
The BUS traffic rating was green for 2007 and amber for 2008 (Figure 5.3, page 101). This difference is related to the slightly higher levels of dissatisfaction and neutrality in 2008, although the level of satisfaction was very similar. In 2008, the score was close to the benchmark mean, whereas in 2007 it was significantly higher.

There was no open-ended question associated with this issue and it was not something which was specifically mentioned in comments responding to other questions or in focus groups and interviews. However this variable is one that touches upon flexibility, spatial variety, functionality and spatial planning, and these were mentioned in responses to open-ended questions about design overall, what works well and facilities meeting needs. Another relevant but more detailed issue raised in focus groups and interviews in response to the question about whether the facilities meet needs, is the separation of staff offices from the student areas. All these related issues have been discussed under the headings of other variables. 'Enough space' is one of five factors which make a difference to human performance in the workplace. When these five factors are present, occupants report higher perceived productivity, and are healthier and happier as well (Leaman and

Bordass, 2005). The effective use of space in the School of Architecture and Design was rated very positively, and is further evidence of overall satisfaction and delight with the building.

7.5 Facilities meeting needs (in the building overall)

Figure 7. 5 Facilities meeting needs ratings: 2007 – red, 2008 – blue (BUS graphics)



In 2007, 64 per cent of participants, n. 71/111, were satisfied that in the building as a whole the facilities met their needs and 14 per cent, n.16/111, were dissatisfied. In 2008, 70 per cent, n.145/204, were satisfied and 12 per cent, n. 26/204, dissatisfied (Figure 7.1). In both years the BUS traffic light rating was green. This variable was the only one related to the building overall to score a green rating in both years, and indicates high satisfaction with the building overall (Figure 5.3, page 101).

There was also an open-ended question asking for comments about needs. In 2007, 43 of the 112 participants wrote comments. In 2008, 65 of the 204 participants wrote comments. In spite of the very high scores in the rated-response question, most of the comments in both years were negative (Figures 5.5c and 5.5d, page 104). The most frequently mentioned issues were problems with thermal comfort and noise in 2007, and thermal comfort, equipment and management issues in 2008. Thermal comfort and noise were discussed in the previous chapter and issues of equipment and management are not considered relevant to this research. In both years many of the comments focused on the types of spaces provided or lacking. In 2007, the

lack of a library featured in several responses, but this was not mentioned in 2008; that facility is located on the Newnham Campus, some five kilometres from the Inveresk site where the School of Architecture and Design is located. Also mentioned in both years were the lack of indoor and outdoor social spaces, and the lack of small spaces or stations for individual work.

In both years the majority of positive comments were non-specific. For example:

> Good and met [needs] (Facilities meeting needs, 2007).
>
> Facilities generally meet requirements (Facilities meeting needs, 2008).
>
> General function requirements are more than satisfactory (Facilities meeting needs, 2008).

However more detailed information on the ways in which facilities met participants' needs was provided during focus groups and interviews. In analysing these data, needs include practical functional requirements, intellectual inspiration and emotional well-being. Examples of comments about functional needs being met included the following:

> It's a supportive environment for work. 24/7 access allows for group work. There's a range of spaces, good facilities. The spaces are big enough for big models, making furniture, big groups, group work. The building supports our needs well (Fay, 2009).
>
> The space is very flexible. It's a very easy building to work in(Staff focus group, 2007).
>
> Spaces for individual, group and whole class is well distributed (Facilities meeting needs, 2008).

The building is seen as stimulating and inspiring and occupants are able to interact with it in a number of ways—for example as a demonstration of construction detailing, an exemplar of sustainable architecture, a workshop for adaptation. In one discussion I was told that:

> We see [the building] as a workshop not a finished building. It's one of its advantages. Whilst there are all these little problems, the

> designers in us all find that part of the challenge. Interesting to start using it more as a teaching tool and set up some decent research projects where we monitor the same set of measures every year (Staff focus group, 2007).

The building is seen as encouraging well-being and being psychologically nurturing and healthy, and comments illustrating this include the following:

> It sets up a mood of how you feel. When you leave home, you have this anticipation of using this nice new space which is very free and open. I have a positive attitude to it that is carried through to work and well-being (Student interview, 2008).
>
> In terms of psychological health, it's good. People like the building, it's a good place to work (Fay, 2009).
>
> Space reminds me of primary school. I feel comfortable within the space… (Productivity, 2007).

Views and connection to nature are some of the ways the building engenders well-being. These aspects of a building are known to be physically and psychologically restorative (Kaplan, 1998).

> Now I don't work at home at all because I find my office such a nice place to be. I get the view out to Riverside which is really beautiful. We're elevated so we can see from mountain, rural, suburban to the river. That's what makes the upper studios beautiful too (Staff focus group, 2007).
>
> Yesterday the sun came out and that corrugated iron wall, when the sun sets, changes colour all the time, so it was just beautiful sitting in the studio and generally it's really gorgeous (Staff focus group, 2007).

Social interaction is another contributor to happiness and psychological well-being (Bradley, 2008, Heerwagen, 2005) and participants felt the design of the building encouraged this sense openness and generous circulation routes. This aspect of the building was commented on in the open-ended questions, focus groups and interviews as the following examples show:

> Good big table, open space. Bright sunny environment. Friends around a table (Work well, 2008).
>
> Interaction with other students on circulation paths (Work well, 2007).

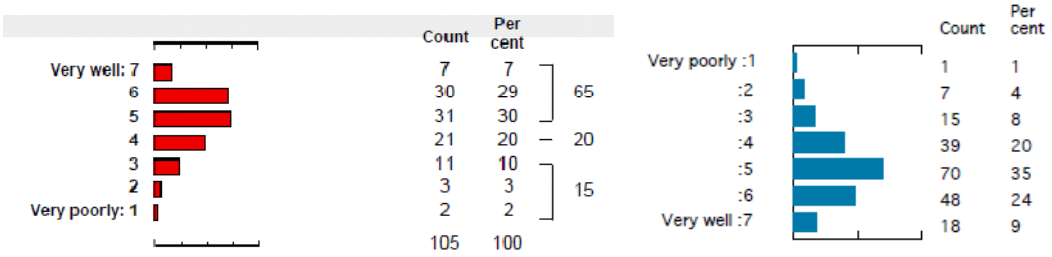
Open studio/circulation space so meet people easily and feels safe. Good 24 hr access (Work well, 2008)

It is an exciting space, always something going on (Work well, 2007).

The extent to which facilities meet needs is an important measure of overall evaluation of the building. The fact that the Inveresk building received a green traffic light rating for both years of the survey indicates strong satisfaction with this significant aspect of the building. The pleasure derived from the fulfilment of needs would undoubtedly provide delight.

7.6 Facilities meeting needs (specific to work requirements)

Figure 7. 6 Facilities meeting work needs ratings: 2007 – red, 2008 – blue (BUS graphics)



This question ('Specifically, for the work that you carry out, how well do the facilities meet your needs?') differs from that discussed immediately above in that it refers to the ability of the facilities to meet participants' needs which are specific to their work, rather than the facilities in the building as a whole meeting non-specific or generalized needs. There is some overlap between the two rated –response questions and the comments from the open-ended questions, focus groups and interviews. In both 2007 and 2008, this variable was rated highly with 65 per cent, n. 68/105, and 68 per cent, n. 136/198, respectively satisfied and 15 per cent, n. 16/105, and 13 per cent, n. 23/198, respectively dissatisfied (Figure 7.1). The BUS traffic light rating was amber for both years (Figure 5.3, page 101).

There was also an open-ended question with two parts, asking for examples of things which can hinder effective working and secondly things which usually work well (Figure 5.5e, 5.5f, 5.5g, 5.5h, page 105). In both years the most frequently mentioned things which hinder effective working were lack of thermal comfort and noise followed by lighting, equipment and glare. In 2007, the most frequently mentioned things that work well were the computer labs; light, especially natural light; equipment; social interaction; tutorial rooms; planning and amount of space. In 2008, the most frequently mentioned things that work well were equipment; flexibility; management issues; studios; amount of space; openness; planning; work spaces; tutorial rooms; lighting and social interaction. Of all open-ended questions in the questionnaire, this one asking what works well provides the best opportunity for participants to write positive comments about the building. It is important for this reason.

There were many positive comments about the computer labs, although most participants did not provide details about why they liked those facilities. As spaces smaller and more enclosed than the studios, they are warmer and in them students across the full degree program work side by side. Examples of comments of about the computer labs are as follows:

> The computer labs—nice lights, heating and arrangement. I think as we learn to use the building better, more spaces will work well (Work well, 2007).
>
> Computer systems generally well put together. Computer rooms HEATED (Work well, 2008).
>
> The computer lab spaces are really good, the lecture theatre everyone likes and the workshop is a really great space (Work well, 2007).

Connection to nature, a major quality of restorative environments (Kaplan, 1998) achieved by providing views and natural light was considered an aspect of the building that worked well.

> Good access to natural light, healthy atmosphere (Work well, 2008).
>
> Lots of space, daylight (Work well, 2007).
>
> Lighting (natural), sleeping in hidden places when overworked (Work well, 2007).
>
> The studio when it is not full eg not at teaching times and you can sit near a window! (Work well, 2007).
>
> Windows are really important. People like to sit near the windows in the top studio. It's good to be able to look up from work every now and then and out the window (Student focus group, 2007).

Many identified opportunities in the building for social interaction as an important aspect of learning. Those opportunities also engender psychological well-being, happiness and delight (Bradley, 2008, Heerwagen, 2005). Comments about social interaction include:

> Social side. Working as a group together. Location is good! Being all together – all of the architecture students (Work well, 2007).
>
> Spaces to interact and evolve a collection of ideas (Work well, 2007).
>
> People can mingle during study, between years, helps develop ideas and understanding of subject (Work well, 2008).
>
> Ability to see and communicate with people in a large space, able to move in different sized spaces (Work well, 2008).
>
> There's greater social interaction. For example, there might be a presentation or a tute in one space and due to the openness you're almost forced to observe or interact with it (Student focus group, 2008).

The variety and flexibility of spaces and equipment/furniture worked well. Indeed, many comments related to flexibility for group work encompasses social interaction; for example:

> Tables are huge enough and can be arranged in a flexible way (Work well, 2008).
>
> Open space, large working areas. Flexible spaces. Group areas (Work well, 2008).

> Tute rooms along with open plan areas that can change their uses (Work well, 2007).

The layout that separates staff areas from the student work areas and teaching spaces was appreciated by staff on the grounds that it encourages productivity and collegiality amongst staff. Comments reflecting this include:

> Zoning of building: separation of staff admin facilities and offices in one zone with teaching spaces adjacent. Students can access staff when needed, but staff can work relatively uninterrupted when needed (Work well, 2007).
>
> Staff need space for research, quiet space. Students have reasonable access to staff (Fay, 2009).
>
> There's pressure on staff to be research active now. In the staff enclave, students can still see you but respect that you have other work to do. If we want to work in the studios we can take our laptops upstairs and sit there (Staff focus group, 2007).
>
> I can see the advantage of having all the offices together, mixing with other staff on a daily basis. We're all part of the upstairs conversations and informal interaction (Staff focus group, 2007).

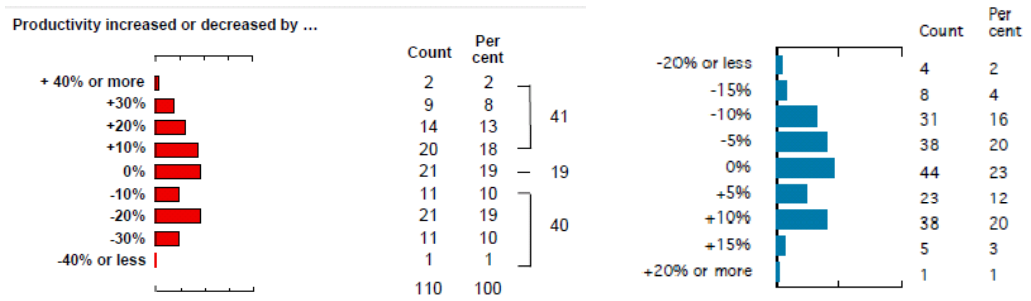
The ability to learn from the building in a variety of ways was seen as an advantage, for example:

> Good to demonstrate design and ESD principles (Work well, 2007).
>
> The way the structure is exposed makes it easy to teach students about structure (Staff focus group, 2007).
>
> We had a student project making screens for the windows (Staff focus group, 2007).

In summary, there was a diversity of ways in which the building was seen to satisfy participants specific work needs. This variable, combined with the more general one of facilities meeting needs, provides a strong case for occupant satisfaction with the building's ability to meet their needs.

7.7 Perceived productivity

Figure 7.7 Perceived productivity ratings: 2007 – red, 2008 – blue (BUS graphics)



This question had a rating different from other questions. Participants were asked to estimate how they thought their productivity was diminished or increased by the environmental conditions in the building on a 9-point rating scale from -40 per cent or less to +40 per cent or more in 2007 or from -20% or less to +20% or more in 2008. Although a measure of perceived rather than actual productivity, it is an established means of rating the building's impact on productivity and has been found to be a good indicator of actual productivity (Leaman, 2005).

In 2007, the score was balanced with 41 per cent of participants, n. 45/110, estimating productivity to have increased, 19 per cent, n. 21/110, estimating it to have neither increased nor decreased and 40 per cent, n. 44/110, estimating it to have decreased. Forty-seven per cent, n. 52/110, estimated their productivity to be in the middle band of -10% - + 10 per cent. In 2008, the score was slightly lower than in 2007, but overall predominantly neutral with 55 per cent of participants, n.105/194, estimating their productivity to be in the middle band of -10% to +10 per cent. Thirty-six per cent, n. 67/194, of participants estimated productivity to have increased, 23 per cent, n.44/194, estimated it to have neither increased nor decreased and 42 per cent,

n.80/194, estimated it to have decreased (Figure 7.1). The BUS traffic light rating for both years was amber (Figure 5.3, page 101).

There was also an open-ended question for comments about productivity (Figures 5.5i and 5.5j, page 106). The most frequently-mentioned negative impact on productivity was thermal comfort, which has been discussed in the previous chapter. Among the positive statements recorded, indoor environmental quality (warmth, natural light and fresh air), privacy and facilities were mentioned as contributing to productivity:

> Ample natural light, fresh air and privacy when I need it allow for good productivity (Productivity, 2007).
>
> Having an office with only one other person and being able to keep it warm and utilize natural light increases productivity (Productivity, 2008).
>
> Separation of staff areas and well-appointed office makes a great and convenient place to work (Productivity, 2007).

Social interaction as a result of the building design was also considered an important contributor to productivity:

> For me this is a learning environment. There is great value in interacting with others which the building facilitates well (Productivity, 2008).
>
> More inclined to work in studio so more work completed at uni (Productivity, 2007).
>
> I become more creative! (Productivity, 2007).

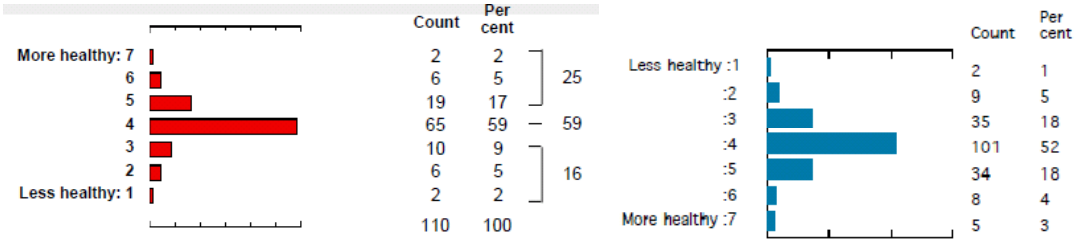
Productivity was not specifically mentioned in focus groups and interviews. However it can be assumed that a reasonable level of productivity is implied by the positive comments about the facilities meeting needs.

Students under 30 are unlikely to have had much experience of working in other similar buildings to use as a comparison when rating the productivity of this building. This may explain the predominantly neutral score.

Given the link between thermal comfort and productivity (Leaman and Bordass, 2005), the relatively positive rating for productivity compared to the specific comfort variables indicates forgiveness of discomfort.

7.8 Health

Figure 7. 8 Health ratings: 2007 – red, 2008 – blue (BUS graphics)



Although health is related to comfort, especially indoor air quality, it has been included with the other overall building variables under the delight theme because, like productivity, it is an indicator of overall satisfaction with the building. This is consistent with the BUS Satisfaction Index which includes health and productivity.

The questionnaire asked participants to rate whether they felt less or more healthy when they were in the building. There was also space to write comments about health. In 2007, 59 per cent of participants, n. 65/110, responded that they felt neither more nor less healthy in the building, with 16 per cent, n. 18/110, feeling less healthy and 25 per cent, n. 27/110, feeling more healthy. In 2008, 52 per cent of participants, n. 101/194, responded that they felt neither more nor less healthy in the building, with 24 per cent, n. 46/194, feeling less healthy and 25 per cent, n. 47/194, feeling more healthy (Figure 7.1). The BUS traffic light rating was amber for both years (Figure 5.3, page 101).

There was also an open-ended question asking for comments about health (Figures 5.5k and 5.5l, page 106). Not many comments were received and the

majority of comments in response to the open-ended question were neutral, non-specific comments, for example:

> Normal (Health, 2007).
>
> Didn't affect my health (Health, 2007).
>
> I'm not sure if I feel less healthy. But I do not feel more healthy (Health, 2007).
>
> Average—haven't noticed any difference (Health, 2008).
>
> Nothing different (Health, 2007).

The negative comments frequently mentioned the impacts of temperature, ventilation, draughts , air quality (odours) and poor lighting. Headaches, colds and flu were mentioned as the consequences of conditions in the building; these have been discussed in the previous chapter.

The positive comments mentioned fresh air, good lighting and the psychological benefit of openness, for example:

> Healthy building, clean air and good lighting (Health, 2007).
>
> Because the temperature relates so much to the outside, we do have a good connection to the seasons (Health, 2008).
>
> Good fresh air, bright environment (Health, 2008).
>
> Open space good for air flow and positivity (Health, 2008).

Health was also mentioned in a few of the responses to open-ended questions in the questionnaire relating to other aspects of the building experience such as comfort overall. They generally related to temperature and ventilation and have been discussed in the previous chapter.

There were very few comments specifically about health in the questionnaire or focus groups and interviews. I suggest that as the majority of participants were aged under 30, health is not an issue they pay much attention to and this was reflected in the number of comments. However, health can include not just avoidance of sickness, but encouragement of physical and

psychological well-being. This aspect of health *was* mentioned in response to other questions and it is evident that the building has many features which lift the spirit and engender well-being and delight.

7.9 Satisfaction Index

Like the Comfort Index, the BUS Satisfaction Index is based on a formula, attempting to give an objective rating for overall satisfaction with the building. It is based on the average of the Z scores for design overall, facilities meeting needs, health and productivity, i.e.

$$\frac{(Z\ design + Z\ needs + Z\ health + Z\ productivity)}{4}$$

The Satisfaction Index is based on a scale of -3 to +3 and for the School of Architecture and Design building was 0.42 in both 2007 and 2008; this is above the scale midpoint of 0. It indicates satisfaction with the building, but is not a strongly positive evaluation.

The Satisfaction Index is based on selected variables from the questionnaire and does not include some of the variables discussed in this chapter. It also doesn't include data from open-ended questions. As such it is an indicator of satisfaction, but does not fully represent participant evaluation of the building's overall aspects.

7.10 Chapter summary

In this chapter, data relating to participant evaluation of the overall aspects of the building have been presented, analysed and discussed. These data included the variables of design overall; image; effective use of space; facilities meeting needs in the building as a whole and for participants' specific work requirements; productivity and health.

It is evident that participants were satisfied and delighted with the building overall. They appreciated the building's design, image, effective use of space, its ability to satisfy their needs and specific work requirements. They also felt neither more nor less productive in the building and slightly healthier. In particular, participants expressed delight in the characteristics which encourage well-being such as natural light, views to the external landscape, design of the interior to encourage social interaction and the aesthetics of the building (Heerwagen, 2005, Kaplan, 1998, Rohles, 2007). They felt the building gave a positive identity to the school and themselves individually and felt proud to be connected to it. This experience encourages psychological well-being and delight (Heerwagen, 2005).

This satisfaction and delight with the building is experienced despite the negative ratings for the comfort variables. It indicates forgiveness of discomfort in the overall evaluation of the building.

Chapter 8 Forgiveness

8.1 Introduction

In the literature on sustainable buildings (Baird, 2010, Deuble and de Dear, 2010, Leaman and Bordass, 2005), *forgiveness* describes the ability of building occupants to tolerate variability and discomfort in their internal environments and still experience satisfaction with a building's overall comfort. Leaman and Bordass (2005) define forgiveness as the 'tolerance occupants have for chronic faults in the building'. It occurs when the overall comfort is rated more positively than the individual specific comfort variables; this was discussed in more detail in Chapter 3. The data on comfort discussed in Chapter 6 provides evidence of forgiveness of discomfort in the occupants' more positive rating of overall comfort.

It is evident in this study and other research (Deuble and de Dear, 2010, Heerwagen, 2005, Humphreys, 2005) that the tolerance of discomfort by building occupants resulting in an expression of satisfaction extends beyond satisfaction with *overall comfort*, to satisfaction with variables relating to the *overall building*. I am thus extending the commonly used definition of forgiveness to include satisfaction with the *overall building* in spite of discomfort.

This chapter demonstrates how the data supports this definition as well as the narrower one, and investigates why this phenomenon has occurred in the School of Architecture and Design. The chapter content moves between the data and the literature presented in Chapter 3, investigating correlations

between them in order to develop understanding of forgiveness in the study building.

8.2 Relationship between comfort and delight themes

Traffic light ratings for the comfort and overall building variables are shown in Figure 5.3 (page 193). It can be seen that the red ratings are concentrated in the comfort variables, specifically temperature and noise. The majority of the remaining comfort variables are amber. The overall building variables are mostly green ratings with the remainder amber. Two clusters of ratings are obvious: the negative comfort variables and the positive overall building variables. Initially I was surprised by the lack of correlation between these two groups. With comfort being a critical aspect of the building experience, it seemed obvious that it should have a significant influence on the rating for the overall building variables, however this is clearly not the case. Discomfort is obviously tolerated and forgiven, not just in rating overall comfort, but also in rating the overall building. I postulate that forgiveness is the link between the themes of comfort and delight.

8.3 Why forgiveness?

In the literature, tolerance or forgiveness is attributed to a number of factors associated with satisfaction with the building. Most of these factors have the ability to engender delight, well-being and a positive mood. The following factors have been identified as contributing to forgiveness and satisfaction with overall comfort and the building overall in spite of discomfort; each is listed and then elaborated upon below.

- Good design (Leaman and Bordass, 2007)

- Values expressed by the building (Deuble and de Dear, 2010, Heerwagen, 2005)
- Aesthetics (Ohta et al 2008 ; Rohles 2007),
- Contact with nature through views (Heerwagen, 2005; Kaplan, 1998)
- Positive experience of using the building (Leaman and Bordass, 2007)
- Design of the space to enhance social interaction (Bradley, 2008; Heerwagen, 2005,). (NTS Bradley says social interaction makes you happy, but not forgiving.)
- Understanding of design intent (Leaman and Bordass, 2007)
- Perceived personal control over environmental conditions (Leaman and Bordass, 2007)
- Shallow plan forms (Leaman and Bordass, 2007)
- Use of natural light (Heerwagen, 2005; Leaman and Bordass, 2007)
- Care taken with briefing, design and management (Leaman and Bordass, 2007)

Good design. Leaman and Bordass (2007) found that occupants are more tolerant of sustainable buildings when they can see 'good design'. In this study, design is a broad factor which encompasses some of the others discussed below. Design overall in the School of Architecture and Design building was rated highly by participants, who were asked to rate design while considering 'all things'. Aspects of design that participants valued included the building's ability to inspire and facilitate learning and teaching which is critical to successful design of an educational facility; the image of the building and hence its ability to speak to the participants; the building's expression of sustainability; the building's aesthetics; the openness of the building which contributes to social interaction and sense of community; and the flexibility of the spaces, allowing the building to be adapted and to evolve over time. Comments demonstrating statements about good design

tempered by negative statements about comfort were discussed in chapter seven. A staff member's comment provides another example:

> The infill has got some really beautiful architectural moments in it that are fantastic lessons for the students to be able to experience. Which is great and I think that's what we all love about it. It's just slightly irritating that the breeze keeps blowing down my back (Staff focus group, 2007)

While the survey data do not demonstrate a direct causal relationship between good design and forgiveness, in the light of other research showing this, it is likely that the design aspects mentioned above have encouraged forgiveness and influenced the rating of comfort overall as well as the other overall building variables.

Data demonstrate that good design is likely to be encouraging forgiveness in the School of Architecture and Design. The rating for design overall was strongly positive compared to the negative ratings for comfort variables, in particular temperature and noise.

Values. Psychological well-being is strongly influenced by the congruence between values and activities (Heerwagen, 2005) and Deuble and de Dear (2010) found that in sustainable buildings, participant satisfaction with overall comfort was higher for those participants with environmental values. A building expresses values by means of its image and at the Inveresk site this was rated highly by participants for both years. Image was seen to give identity to the school and the individuals. Both students and staff found it an inspiring and vibrant place for teaching and learning and expressed pride in being a member of the school community with environmental values; and I have assumed that they would thus be likely to be more forgiving in their evaluation of overall comfort. It is likely that this forgiveness would extend to evaluation of the overall building (Heerwagen , 2005). The sense of

identity and pride resulting from the resonance of participant values with the building image is likely to engender psychological well-being.

Aesthetics. Aesthetics was commented on in response to the question on design. Mention was made in the comments of natural light which is known to lift the spirit (Heerwagen, 2005) and natural materials which were shown in experiments to increase perception of comfort (Ohta et al., 2007, Rohles, 2007). These and other aesthetic elements are likely to have enhanced the mood of participants and influenced satisfaction with overall comfort and the building overall.

Contact with nature. Around half of all participants reported sitting next to windows. Both students and staff commented on the importance of views from their workspace and this is consistent with research on restorative environments which shows that views to natural areas enhanced mood, reduced stress and promoted higher quality of life (Heerwagen, 2005, Kaplan, 1998). These positive feelings are likely to have influenced satisfaction with overall comfort and the building overall.

Positive experience of using the building. Leaman and Bordass (2007) found that occupants were more tolerant of sustainable buildings when they had a positive experience of using the building and it was supportive of their needs, especially work needs.

Participants in the study rated the building's ability to meet their needs very highly. This overall building variable was given a green traffic light rating for both 2007 and 2008. The more specific question about the facilities meeting work needs also scored well and received an amber traffic light rating for both years. Participants valued the building's ability to meet not just their functional needs, but also to provide inspiration, social interaction and psychological comfort. Productivity and health can also be considered indicators of the building's ability to meet occupant needs. These two aspects

received predominantly balanced ratings from participants and an amber traffic light rating. There was neither a significant positive nor negative trend in either productivity or health responses. From the data, it is evident that participants' experience of using the building is positive and supportive of their work, and that this experience is encouraging tolerance and forgiveness of discomfort.

Design to enhance social interaction. Social interaction brings happiness (Bradley, 2008) and a positive mood is known to increase perception of comfort (Ong, 1995). Design that enhances social interaction contributes positively to the overall experience of a building (Heerwagen, 2005). There were no questions relating specifically to social interaction but it was mentioned in response to questions on design overall, satisfaction of needs and what works well; as well as in interviews and focus groups. Participants valued visual connections to activity, informal social interaction on circulation routes, and group work in studios. They mentioned the importance of social interaction to lift the spirit and as an important aspect of teaching and learning. Aspects of the design which participants mentioned as contributing to social interaction included: openness, design of circulation and layout of spaces.

The data show that the encouragement of social interaction is one of the strengths of the building and that this is likely to have influenced satisfaction with both comfort overall and the overall building.

Understanding of design intent. Understanding the design intent of the building is known to improve satisfaction with both overall comfort and the overall building (Leaman and Bordass, 2007). By design intent, Leaman and Bordass are referring to the means of managing and operating the building and not the higher level design philosophy and strategy. (The higher level of design intent is related to the values expressed by the building.) In the

sustainable building, design intent as defined by Leaman and Bordass generally relates to managing and operating the building to achieve comfort and environmental objectives. Designer occupants tend to be more tolerant of poor comfort conditions and this is attributed to them being knowledgeable occupants and thus having a better understanding of design intent (Leaman and Bordass, 2005, Part 3). Although occupants of the study building were designers, it is evident from comments in interviews and focus groups, that many did not understand the design intent of the building. Professor Fay admitted that this was an issue that needed to be addressed. In the study building, design intent would include the sustainability objectives generally; the adaptive approach to comfort and the means to achieve this; zoning of the building and how to use this effectively; how to use the heating, cooling and ventilation systems. Better occupant understanding of the design intent would not only help achieve the comfort and environmental goals more effectively, but is also likely to increase satisfaction with overall comfort and the overall building.

Personal control over environmental conditions. Perceived personal control over environmental conditions is known to increase forgiveness and satisfaction with overall comfort. Research shows that it is the perception of control which is significant even if control does little to change the physical conditions (Leaman and Bordass, 2007). The ability to control environmental conditions also brings a sense of mastery over one's environment, contributing to psychological well-being which is likely to influence perception of overall comfort and of the overall building (Truneckova, 2012).

The data show that most participants feel they have little or no control over environmental conditions, especially noise; some of this relates to having a limited understanding of design intent. Opportunities for control are there, but not utilized effectively because of a lack of understanding. Most participants felt that the ability to control the environmental conditions was

not important. Communicating the design intent to building occupants is likely to change this view and encourage them to seek out controls and use them effectively.

From the data, it is evident that adaptation to achieve comfort is occurring in the building; this can be interpreted as a form of control over one's environmental conditions. Thus although the responses to the direct questions about personal control were negative, control over environmental conditions is occurring through adaptive behaviour; this is likely to have influenced perception of overall comfort and forgiveness of discomfort. The psychological well-being resulting from adaptation is also likely to have had a positive influence on satisfaction with overall comfort and the overall building.

Shallow plan forms. These plan forms have been identified as features which occupants like and which increase satisfaction with the overall building (Leaman and Bordass, 2007). Combined with open planning, they are often a feature of sustainable buildings because of the resulting increased access to natural light and views and more effective natural ventilation. In the school, the building is wider than recommended by Leaman (Leaman et al, 2007), but the open planning of the studios and the layout of staff offices allows good access to natural light and views from these spaces. There are some internal rooms such as tutorial rooms and participants expressed dissatisfaction with the lack of natural light and poor ventilation in these spaces. Although the building does not have a particularly shallow floor plan, it has many of the benefits that a shallow floor plan brings and these are likely to increase satisfaction with the overall building, encouraging forgiveness.

Natural light. Natural light contributes to psychological well-being, (Heerwagen, 2005; Kaplan, 1998,) visual comfort and health, as well as to

overall satisfaction with a building and tolerance or forgiveness of discomfort (Leaman and Bordass, 2007). The danger is that too much natural light can cause discomfort, health issues and glare. Natural light is plentiful in the study building and although some participants mentioned natural light as contributing to their productivity, health and things that work well, the rating indicated that they considered there was too much natural light and glare from the sun and sky. The data thus present two points of view on natural light. It is possible that the positive perception of natural light influenced satisfaction with overall comfort and the overall building and thus encouraged forgiveness.

Care taken with briefing, design and management. Sustainable buildings tend to have more care taken with briefing, design and management than conventional HVAC buildings and this encourages satisfaction with the overall building (Leaman and Bordass, 2007). For the design of the school building, there was a lot of user consultation during the briefing and design process and the design process was undertaken to ensure compliance with a 5-star Green Star rating. The research does not include information about the management of the building, but as the occupants have a professional interest in the building's performance, it is likely that the building would be monitored and any problems uncovered would be addressed. AMS staff also carry out monitoring of some aspects of the building for input to the TEFMA database. As an indicator of management, responses to the 2008 question asking about speed of response to requests for changes, 51 per cent (n. 29/57) of participants rated the speed of response as unsatisfactory. It is likely that the school receives better management compared to other university buildings due to the occupants' professional interest in the building, but as an educational building in an institution with tight budgets, it possibly receives less care in management than other building types, for example a commercial building where customers and clients are regular visitors.

The care taken in the briefing, design and to some extent management of the building would contribute to overall satisfaction with the building and encourage forgiveness of discomfort.

8.4 Forgiveness Index

The Forgiveness Index used in the BUS questionnaire analysis attempts to quantify the level of tolerance occupants have for discomfort, by using a ratio of the rating of overall comfort to the average of the ratings for the specific comfort variables. It thus quantifies the interpretation of forgiveness involving overall comfort. The formula is:

$$\frac{\text{comfort overall}}{\frac{\text{air winter} + \text{air summer} + \text{temp winter} + \text{temp summer} + \text{light} + \text{noise}}{6}}$$

Values for the BUS Forgiveness Index are normally in the range 0.8 – 1.2 with values greater than 1.0 indicating relatively more forgiveness. For the School of Architecture and Design, the BUS Forgiveness Index was 1.13 in 2007 and 1.14 in 2008, indicating a very high degree of forgiveness. This high degree of forgiveness as demonstrated by the Forgiveness Index is consistent with other research on sustainable buildings (refer to Chapter 3).

8.5 Chapter summary

From the data, it is evident that there is a high level of forgiveness of the building's shortcomings and idiosyncrasies among participants. I have used

the term forgiveness to indicate satisfaction with both overall comfort and the overall building in spite of dissatisfaction with the specific comfort variables.

With reference to the literature, it appears that this level of forgiveness can be attributed to the following factors: good design; values; aesthetics; contact with nature; positive experience of use; social interaction; personal control through adaptive behaviour; shallow plan form; natural light; and care taken with briefing, design and management. Many of these factors are effective due to their ability to engender well-being and delight, creating a positive mood which encourages positive perception of comfort and the overall building.

Other factors which research shows encourage forgiveness include understanding of design intent and perceived personal control over environmental conditions. The data did not show that these factors were represented in participant responses. There is an opportunity here to increase understanding of these factors so that the building can be effectively used as the architects intended.

Forgiveness relies on dissatisfaction with specific comfort as well as satisfaction with overall comfort and the overall building. In focussing on the benefits of forgiveness, it is important not to overlook what Leaman and Bordass (2005) describe as chronic faults; these need to be investigated and resolved where possible as discomfort can have a significant impact on productivity (ibid). It is likely that resolving these problems, particularly those related to thermal conditions and noise, would result in higher levels of productivity and increased satisfaction with both overall comfort and the overall building.

Forgiveness is a positive phenomenon in the sustainable building. It is a phenomenological experience which broadens the range of conditions which

occupants find comfortable and at the same time increases satisfaction with comfort levels and the overall building. It thus facilitates acceptance of sustainable buildings and at the same time has psychological, social and environmental benefits.

Chapter 9 Conclusions and recommendations

9.1 Summary of results in relation to research question

The research question underpinning this project was introduced in Chapter 1 as:

> *What, if any, aspects of occupant experience in the School of Architecture and Design building have relevance for sustainable architecture and advance the organisation's sustainability initiatives? How do they do this and to what effect?*

The three previous chapters have described, analysed and discussed the major aspects of the occupant experience of the School of Architecture and Design around the three dominant themes emerging from the data: forgiveness, comfort and delight. In sustainable architecture, minimising the energy expended on achieving comfort is arguably the most effective means of reducing greenhouse gases. However, sustainability initiatives in the physical fabric and building services alone without consideration of the phenomenological relationship the occupants have with the building can only partially realize their full potential. This study demonstrates that achieving comfort is a phenomenological experience influenced by psychological and physiological factors and that incorporating this understanding into the design of sustainable architecture encourages the use of energy efficient systems which more closely follow the external climate and provide a greater temperature range than the thermal monotony of a sealed air-conditioned building, as well as introducing elements of delight into the building.

As discussed in the previous three chapters, occupants of the School of Architecture and Design building were forgiving of specific aspects of discomfort when they expressed satisfaction and delight with overall comfort and the overall building. In particular, their very positive evaluation of the building design and image indicate great satisfaction and delight. Forgiveness therefore may be seen as the fulcrum which links and balances comfort and delight; occupants of a building which engenders delight will tend to forgive the variable comfort conditions often found in sustainable buildings and feel more comfortable. Forgiveness is a phenomenon to be encouraged in the design of sustainable buildings.

The literature indicates that forgiveness may be encouraged through facilitating adaptive comfort, providing personal control of occupants' indoor environmental conditions, having a building which expresses the values of the occupants, communicating the green design intent, and appropriate design and aesthetics which encourage well-being.

This study contributes to the research on occupant experience of sustainable buildings. This aspect of sustainable architecture is not well represented in current research, yet an understanding of it is essential to the success of sustainability initiatives. Post occupancy evaluation (hindsight) to close the loop on building performance and develop forward views (foresight), is crucial for the further development of sustainable architecture. The use of methods such as the BUS questionnaire facilitates knowledge sharing so that lessons can be learned more quickly and applied more broadly (Leaman et al, 2007).

As one component in an educational facility the building has the ability to influence other components to move towards a sustainable educational community. As an educational building, it has the power to increase community awareness and attitudes towards sustainability. Occupants,

including visitors, who are satisfied with a building are more likely to be prepared to engage in adaptation, expand their comfort experience and comfort expectations and communicate their experience of sustainability in a positive manner. As an architectural education building, the School has more potential than other buildings to be influential in the promotion of sustainable architecture and sustainable universities. It is likely that by occupying and experiencing this building, future architects are having their comfort expectations broadened and their environmental values strengthened. This has the potential to be carried over to the genuine incorporation of sustainability values into the design of a range of buildings in the future.

9.2 Recommendations

The following design principles for sustainable architecture have been developed from my research findings and contribute to one of my research aims which is to develop practical applications from the research. They have relevance for the design of sustainable architecture, particularly in universities; for the University of Tasmania and for the case study building, the School of Architecture and Design.

Principle 1: Develop processes and practices which will encourage forgiveness of discomfort

By designing to encourage forgiveness, the thermal variability and greater temperature range often associated with sustainable buildings can be accepted and possibly enjoyed. The research findings support the literature (Deuble and de Dear, 2010; Leaman et al, 2007; Leaman and Bordass, 2005; Leaman and Bordass, 2007) on factors which encourage forgiveness. These factors form the basis of the following eight principles.

Principle 2: Involve the building occupants in the design brief development and early design stages

This involvement encourages the expression of occupant values in the design and the likelihood that they will understand and support the design intent. Understanding the design intent has been shown to encourage greater tolerance of the overall building and forgiveness of discomfort (Leaman and Bordass, 2005). Resonance with the values expressed in a building through its image engenders psychological well-being in the building occupants (Heerwagen, 2005) which in turn positively influences perception of comfort (Ong, 1995) and thus forgiveness of discomfort. In the study building, occupant involvement in the design process was a likely contributor to the strong satisfaction expressed with the image of the building and the high level of forgiveness of discomfort. In following this principle, consideration needs to be given to the fact that a significant number of occupants in university buildings comprise a transient student group. The need to express the values of the occupants should be balanced with the need for flexibility and possible future adaptation of the building.

Principle 3: Incorporate opportunities for personal control of the internal environment

Personal control of the internal environment is identified in the literature as a means of encouraging forgiveness (Leaman and Bordass, 2005). It relates to personal controls for heating, cooling, lighting and ventilation. For example such features as personal heaters, task lighting, operable windows and blinds provide the opportunity for occupants to achieve comfort. However it is as much the *perception* of control which is effective, irrespective of the changes in physical conditions (Leaman and Bordass, 2005c), most likely due to the psychological well-being engendered by a sense of mastery over conditions (Truneckova, 2012). Occupants did not consider The School of Architecture

and Design provided many opportunities for personal control and it is possible that this may have influenced the negative ratings for comfort variables.

Principle 4: Provide spatial flexibility and variety to encourage adaptive comfort

By providing a variety of flexible spaces occupants can practice adaptive behaviour by finding a space with environmental conditions which are appropriate to their work requirements and personal preference. This adaptive behaviour can be seen as a means of having control over environmental conditions (Principle 3). The School of Architecture and Design's spatial variety in terms of size of space, degree of enclosure, access to natural light, sun penetration, glare, noise levels and thermal conditions provides different options for occupants depending on their requirements and comfort preferences. Large spaces such as studios are flexible and allow for individual or group work. Equipment, furniture, services and technology should support flexibility of use with, for example, mobile technology and wireless internet access. Zoning of services for energy efficiency should support the mobility of occupants, allowing them to relocate within the building. Spatial flexibility has the added benefit of supporting current developments in flexible teaching and learning (Jamieson et al, 2000).

Principle 5: Provide opportunities to adapt/fine-tune the building

This principle involves another form of adaptive behaviour which has relevance for building owners and managers as well as architects. It embraces the idea that the sustainable building is never complete and is always evolving. Fine-tuning the School of Architecture and Design building is resulting in increased thermal comfort and decreased impact of noise. Continuing adaptation such as the suggested mezzanine, will further these improvements. The process of adapting and fine-tuning the building has

educational benefits for the architecture students. Post occupancy evaluation should be used to identify opportunities for adaptation and fine-tuning.

Principle 6: Incorporate features which engender delight and well-being in the occupants

There is a link between mood and perception of comfort. Features which engender delight and well-being in building occupants are likely to increase perception of comfort, as well as productivity and health (Deuble and de Dear 2010, Heerwagen, 2005, Kaplan, 1998, Ohta, 2008, Ong, 1995, Rohles, 2007). These features include values which resonate with occupants expressed through the building's image; connection to nature through views and operable windows; natural light; fresh air; thermal delight (for example, sun patches); opportunities for social interaction; and aesthetics which increase perception of comfort (for example: soft, natural materials for warmth). Openness in the internal environment achieves or supports many of these. The School of Architecture and Design includes many of these features. Openness, natural light, fresh air, social interaction and image were all identified as things that work well and contributed to well-being and satisfaction. In facilities with many buildings, such as universities, a body of knowledge on building features which engender delight can be built up through post occupancy evaluation.

Aesthetics need to be based on values and balanced with common sense. If aesthetics celebrate sustainability, this expression of values will appeal to green occupants.

Principle 7: Increase occupant awareness of the design intent

Understanding the design intent, how to occupy the building so that the intended sustainability goals can be realised and how to operate controls to achieve comfort are essential aspects of occupying the sustainable building.

Occupants in the School of Architecture and Design admitted to not fully understanding how to operate controls in the building, yet as designers they are more likely than non-designers to be knowledgeable users. Leaman (2005) attributes the increased understanding of design intent and knowledge about operation of the building in designer occupants to their increased level of forgiveness. Increased awareness of design intent is thus particularly important in the more usual situation with non-designer occupants.

Sustainable buildings often incorporate adaptive comfort where the occupant is provided with the 'means of achieving comfort' rather than a situation where building services provide comfort (Nicol, 2011). Occupants may not be aware of how to achieve comfort effectively and efficiently. On-going processes for raising awareness are required to cater for transient occupant populations, such as students in universities.

Principle 8: Address issues of discomfort where there are cost-effective solutions

Whilst forgiveness should be encouraged, the very notion of forgiveness indicates that there is discomfort or 'chronic faults' as Leaman and Bordass (2005) describe it, to be forgiven. Some of this discomfort may be associated with the variability and broader temperature range characteristic of sustainable buildings and is not possible to change easily. However where there are cost-effective solutions, these faults should be resolved as they may impact on well-being, health and productivity (Leaman and Bordass, 2005). The installation of carpet on the ground floor studios in the study building was identified as making a positive difference to thermal comfort and noise. Quick effective response to issues has been identified as contributing to increased satisfaction with a building (ibid). Post occupancy evaluation is an effective means of identifying the most significant issues for occupants.

Principle 9: Incorporate zoning of building services

One of the characteristics of adaptive comfort is that occupants are more mobile. The mobility of occupants supports zoning of building services so that when buildings are not fully occupied, only specific zones are serviced. This is particularly relevant for university buildings which often have 24 hour access, but are not fully occupied after hours, such as the School of Architecture and Design. Zoning in the study building maximises the efficiency of heating provision by restricting it to the smaller spaces after hours. Most university buildings are also not fully occupied during the long summer vacation and consideration could be given to applying this principle at the campus scale as well as the building scale.

Principle 10: Employ post occupancy evaluation to close the loop on sustainable architectural practice

POE can be used to fine-tune/adapt the building being evaluated and may also be used for other similar buildings. Sustainable architecture considers the entire life cycle of a building 'cradle to cradle' (McDonough, 2002) and POE is an important component in closing this loop.

For facilities such as universities, knowledge generated by evaluating one building is likely to be relevant for other buildings within the facility.

This POE research has generated information about the study building which may be useful in fine tuning the building and for other UTAS buildings.

Principle 11: Choose wisely when selecting buildings for adaptive re-use

Adaptive re-use is an important aspect of sustainability. In selecting buildings for re-use, it is wise to ensure that basic sustainability requirements such as location, orientation, potential to alter unsustainable fabric etc are appropriate. The poor solar orientation and façade construction in the

School of Architecture and Design contribute to its significant thermal comfort issues. The heritage constraints which prevent alteration of the facades exacerbates the situation.

Principle 12: Universities should be exemplars of sustainability.

Universities are ideal sites for sustainable architecture. They are respected leaders in the community, educate the future decision makers, grow ideas in the community, have a collection of buildings continually undergoing change and provide opportunities to implement sustainability initiatives at a community scale.

In particular, the University of Tasmania's School of Architecture and Design as the site for the education of future architects, is an excellent opportunity to promote sustainable architecture. This building has the potential to inspire new thinking about sustainable architecture in teaching and learning. Also by experiencing a thermal environment which is not a static and narrow comfort band, a cohort of young people will redefine their comfort experience and expectations. As architects they will have more influence than other members of the community in promoting acceptance of a wider comfort band. It is therefore essential that the building continues to inspire them to contribute to a sustainable future.

9.3 Limitations of research

The demographic of the study sample is not representative of the general population, in that approximately 90% of participants were under 30. Because of this, the extent to which results can be generalised is questionable. The sample is however representative of the occupants of most university buildings and possibly many other educational buildings. The results

therefore have relevance for universities in achieving sustainable architecture for the campuses.

The results of this case study are consistent with the literature on forgiveness, adaptive comfort and sustainable buildings and therefore are likely to have broader relevance for sustainable architecture.

Another aspect of the generalization of my results is the fact that architects and architecture students may have different ways of experiencing buildings compared to non-designers. Leaman (2005) comments that designer occupants are less critical and more tolerant possibly because they are knowledgeable users and understand design intent better. The case study results are consistent with overall trends in the experience of sustainable buildings as documented in the literature, but the level of forgiveness in the case study sample is likely to be stronger than that of non-designer occupants.

9.4 Further research

This research involved post occupancy evaluation of one university building. To test the ability to generalise the findings, and build a body of knowledge about the occupant experience of sustainable university buildings, further post occupancy evaluations are necessary. Sustainable buildings at the University of Tasmania should have first priority, but buildings from other Australian universities could also be included. This could be an on-going project for architecture students to provide them with valuable insights into sustainable architecture.

There appears to be limited research on the relationship between design, mood and perception of comfort. As an issue which has great relevance for understanding the influences on forgiveness, it is an important area for the development of sustainable architecture. In particular understanding what

building characteristics engender delight, how this delight affects well-being and subsequently how it increases perception of comfort are areas for further research.

9.5 Conclusion

For centuries, architects have been guided by the Vitruvian triad of *firmitas, commoditas, venustas*, translated as *firmness, commodity and delight*as they endeavour to create inspiring architecture responding to the requirements of the site, client and occupants. Firmness is usually interpreted as structural stability; commodity describes the ability of a building to accommodate its intended function; and delight is often simply interpreted as beauty. The relative weighting of each of these three principles in the design of a building varies with every project and its particular requirements. However, in this age of sustainability, the triad of *firmness, commodity and delight* alone will not produce architecture which reduces our carbon footprint and minimises our impact on the Earth's diminishing resources.

To address this gap, this thesis proposes retaining delight, and adding two new elements of a revised and additional triad, *forgiveness, comfort and delight*. Such an addition is not to replace but to augment the original. This revision may provide new ways of thinking about and creating sustainable architecture for the twenty-first century.

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Appendix 1 Approvals

A 1.1 Ethics approval

A 1.2 Permission to use School of Architecture and Design as case study for research project

A 1.3 BUS Licence Agreement

A 1.1 Ethics approval

COPY

Private Bag 01 Hobart
Tasmania 7001 Australia
Telephone (03) 6226 2764
Facsimile (03) 6226 7148
Marilyn.Knott@utas.edu.au
http://www.research.utas.edu.au/index.html

MEMORANDUM

HUMAN RESEARCH ETHICS COMMITTEE (TASMANIA) NETWORK

MINIMAL RISK ETHICS APPLICATION APPROVAL

7 September 2007

Dr Elaine Stratford
Geography and Environmental Studies
Private Bag 78
Hobart

Ethics reference: H9715

Designing the healthy building: Evaluating a University's internal initiatives towards sustainability.

Student: Prue Slatyer (Masters)

Dear Dr Stratford

Acting on a mandate from the Tasmania Social Sciences HREC, the Chair of the committee considered and approved the above project on 6 September 2007.

All committees operating under the Human Research Ethics Committee (Tasmania) Network are registered and required to comply with the *National Statement on the Ethical Conduct in Research involving Humans 1999* (NHMRC guidelines).

Therefore, the Chief Investigator's responsibility is to ensure that:

1) All researchers listed on the application comply with HREC approved application.
2) Modifications to the application do not proceed until approval is obtained in writing from the HREC.
3) The confidentiality and anonymity of all research subjects is maintained at all times, except as required by law.
4) Clause 2.37 of the *National Statement* states:
   An HREC shall, as a condition of approval of each protocol, require that researchers immediately report anything which might warrant review of ethical approval of the protocol, including:
   a) *Serious or unexpected adverse effects on participants;*
   b) *Proposed changes in the application; and*
   c) *Unforeseen events that might affect continued ethical acceptability of the project.*

   The report must be lodged within 24 hours of the event to the Ethics Executive Officer who will report to the Chairs.

5) All participants must be provided with the current Information Sheet and Consent form as approved by the Ethics Committee.
6) The Committee is notified if any investigators are added to, or cease involvement with, the project.
7) This study has approval for four years contingent upon annual review. An *Annual Report* is to be provided on the anniversary date of your approval. Your first report is due [12 months from 'Ethics Committee Approval' date]. You will be sent a courtesy reminder by email closer to this due date.
   Clause 2.35 of the National Statement states:
   As a minimum an HREC must require at regular periods, at least annually, reports from principal researchers on matters including:
   a) Progress to date or outcome in case of completed research;
   b) Maintenance and security of records;
   c) Compliance with the approved protocol, and
   d) Compliance with any conditions of approval.
8) A *Final Report* and a copy of the published material, either in full or abstract, must be provided at the end of project.

Yours sincerely

Ethics Executive Officer

A 1.2 Permission to use School of Architecture and Design as case study for research project

Roger Fay <Roger.Fay@utas.edu.au>

12/01/2007 01:56 PM

To Matt Smith <M.A.Smith@utas.edu.au>
cc Elaine Stratford <Elaine.Stratford@utas.edu.au>, Wendy.Kesseling@utas.edu.au, Prue Slatyer <slatyerp@hobartcity.com.au>
Subject Re: evaluating a uni building

Dear Matt,

I have no objection. The new building, with all its strengths and weaknesses, will make a good case study. As someone who has been publically critical of the design professions for not being prepared to allow their buildings to be scrutinised openly, I can hardly say no!

Regards,

Roger

.....
Professor Roger Fay
School of Architecture and Design
University of Tasmania
Locked Bag 1323, Launceston TAS 7250
Australia
E Roger.Fay@utas.edu.au
T +61 (0)3 6324-3576
F +61 (0)3 6324-3557
M 0438-243-576

From: M.A.Smith@utas.edu.au [mailto:M.A.Smith@utas.edu.au]
Sent: Friday, 12 January 2007 8:33 AM
To: Slatyer, Prue
Cc: Elaine.Stratford@utas.edu.au; Roger.Fay@utas.edu.au; Wendy.Kesseling@utas.edu.au
Subject: Re: evaluating a uni building

Dear Prue,
As discussed yesterday, the refurbishment of the Exhibition Bldg in LCN for the School of Architecture and Design would be a good candidate building. You advised that you would undertake your study later this year, giving occupants time to settle in and going through summer/winter periods. Roger is on leave at the minute, and I would need his concurrence before giving the 'final nod'.

Roger,
Are you agreeable to the proposal below (and above), with the Architecture bldg at Inveresk being nominated the case study building? I would see it providing good information for the BEC, AMS, the School, and generally pushing the UTAS EM governance level principle objectives.

Regards, Matt Smith

Director, Asset Management Services
University of Tasmania
Private Bag 35
Hobart Tasmania 7001 Australia
T (03) 6226 2796
M 0418 132 079 (5549 speed dial - internal use only)
F (03) 6226 7699
E-mail - M.A.Smith@utas.edu.au

Our Vision - "Managing Assets for UTas Excellence"

Please visit the AMS website at www.utas.edu.au/ams

"Slatyer, Prue" <slatyerp@hobartcity.com.au>

09/01/2007 06:11 PM

To <M.A.Smith@utas.edu.au>
cc <elaine.stratford@utas.edu.au>
Subject evaluating a uni building

Hi Matt,

I am currently undertaking a masters by research degree in environmental studies with a topic of healthy buildings within a framework of sustainability.
As I work for Hobart City Council, I planned to use a building I have been working on as a case study. However progress on this has been delayed and it no longer fits my research timetable.

Elaine Stratford, my supervisor, suggested I talk to you about using a uni building instead. I am looking for a building which has been designed on sustainability principles and which has been recently constructed or refurbished. I would like to carry out a post occupancy evaluation by surveying the building occupants to ascertain their satisfaction with the building.

The results of post occupancy evaluations can be very useful for building owners and managers in providing feedback about a particular building, informing future design briefs to architects and assisting with facilities planning and management.

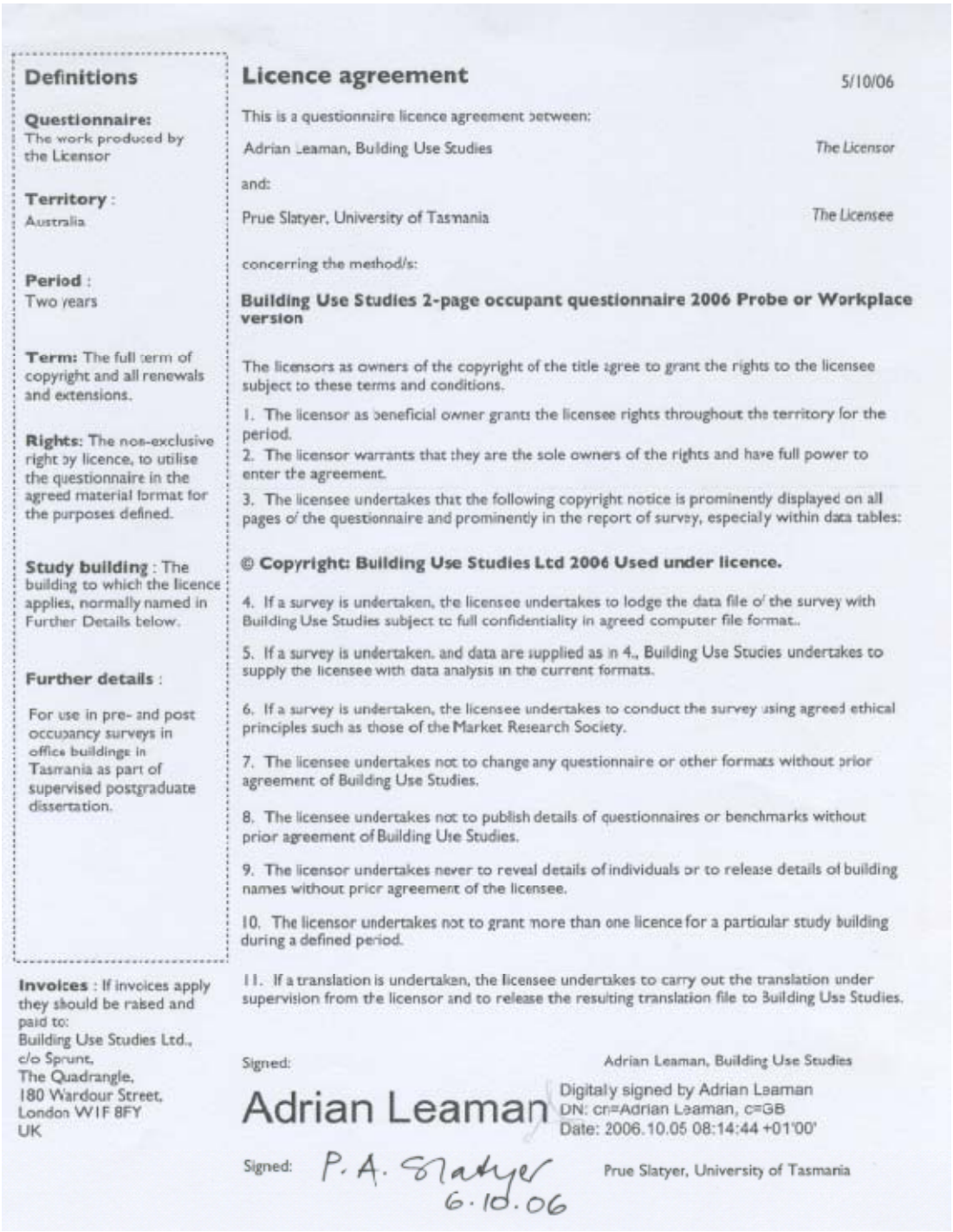
Would it be possible to meet and discuss the possibility of evaluating a uni building? If so, Elaine would be interested in joining us and it may be best to find a time that suits her first as I am more flexible.

Best wishes,
Prue

Prue Slatyer
Manager, Architectural Projects Unit
Professional Services Group
Hobart City Council
GPO Box 503
Hobart
Tasmania 7001

ph 03.62382907
fax 03.62349757
slatyerp@hobartcity.com.au

A 1.3 BUS Licence Agreement



Definitions

Questionnaire: The work produced by the Licensor

Territory : Australia

Period : Two years

Term: The full term of copyright and all renewals and extensions.

Rights: The non-exclusive right by licence, to utilise the questionnaire in the agreed material format for the purposes defined.

Study building : The building to which the licence applies, normally named in Further Details below.

Further details :

For use in pre- and post occupancy surveys in office buildings in Tasmania as part of supervised postgraduate dissertation.

Invoices : If invoices apply they should be raised and paid to:
Building Use Studies Ltd.,
c/o Sprunt,
The Quadrangle,
180 Wardour Street,
London W1F 8FY
UK

Licence agreement 5/10/06

This is a questionnaire licence agreement between:

Adrian Leaman, Building Use Studies — *The Licensor*

and:

Prue Slatyer, University of Tasmania — *The Licensee*

concerning the method/s:

Building Use Studies 2-page occupant questionnaire 2006 Probe or Workplace version

The licensors as owners of the copyright of the title agree to grant the rights to the licensee subject to these terms and conditions.

1. The licensor as beneficial owner grants the licensee rights throughout the territory for the period.
2. The licensor warrants that they are the sole owners of the rights and have full power to enter the agreement.
3. The licensee undertakes that the following copyright notice is prominently displayed on all pages of the questionnaire and prominently in the report of survey, especialy within data tables:

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4. If a survey is undertaken, the licensee undertakes to lodge the data file of the survey with Building Use Studies subject to full confidentiality in agreed computer file format..
5. If a survey is undertaken, and data are supplied as in 4., Building Use Studies undertakes to supply the licensee with data analysis in the current formats.
6. If a survey is undertaken, the licensee undertakes to conduct the survey using agreed ethical principles such as those of the Market Research Society.
7. The licensee undertakes not to change any questionnaire or other formats without prior agreement of Building Use Studies.
8. The licensee undertakes not to publish details of questionnaires or benchmarks without prior agreement of Building Use Studies.
9. The licensor undertakes never to reveal details of individuals or to release details of building names without prior agreement of the licensee.
10. The licensor undertakes not to grant more than one licence for a particular study building during a defined period.
11. If a translation is undertaken, the licensee undertakes to carry out the translation under supervision from the licensor and to release the resulting translation file to Building Use Studies.

Signed: Adrian Leaman, Building Use Studies

Adrian Leaman

Digitaly signed by Adrian Leaman
DN: cn=Adrian Leaman, c=GB
Date: 2006.10.05 08:14:44 +01'00'

Signed: P. A. Slatyer 6.10.06 Prue Slatyer, University of Tasmania

Appendix 2 Research tools

A 2.1 Participant consent forms and information sheets

A 2.2 Framework for interviews and focus groups

A 2.1 Participant consent forms and information sheets

Private Bag 78 Hobart
Tasmania 7001 Australia
Telephone (03) 6226 2999
Facsimile (03) 6226 2018

SCHOOL OF GEOGRAPHY AND ENVIRONMENTAL STUDIES

3.9.07

Dear student/staff member at the School of Architecture, University of Tasmania,

Information Sheet

Designing the Healthy Building: Evaluating a University's Internal Initiatives for Sustainability

You are invited to participate in a research project which explores the design of healthy buildings within a framework of sustainability. The research is being carried out by Prue Slatyer to fulfil the requirements of a Master of Environmental Studies degree, in the School of Geography and Environmental Studies at the University of Tasmania.

The research aims to investigate the relationship between the built environment and human health and well-being and focuses on the opportunity for universities to create healthy buildings as part of their initiatives towards sustainability. The results of the research project will provide useful information for architects and universities, particularly Asset Management Services at the University of Tasmania.

The School of Architecture will be used as a case study to explore attributes of the building which contribute to, or impact on, the occupants' health and sense of well-being as well as aspects of the building contributing to sustainability. It is hoped that as many staff and students possible participate in the research so that the full spectrum of opinions can be canvassed.

Participation is voluntary and involves responding to the same questionnaire on two occasions: in September 2007 while the building is relatively new and one year later when the building's performance has had time to be fine tuned. As the project nears completion in late 2008, all participants will be provided with a summary report of the research findings.

The questionnaire is from an established building research organisation in the UK, the Usable Buildings Trust. Questionnaire responses are sent to Usable Buildings Trust for analysis and data are returned in the form of tables and graphs. The questionnaire will be distributed and collected on the same day and is expected to take 5 - 10 minutes to complete. Your responses should be frank and honest so that research data are as accurate and useful as possible.

Responses will be treated as strictly confidential by the Usable Buildings Trust and individual participants will not be identifiable in the returned data. However, you will be asked to provide your name on the cover sheet of the completed questionnaire so that Prue can follow up with interviews and/or focus groups on specific issues of interest if participants are willing. To protect any confidences that may emerge, identifiable responses will not be reported in any form to anyone beyond the research team.

Completed questionnaires will be stored in a locked cabinet in the School of Geography and Environmental Studies at the University of Tasmania. It is a research ethics requirement that they are kept for a minimum period of five years and then may be destroyed. The project has received ethical approval from the Human Research Ethics Committee (Tasmania) Network (HREC).

Please contact Prue Slatyer on 03. 62252504, 0438366092 or slatyerp@utas.edu.au , if you have any questions of a general nature. You may also talk with supervisors, Dr Elaine Stratford (phone 03. 62262462, Elaine.Stratford@utas.edu.au) and Dr Aidan Davison (phone 03. 62267590, Aidan.Davison@utas.edu.au). If you have any concerns or complaints about any aspect of the project, please contact the Ethics Office of the HREC (03. 62267479 or human.ethics@utas.edu.au).

Thank you in anticipation of your valued participation.
Yours sincerely,

Prue Slatyer, Dr Elaine Stratford, Dr Aidan Davison

Private Bag 78 Hobart
Tasmania 7001 Australia
Telephone (03) 6226 2999
Facsimile (03) 6226 2018

SCHOOL OF GEOGRAPHY AND ENVIRONMENTAL STUDIES

Health and Well-being in the Sustainable Building: Evaluating a University's Internal Initiatives towards Sustainability.

16.9.08

Focus group consent: students

Dear architecture student,

I am undertaking research for a Master of Environmental Studies degree at the University of Tasmania. My research topic is *Health and Well-being in the Sustainable Building: Evaluating a University's Internal Initiative towards Sustainability*. A major component of my research is the post occupancy evaluation of the School of Architecture at UTAS. Please find attached an information sheet which provides more details about the post occupancy evaluation.

One stage of the evaluation is a questionnaire. Another opportunity to contribute are the focus groups with students.

Please sign this form to indicate your willingness to participate in a focus group.

Thanks very much for your valued involvement,

Prue Slatyer

Masters candidate, School of Geography and Environmental Studies, University of Tasmania

Student name	(eg. Arkie SMITH)
University email address	@postoffice.utas.edu.au
Year of study	1 2 3 4 5
Male or female?	male female
Signature	

Private Bag 78 Hobart
Tasmania 7001 Australia
Telephone (03) 6226 2999
Facsimile (03) 6226 2018

SCHOOL OF GEOGRAPHY AND ENVIRONMENTAL STUDIES

Health and Well-being in the Sustainable Building: Evaluating a University's Internal Initiatives towards Sustainability.

19.6.07

Interview consent: staff

Dear staff member,

I am undertaking research for a Master of Environmental Studies degree at the University of Tasmania. My research topic is *Health and Well-being in the Sustainable Building: Evaluating a University's Internal Initiative towards Sustainability*. A major component of my research is the post occupancy evaluation of the School of Architecture at UTAS. Please find attached an information sheet which provides more details about the post occupancy evaluation.

One stage of the evaluation is a questionnaire. Another opportunity to contribute is an interview.

Please sign this form to indicate your willingness to participate in an interview.

Thanks very much for your valued involvement,

Prue Slatyer

Masters candidate, School of Geography and Environmental Studies, University of Tasmania

Staff name	
University email address	@.utas.edu.au
Signature	

A 2.2 Framework for interviews and focus groups

FOCUS GROUPS 2007: QUESTIONS

SCHOOL OF ARCHITECTURE AND DESIGN STUDENTS, Years 2,3,4, max 12

AIMS/OBJECTIVES

To obtain detailed information on student response to the building to complement the overview response obtained via the questionnaire.

ISSUES AND QUESTIONS

Indoor climate

What is a comfortable indoor climate?
How should the internal climate relate to the external climate?

Thermal comfort (heating, cooling, ventilation)

How comfortable is the building in summer? In winter?
Explain thermal comfort/discomfort/symptoms experienced.
Explain the impact of comfort/discomfort. What do you feel causes this comfort/discomfort?

Air quality (humidity, IAQ, freshness)

How comfortable is the indoor air?
Explain comfort/discomfort experienced.
Explain the impact of comfort/discomfort. What do you feel causes this comfort/discomfort?

Aural comfort/noise

How comfortable is the aural environment?
Explain aural comfort/discomfort experienced.
Explain the impact of comfort/discomfort. What do you feel causes this comfort/discomfort?

Artificial lighting

How comfortable is the artificial lighting?
Explain comfort/discomfort experienced.
Explain the impact of comfort/discomfort. What do you feel causes this comfort/discomfort?

Access to windows

Do you have access to windows for daylight? For views? For fresh air?
Explain the impact of access to windows in the building.
How could access to windows be improved?

Individual control over environmental conditions

Are you able to control heating/cooling/ventilation/lighting in your immediate environment?
Explain the impact of this control/lack of control.

Social spaces

Does the building have sufficient spaces for relaxing and socializing away from study/work areas?
Do these relaxing/social spaces accommodate a range of activities eg individuals, small groups, large groups, passive, active, eating, drinking?
How important are relaxing/social spaces in the building?

Outdoor spaces
Are there adequate outdoor spaces associated with the building?
What is your perception of the quality of the outdoor spaces?
Is there a strong relationship between indoor and outdoor spaces?
Is this necessary? Why/why not?
What is the impact of the provision of outdoor spaces?

Location
How sustainable is the location?
Does the location have health benefits?
What is the impact of the location relative to the main campus (Newnham)?

Landscape setting
How successfully does the building relate to its landscape setting?
Does it reinforce the sense of place? How does this effect your well-being?

Personal safety and security
How successfully have occupational safety (OH&S) issues been resolved in the building?
How safe do you feel in and around the building, especially after hours?
What is the impact of this?

Accessibility
Are all parts of the building accessible, especially for those with restricted mobility?
If not, what are the problems? What impact do they have?

Health and hygiene
Are there adequate toilets, showers, sick rooms? What is the impact of this?

Image
How do you feel about the image of the school?
Does the building express the culture of the university/school?
Does the building engender in students a sense of belonging to the university/school?
In what way/s?
Is the building welcoming to visitors? In what way/s?
How easy is wayfinding within the building? What are the successes/problems?

Psychological factors
Do you think the building affects how you relate to others? In what way/s?
Does the building support confidentiality when required? In what way/s?
Does the building support collaborative team working? In what way/s?
Does the building support equity? In what way/s?

General
How does the building impact on your health and sense of well-being?
How does the building support or impact on your learning/research?

FOCUS GROUPS 2008: QUESTIONS
SCHOOL OF ARCHITECTURE AND DESIGN STUDENTS

INTRODUCTION
Pip, Prue

RESEARCH PROJECT
Looking at social aspects of sustainability. Do sustainable buildings promote health and well-being in occupants?

AIMS/OBJECTIVES OF FOCUS GROUP
To explore issues arising out of responses in the 2007 questionnaire.

ISSUES AND QUESTIONS

Design and Image
What factors contribute to good design?
How do you define image?
Does image contribute to building quality? In what way?
How important is comfort when rating the design quality of a building?
Do architecture students perceive design differently to the general population?
Do architecture students place a different value on design to the general population?
How will this affect their work as an architect?

Health and well being and productivity
How does the building impact on your health and sense of well-being?
How does the building support or impact on your learning/research?

Social interaction
Have social spaces developed since last year? Inside and/or outside?
Has interaction between staff and students changed?

Awareness of building operation
Any changes which increase understanding of the building's operation?

Individual control over environmental conditions
Any changes to individual control of heating/cooling/ventilation/lighting?

Thermal comfort and Noise and Indoor air quality (freshness, humidity, IAQ)
Any significant changes since last year?

Lighting
Adaptation to lighting issues?
Adaptation to glare?

Access to windows
Has access to windows improved?

Outdoor spaces
Any developments?

Personal safety and security
Issues?

Any other comments?

INTERVIEWS 2007: HOS QUESTIONS

AIM/OBJECTIVES
To provide background information on:

- the decision-making leading to the location of the school and the choice of building
- selection of architects
- design briefing
- the school's involvement in the design process
- HOS satisfaction with the procurement process
- HOS satisfaction with the design.

ISSUES AND QUESTIONS
Preliminary decision making
How was the decision on the school's location made?
What other options were investigated?
How was the decision made to use the former diesel workshop?
What are the advantages/disadvantages of the chosen location and building?
How do the decisions relate to UTAS policies on sustainability?

Selection of architects
How were the architects chosen?

Design briefing
What was the scope of the design brief?
Who developed the brief?

Design process
What was the school's involvement in the design process?
As client, do you feel the architects responded to your requirements?

HOS satisfaction with the procurement process
How satisfied are you with the procurement process?
What were the successes/problems?

HOS satisfaction with the design
Overall, how satisfied are you with the finished building?
Does it comply with the brief?
Is it being used as intended?

INTERVIEW: 2009 HOS QUESTIONS

INTRODUCTION
Prue

RESEARCH PROJECT
Looking at social aspects of sustainability. Do sustainable buildings promote health and well-being in occupants?

AIMS/OBJECTIVES OF INTERVIEW
To explore both HOS assessment of how well the building promotes the philosophy of the school and satisfies its requirements and also own experience. Some of the questions relate to results from the 2 POEs.

ISSUES AND QUESTIONS
Design and Image
What should this building say about the School of Architecture? To students? To staff? To visitors?
How well does this building do this?

In POE, building rated highly by students in terms of design and image.
- What do you think the students feel contributes to good design?
- Does image contribute to building quality? In what way?
- Do architecture students perceive design differently to the general population?
- Do architecture students place a different value on design to the general population?
- How will this affect their work as an architect?

Thermal comfort
How important is comfort when rating the design quality of a building?
How well do you think this building performs in terms of comfort?

Individual control over environmental conditions
How much individual control of heating/cooling/ventilation/lighting should there be?
Does this building provide this level of individual control?

Productivity
In relation to this building, what aspects contribute to its success in terms of satisfying the needs of the occupants? ie How does the building support or impact on learning/research?

Health and well-being
How does the building impact on the health and well-being of students? Of staff?

Access to outside?
How important is physical access to outside?
How well does the building perform?

Access to windows
How important is visual access to outside?
How well does the building perform?

Social interaction
How does the building encourage or restrict informal social interaction?

How does the building encourage or restrict interaction between staff and students?
Is this appropriate?

Awareness of building operation
How well do students and staff understand the operation of the building?

Noise
What is your opinion on noise levels in the building?

Indoor air quality (freshness, humidity, IAQ)
What is your opinion on IAQ?

Lighting
What is your opinion on lighting levels in the building?
What about glare?

Personal safety and security
Issues?

Personal evaluation
What is your personal evaluation of the building in terms of the above factors? Ie what is your experience of the building?

Sustainability
Do you feel there is a correlation between **environmental** and **social** sustainability?

Any other comments?

INTERVIEWS 2007: PROJECT ARCHITECTS (SBE, 6 DEGREES) QUESTIONS

AIM/OBJECTIVES

To provide background information on:

- design briefing
- design intent
- design constraints and opportunities
- the design process
- architects satisfaction with the design and resulting building
- role of architects for sustainable, healthy buildings
- architects opinion of post occupancy evaluation

ISSUES AND QUESTIONS

Design briefing

Describe the brief you were given for the building design.
Did it provide the right information?
If not how did you source the relevant information?

Design intent

Please describe your aims for the building.
To what extent was sustainability one of your objectives?
To what extent was occupant health and well-being one of your objectives?
Is there a relationship between the two? In what way?

Design constraints and opportunities

To what extent did the decision to recycle an industrial building at Inveresk provide opportunities or constraints to further your aims?

Design process

Please describe the deign process.
What were the highs and lows?
How easy was it having a School of Architecture and Design as your client?
What was your relationship with the School during the design process?

Architects satisfaction with the design and resulting building

To what extent did the final design fulfill your aims?
To what extent does the final building fulfill your aims?
What have you learnt from the project?

Role of architects for sustainable, healthy buildings

Does the architect's role change for sustainable buildings?
At what stage in the life of a sustainable building is the architect's involvement over?

Post occupancy evaluation

Do you carry out poe on buildings you have designed?
Why? Why not?
How useful is the information from poe?

INTERVIEWS 2007: STAFF QUESTIONS

SCHOOL OF ARCHITECTURE AND DESIGN STAFF ACADEMIC
GENERAL
TIMBER RESEARCH UNIT

AIMS/OBJECTIVES

To obtain detailed information on staff response to the building to complement the overview response obtained via the questionnaire.

ISSUES AND QUESTIONS

Thermal comfort (heating, cooling, ventilation)

How comfortable is the building in summer? In winter?
Explain thermal comfort/discomfort experienced.
Explain the impact of comfort/discomfort. What do you feel causes this comfort/discomfort?

Air quality (humidity, IAQ, freshness)

How comfortable is the indoor air?
Explain comfort/discomfort experienced.
Explain the impact of comfort/discomfort. What do you feel causes this comfort/discomfort?

Aural comfort/noise

How comfortable is the aural environment?
Explain aural comfort/discomfort experienced.
Explain the impact of comfort/discomfort. What do you feel causes this comfort/discomfort?

Artificial lighting

How comfortable is the artificial lighting?
Explain comfort/discomfort experienced.
Explain the impact of comfort/discomfort. What do you feel causes this comfort/discomfort?

Access to windows

Do you have access to windows for daylight? For views? For fresh air?
Explain the impact of access to windows in the building.
How could access to windows be improved?

Individual control over environmental conditions

Are you able to control heating/cooling/ventilation/lighting in your immediate environment?
Explain the impact of this control/lack of control.

Social spaces

Does the building have sufficient spaces for relaxing and socializing away from study/work areas?
Do these relaxing/social spaces accommodate a range of activities eg individuals, small groups, large groups, passive, active, eating, drinking?
How important are relaxing/social spaces in the building?

Outdoor spaces

Are there adequate outdoor spaces associated with the building?
What is your perception of the quality of the outdoor spaces?
Is there a strong relationship between indoor and outdoor spaces?
Is this necessary? Why/why not?
What is the impact of the provision of outdoor spaces?

Landscape setting
How successfully does the building relate to its landscape setting?
Does it reinforce the sense of place? How does this effect your well-being?

Personal safety and security
How successfully have OH&S issues been resolved in the building?
How safe do you feel in and around the building, especially after hours?
What is the impact of this?

Accessibility
Are all parts of the building accessible?
If not, what are the problems? What impact do they have?

Health and hygiene
Are there adequate toilets, showers, sick rooms? What is the impact of this?

Image
Does the building express the culture of the school?
Does the building engender in staff a sense of belonging to the school?
In what way/s?
Is the building welcoming to visitors? In what way/s?
How easy is wayfinding within the building?
What are the successes/problems?

Psychological factors
Do you think the building affects the way you relate to others?
In what way/s?
Does the building support confidentiality when required?
In what way/s?
Does the building support collaborative team working?
In what way/s?
Does the building support equity?
In what way/s?

General
How does the building impact on your health and sense of well-being?
How does the building support or impact on your teaching or working?

Appendix 3 Analysis

A 3.1 Analysis of questionnaire comments

BUILDING DESIGN OVERALL 2007		
COMMENT	**MAJOR ISSUES**	**-/o/+**
Teething problems, cold and the first and second year studios are way too noisy.	Thermal, noise, adjustment.	-
1ST and 2nd year studios cold and very loud.	Noise, thermal.	-
2nd year studio too noisy, too bright in summer.	Noise, glare.	-
Year 1 studio either too cold in morning and too bright in the afternoon. Curtains needed.	Noise, glare.	-
Certain factors need to be reconsidered such as noise and excess sunlight in lower studios.	Noise, glare.	-
Glare is a problem in studio space. Noise is also a problem.	Noise, glare.	-
Problems with acoustics and teaching spaces, lighting.	Noise, lighting.	-
Acoustically not satisfactory. Glare factor throughout building. Temperature issues throughout 24 hour period.	Noise, glare, thermal.	-
Acoustics, glare, ventilation and heating are serious concerns.	Noise, glare, thermal, ventilation.	-
Old building, heating is not good. Lots of noise and echoes. No sense of belonging. No warm water for shower.	Noise, thermal, belonging.	-
NOISE! Acoustic poor. Thermal condition – poor.	Noise, thermal.	-
The building is often too cold and noisy in the studio spaces.	Noise, thermal.	-
Problems: heating, excessive lighting, noise in many areas where it is paramount that silence is maintained.	Noise, thermal, glare.	-
Too cold in winter, too hot in summer, sunglasses need to be worn in 2nd year studio in summer.	Thermal, glare.	-
Too cold/too warm. Inefficient to heat the whole building.	Thermal.	-
Very cold.	Thermal.	-
Quite cold in studios, hot sun in summer due to large glazing.	Thermal.	-
Studio rooms get way too hot in afternoon. Windows need to be double glazed or tinted. It's very glarey about 2-3ish.	Thermal, glare.	-
It is freezing cold inside the building and the library is quite far away.	Thermal, library.	-
Although the building is designed for sustainability, conditions can become uncomfortable. Computer labs often stuffy.	Comfort, ventilation.	-
Can be noisy due to open plan.	Noise, openness.	-
Noisy – our studio is a circulation area.	Noise, planning.	-
Some issues such as noise and privacy.	Noise, privacy.	-
Spacious, noisy, not intimate.	Noise, privacy.	-
Temperature control not even. No relaxing/enclosed spaces.	Thermal, enclosed spaces, social spaces.	-
'The building lacks social spaces and areas for rest or areas to have a break from your work spaces –no promotion of social	Social spaces, planning.	-
Too bland aesthetically. Too little intermediary space.	Image, spatial type.	-
Bad design with a lot ESD bullshits.	Design, ESD	-
The building LEAKS!!!! (Lecture room)	Waterproof	-
Doesn't provide a proper study environment – is basically a factory.	Image, functionality.	-
No after hours entry at front.	Management	-
Sole second year studio would be nice.	Planning.	-
Sucks.	Non-specific.	-
Aesthetics-wise good, comfort- wise poor.	Aesthetics (+), comfort (-).	o
No thermostats on individual office heating. Poor sound isolation between spaces. SPATIALLY GREAT.	Image (+), thermal (-), noise.	o
Cool design, however falters functionally due to heating.	Image(+), thermal (-).	o
Great design visually but needs to be more sound and warmth effective.	Image (+), noise (-), thermal (-).	o
Very good, can be quite cold at night because of the high ceiling.	Design (+), thermal (-), noise (-).	o
It's good to get natural sunshine, but 3-4pm I cannot find shadow place and sometimes too hot.	Sun (+), thermal(-)	o

BUILDING DESIGN OVERALL 2007		
COMMENT	**MAJOR ISSUES**	
Nice and light, but issues with noise and social areas.	Nat. lighting (+), noise (-), social spaces (-)	o
Good design layout but small details not considered. Glare from large windows, also heating, cooling of large space and echo	Planning (+), thermal (-), glare (-), noise (-	o
It's good that it has created an open space but the noise that can be created at some stages is an issue.	Openness (+), noise (-)	o
Good design, ESD strategies but thermal and glare and leaking.	Design (+), ESD (+), thermal(-), glare (-), waterproofing (-).	o
Ideas are there but it doesn't seem to work that well.	Design principles (+), design (-).	o
The design is great in principle, but there are elements which do not work.	Design principles (+), design (-).	o
Good spaces – pleasing generally, but fails in certain areas.	Design (+, -)	o
Flexible but a bit too unfinished.	Flexibility (+), image (-)	o
Taking time to refine design based on feedback.	Adaptability (+), rate of (-)	o
Budget constraints limited initial intentions. That considered, it is very well designed.	Design	+
Great design visually	Image	+
Sustainable design in a way to encourage group discussion.	ESD	+
Very inspiring space to work in.	Image	+
I really enjoy working in the building, I think it provides many working opportunities and keeps me at school for large hours.	Productivity.	+
Exciting and functional. Healthy interior.	Image, functionality, health.	+
Well thought out. Interesting elements to inspire design.	Design	+
Circulation is pine timber construction and finishes look good.	Materiality.	+
Timber rules!	Materiality.	+
People able to move about easily and access spaces.	Accessibility, circulation.	+
Very useful, brief design, a big workshop, good circulation.	Functionality, circulation	+
Very usable. Space is multi-purpose.	Functionality, flexibility.	+
Good solution for such an old building.	Retrofitting.	+
It is a really impressive refit that everyone is proud of attending.	Image	+
Over the short period of time I have spent here, so far all building design solutions work satisfactory/well.	Functionality	+
Did very well within such a limited budget.	Design	+
Good.	Non-specific	+
Cool design.	Design	+
Great design.	Design	+
Good design	Design	+

BUILDING DESIGN OVERALL 2008		
COMMENT	**MAJOR ISSUES**	**-/o/+**
A bit cold during winter.	Thermal.	-
Building seems to be cold in winter and hot in summer.	Thermal.	-
Cold at times.	Thermal.	-
Cold during winter.	Thermal.	-
Cold in morning.	Thermal.	-
Cold in winter and hot in summer.	Thermal.	-
Cold in winter, overheats in summer, no insulation. Not very green (supposed to be).	Thermal.	-
Cold in winter, warm in summer.	Thermal.	-
Cold when cold, hot when hot.	Thermal.	-
Cold.	Thermal.	-
Cold.	Thermal.	-
Doesn't work, hot or cold. Isn't comfortable.	Thermal.	-
Gets really cold.	Thermal.	-
Gets very cold/hot.	Thermal.	-
Heating and cooling problems.	Thermal.	-
Heating is poor and cooling through summer.	Thermal.	-
Insulation is lacking – very cold in winter.	Thermal.	-
Is too cold in winter.	Thermal.	-
It can be cold at times without heating.	Thermal.	-
It does have a lot of seasonal issues such as heating and cooling. But that's obvious.	Thermal.	-
It gets very cold at the upper level (students work place) during the night.	Thermal.	-
It still becomes VERY cold after hours.	Thermal.	-
It's cold during night time.	Thermal.	-
It's too cold.	Thermal.	-
It's very cold in winter and there are too many windows which let too much sun in and warmth out.	Thermal.	-
Main issue is climate control.	Thermal.	-
Poor insulation.	Thermal.	-
Sun issues and temp issues.	Thermal.	-
Temp range.	Thermal.	-
Too cold every night.	Thermal.	-
Too cold during winter.	Thermal.	-
Too cold in winter. Heater don't seem to be working.	Thermal.	-
Too cold, too many bottle necks.	Thermal.	-
Too cold.	Thermal.	-
Too cold.	Thermal.	-
Too cold. No studio culture.	Thermal.	-
Too cold. Poor heating.	Thermal.	-
Very cold in winter – unbearably of a night.	Thermal.	-
Very cold.	Thermal.	-

BUILDING DESIGN OVERALL 2008		
COMMENT	**MAJOR ISSUES**	**-/o/+**
Cold, loud, noisy, lacking windows for students.	Thermal, noise, windows.	-
Cold, bad acoustics/lighting, not enough work space/quiet rooms.	Thermal, noise, lighting, enclosed spaces.	-
It's not a very warm building, nor is it friendly or sympathetic to us.	Thermal, image	-
Too open, during winter too cold. Cannot really adapt with.	Thermal, openness, adaptation.	-
Not sufficient space for students. It is cold at night and hot in summer.	Thermal, amount of space.	-
Sometimes it gets a bit stuffy in room and cold upstairs in studio.	Thermal, ventilation.	-
When heating and air ventilation issues are fixed.	Thermal, ventilation.	-
Lack of heating/cooling. Noise carries.	Thermal, noise.	-
Lecture theatre-hard to concentrate, loud air con noise and fluorescent buzz. Very hot in summer, very cold in winter.	Thermal, noise.	-
Noise issue – workshop. Sun issues-1st year studio.	Thermal, noise.	-
Noisy, fluctuating temperatures.	Thermal, noise.	-
Noise carries a lot in the building. Light levels bad and hot or cold 1st year studio.	Noise, lighting, thermal.	-
Poor lighting.	Lighting.	-
Bit noisy.	Noise.	-
Poor acoustics.	Noise.	-
Rain is loud.	Noise.	-
2 exits – unable to meet other students around. No gathering/meting point for students.	Social spaces.	-
Lack of social space for social interaction.	Social spaces.	-
No adequate student areas.	Social spaces.	-
Not enough instruction space and courtyard. COURTYARD!	Amount of space, outdoor space.	-
Lack of outdoor space.	Outdoor space.	-
A bit too open, too much general space.	Openness	-
Needs more intimate spaces - feels a bit too open.	Openness, small/private spaces.	-
Poorly spaced out, stuffy, bad computer spaces, no library, noisy, not nice to look at.	Layout, ventilation, noise, spatial type, library, aesthetics.	-
Distribution of facilities is inconvenient.	Planning.	-
The exterior design of this building doesn't look like an architectural building.	Image.	-
Front requires something, looks as though something's amiss.	Image.	-
Fairly poor.	Design	-
Plain but suitable as a school.	Image (-, +).	O
It looks good but it doesn't perform. Cold in winter, hot in summer, lots of glare.	Image (+), thermal (-), glare (-).	O
Contained rooms work well, open spaces too cold/hot in respective seasons.	Enclosed space (+), thermal (-).	O
Daytime is very warm (sometimes too hot) and nice open space at studio but nighttime too cold.	Openness (+), thermal (-).	O
Poor thermal control. Good facilities.	Functionality (+), thermal (-).	O
Good circulation between spaces, except for lecture theatre, heating/cooling issue.	Circulation (+), thermal (-).	O
It's cold, but provides a lot of fresh air and sun.	Thermal (-), ventilation (+), sun (+).	O
Good design but does not perform comfortably very well.	Design (+), thermal(-).	O
Good design, too cold.	Design (+), thermal (-).	O

BUILDING DESIGN OVERALL 2008		
COMMENT	**MAJOR ISSUES**	**-/o/+**
Interesting design, just a little cold in winter and too hot in summer.	Design (+), thermal (-).	O
Generally good. Heating and cooling issues.	Design (+), thermal (-).	O
Nice design only a few issues with volumes of spaces. Noisy and can be cold.	Design (+), spatial volume (-), noise (-), thermal(-).	O
Noisy, hot during summer, cold during winter. Not much other social interaction other than studio, seminar, lab. Good use of material. Cool architecture.	Noise (-), thermal (-), social spaces (-), materiality (+), image (+).	O
Socially encouraging, plenty of types of work spaces, some temperature issues.	Social interaction (+), spatial variety (+), thermal (-).	O
Good form and feel. Lacks in functionality eg heating and cooling systems, sound etc	Image (+), thermal (-), noise (-).	O
Studio space cold, otherwise good. School messed up studio layout.	Thermal (-), planning (-), design (+).	O
Good, noisy sometimes. Leaky air. No congregational space.	Noise (-), ventilation (-), social spaces (-), design (+).	O
Effective but poor acoustics.	Design (+), noise (-).	O
Evocative, lively, student feel, issues with noise main concern.	Image (+), noise (-).	O
Interior ain't bad, exterior not high class enough.	Image (-, +).	O
Good building considering its original *?(illegible)*	Design (+), retrofitting (-).	O
There are many good aspects, but retrofitting a heritage building has its problems. First year studio=BAD.	Design (+), retrofitting (-).	O
Good example of what education facilities can be. Could be improved.	Function (+), non specific (-).	O
Shows potential in theory, but fails to achieve some of these goals eg heating/cooling.	Design principles (+), thermal (-).	O
Well done on low budget, planning and circulation ill considered.	Design (+), planning (-), circulation (-)	O
Neutral. Not too bad, but not standing out either.	Design (o)	O
Building works well and ever evolving.	Functionality, adaptability.	+
Clean, interesting.	Image.	+
Gives architecture students a new identity.	Image.	+
Good flow. Easy to get around.	Circulation	+
It's a nice space to come to and learn.	Functionality, image.	+
Love the open interconnected space.	Openness.	+
Open, good circulation, sense of history of site.	Openness, circulation, retrofitting.	+
Practically functionable.	Functionality.	+
Productive spaces.	Productivity.	+
Simple but nice and comfortable.	Image	+
The recycled building generally works well.	Retrofitting.	+
Very good community space with mezzanine and openness.	Social space, open plan.	+
Very open and great place to work.	Openness, functionality.	+
Works and flows well.	Functionality, planning.	+

NEEDS OVERALL 2007		
COMMENT	MAJOR ISSUES	-/o/+
Access to library poor.	Library.	-
An architecture library.	Library.	-
Architecture without immediate access to a library is unsatisfactory. I need access on site to journals at least.	Library.	-
Library at Newnham, but unavoidable.	Library.	-
More food facilities would be good. Coffee machine!	Lack of food outlet.	-
More student facilities: lounge, warm space, games area, garden/outdoor space, place to go.	Lack of social spaces, outdoor space.	-
No social space.	Lack of social spaces.	-
Need more smaller enclosed space for groups of 2-4 people and privacy space.	Lack of small spaces, privacy.	-
Building too cold, too noisy at times.	Thermal, noise	-
I think the only problems are heating and noise issues but to me they are not major problems.	Thermal, noise	-
Better insulation, more lighting for night environment.	Thermal, lighting	-
Lighting and heating are insufficient.	Thermal, lighting	-
Heating and cooling systems do not always provide for comfort.	Thermal	-
Not totally – in terms of comfort, noise and safety.	Comfort, noise, safety	-
Some spaces (tutorial rooms) poorly ventilated.	Ventilation	-
1st and 2nd years need more permanent space. Space has a noise problem.	Noise, 1st and 2nd year studio.	-
As a second year student, our studio is very noisy-overflow from workshop. It is difficult to hear and it is very glarey.	Noise, glare.	-
Can get crowded in class times in our particular studio area.	Overcrowding.	-
Desk heights for taller students, sore backs from leaning over.	Furniture.	-
It's a factory, not a school.	Image	-
I do hope I can get small space for praying for Muslim.	Lack of prayer space.	-
I really need a money changer from paper money to coin for vending machine.	Equipment.	-
Drinking water dispenser needed!	Equipment.	-
Toilet facilities unsatisfactory – only one set of multiple facilities on ground level.	Toilets.	-
Why is there no A3 scanner in computer lab? I always need to come downstairs (and also card reload).	Equipment.	-
Unsuitable to work overnight.	Non-specific	-
Still some small issues.	Non-specific	-
Most are here except library.	Non-specific (+), library (-).	O
It is too noisy for tutorials in our 2nd year studio. Apart from that need are met.	Non-specific (+), noise (-)	O
Keeping warm sometimes necessitates moving spaces and also glare, but the facilities are great.	Non-specific (+), thermal (-), adaptation (-), glare (-)	O
Computers, desks, tute rooms GOOD. Just comfort of direct sunlight and carpet need to be addressed.	Equipment (+), tute rooms (+), sun (-), finishes (-).	O
All services provided. Alternate spaces provided. Second year studio – terrible space.	Spatial variety(+), 2nd year studios(-)	O

NEEDS OVERALL 2007		
COMMENT	MAJOR ISSUES	-/o/+
All needs met, would like some less open space, nooks to retreat to.	Non-specific (+), small spaces (-).	O
Individual work spaces. Views looking out of the building while sitting down. I sit at window if I can get to it first.	Windows (+), small spaces (-).	O
There are spaces, but it is your choice how you use them, so that can be daunting.	Flexibility (+, -).	O
As we change and live in these spaces, we are getting better at having anything we need.	Adaptability (-, +).	O
Proper tables in studio would be appreciated, otherwise facilities are good.	Non-specific(+), equipment (-).	O
Spacious working area.	Amount of space	+
Facilities fairly flexible.	Flexibility.	+
Availability 24/7 is good.	Availability.	+
The computer network is good.	Equipment.	+
Good and met.	Non specific.	+
As above, in most areas.	?	?

NEEDS OVERALL 2008		
COMMENT	MAJOR ISSUES	-/o/+
Have to work at home sometimes because the temperature in the labs (either stuffy or freezing) makes me ill.	Thermal.	-
Heating needs improvement.	Thermal.	-
Heating still a problem.	Thermal.	-
The ventilation to keep the building warm is not enough.	Thermal.	-
Too cold.	Thermal.	-
Very cold/very hot.	Thermal.	-
You need to be comfortable to work effectively. Putting on 3 jumpers isn't acceptable.	Thermal.	-
Heating and cooling needs not met. Bad sound acoustic.	Thermal, noise.	-
Heating and cooling sometimes irregular and unavailable. Air quality feels worse indoors.	Thermal, ventilation.	-
Needs better ventilation and heating/cooling in offices.	Thermal, ventilation.	-
Night very cold/dark.	Thermal, lighting.	-
Bad lighting.	Lighting.	-
Echo - in building.	Noise.	-
Acoustic and lighting in some places need more work.	Noise, lighting.	-
Facilities? No library.	Library.	-
More worktops/computers. Need architecture books here.	Library, equipment.	-
It needs a café to add ambience and smells!	Food outlet.	-

NEEDS OVERALL 2008		
COMMENT	MAJOR ISSUES	-/o/+
I don't know, maybe I feel like the social part of the building is poor.	Social space.	-
Needs a space for relaxing, eating.	Social space.	-
No student communal space.	Social space.	-
Not enough individual studio space for students, esp 5th years. Therefore, some students prefer working at home.	Work stations	-
Sometimes it's hard to find privacy/rooms to work.	Work stations privacy.	-
Would be great to have more opportunity for solo space.	Work stations.	-
Would be good to have better learning hub and individual work stations.	Work stations, learning hub.	-
Need areas for sleeping, more working space needed.	Sleeping area, work stations.	-
Needs better teaching spaces.	Non-specific	-
The school has made several changes from the initial layout, moving away from the first year of opening. I prefer the	Planning, adaptability.	-
We have to share presentation space with other years' students.	Overcrowding.	-
Limited facilities to share with many.	Overcrowding.	-
Not enough space.	Overcrowding.	-
Insufficient facilities for many students, student couldn't handle some facilities eg heater, not warm enough, lockers	Overcrowding, thermal, storage	-
Not enough toilets for student times.	Toilets	-
Need toilets upstairs.	Toilets	-
Better toilet facilities needed on upper floor.	Toilets	-
If there is more window opening, that would be good.	Windows	-
I find I would rather work at home if I don't have to be at uni.	Non specific.	-
Computers aren't linked to other campuses.	Equipment	-
No need for Macs.	Equipment.	-
Need more light box for tracing.	Equipment.	-
ATM (Commonwealth)	Equipment.	-
Photocopier at other end of school - always occupied.	Management.	-
Photocopier too far away from everything.	Management.	-
Scanner opposite end of building to computers?!	Management.	-
Walking ½ hour to photocopier too far.	Management.	-
Photocopy machines and printer too far and always break down.	Management, equipment.	-
Rooms for industrial/group learning hub, rooms are occupied and owned by many other students, less studio space	Management.	
Spaces are good, heating/cooling/ventilation bad.	Spatial quality (+), thermal (-), ventilation (-).	O
Everything is alright but not the heating system.	Non specific (+), thermal (-)	O
Good facilities but sometimes not quite enough for all.	Non specific (+), overcrowding.	O

NEEDS OVERALL 2008		
COMMENT	MAJOR ISSUES	-/o/+
Has everything required. Maybe a student lounge is needed?	Non specific (+), lack of social space.	O
Has everything to live in. Eat, work, play.	Non specific.	+
Good facilities, computers, workshop and workspaces.	Non specific, eqpt, workshop, work spaces.	+
Love shower and kitchenettes.	Shower, kitchenettes.	+
Spaces for individual, group and whole class is well distributed.	Planning	+
A lot work space and quiet group areas.	Spatial variety and amount.	+
Facilities generally meet requirements.	Non specific.	+
General function requirements are more than satisfactory.	Non specific.	+
I have work and I do it fine.	Non specific.	+
Meet all my needs.	Non specific.	+
Satisfies, provides well.	Non specific.	+
This is a pleasant place to study.	Non specific.	+
Yes.	Non specific.	+
24 hour access is good.	Management.	+
Computers meet my needs. I'd be stuffed without them.	Equipment.	+
Serve basic needs as art school.	Non-specific	+

HINDER EFFECTIVE WORKING 2007	
COMMENT	MAJOR ISSUES
Noise.	Noise.
Noise.	Noise.
Noise.	Noise.
Noise within studio, from all around.	Noise.
Noise between spaces.	Noise.
Noise from neighbouring rooms/spaces.	Noise.
Excess noise from other parts of the building.	Noise.
2nd year studio can be a bit noisy because 1st year just directly next door.	Noise.
Acoustics make it very difficult to concentrate on research or teaching.	Noise.
Noise obstruction is a major issues when trying to work, especially in 2nd year studio as there are no barriers or noise breaks between studios.	Noise.
Temperature, especially heating.	Thermal.
Room temperature.	Thermal
Sometimes gets very cold in studio.	Thermal.
The temperature, sometimes too hot or too cold.	Thermal.
Cold.	Thermal
Temperature, not enough power points. Lack of conducive working space.	Thermal, needs
Location of photocopy machine in the computer lab. Heating in 2nd year studio and some areas.	Thermal, equipment.
No drawing boards in 2nd year studio. No heaters in studio over weekend.	Thermal, equipment.
Drawing in studio sometimes glarey and temperature issues, mostly thermal issues.	Thermal, glare.
Glare from large windows. Too hot or too cold.	Thermal, glare.
Glare, frosty morning desks in winter.	Thermal, glare.
Too much sunlight = hot, glare.	Thermal, glare.
Temperature ie too cold or too hot. Afternoon glare in studio.	Thermal, glare.
Not enough drawing tables (all in first year studio). Very glarey in afternoons. Very cold in mornings and at night.	Thermal, glare, equipment.
Better task lighting. Better temp control. Outdoor social interaction point that has sun light. Non- specific work stations.	Thermal, lighting, outdoor social space, work stations.
Lighting, ventilation, thermal system.	Thermal, lighting, ventilation.
Studio space- unsuitable light, need to wear sunglasses at some times and then too dark other times. Need smaller spaces to	Thermal, lighting, glare, small spaces.
Building management system. Heating, lighting (not enough). Lack of furniture.	Thermal, lighting, control, equipment.
Lack of food facilities after hours. Lack of heating.	Thermal ,food outlet.
Never bother going into computer room to do research as the computer room has really poor ventilation.	Ventilation.
The library return rooms feels stuffy and toxic.	Ventilation, IAQ.
Light (too much).	Light.
Lighting – not being enough in the meeting room space.	Artificial lighting.
Inadequate access to library materials. Lack of training in essential computer packages especially CAD. Glare in the building is a problem because of my eyesight.	Glare, library.
Bad sound insulation, bad thermal insulation.	Noise.
Excessive noise within multi-storey studio space. Poor thermal control within main lecture theatre and seminar space/room.	Noise, thermal.
Insufficient heating. Noise.	Noise

HINDER EFFECTIVE WORKING 2007	
COMMENT	MAJOR ISSUES
NOISE. Temperature at night and in winter.	Noise, thermal.
Noise. After hours heating.	Noise, thermal.
Noise, heat (from solar access). AC dries my skin.	Noise, thermal.
Acoustics is probably the biggest challenge and commissioning has taken some time so there have been some thermal challenges. Pin-up also a problem.	Noise, thermal.
Noise, temperature, inadequate equipment, distractions.	Noise, , equipment.
Excess noise (people, rain, wind), too hot/cold, no comfortable sitting area, lack of storage for paper materials.	Noise, thermal, social space, storage.
Studio areas too noisy for group tutes. No café, lounge areas. Limited study zones.	Noise, social space, food outlet, working stations.
Noise, glare.	Noise, glare.
Poor acoustics, poor task lighting at night.	Noise, artificial light.
Noise of students, table tennis bouncing, desk size and height, sunlight.	Noise, equipment, sun.
Leaking window above me. NOISE!! (general surrounding)	Noise, waterproofing
Noise, tables for hand drawing, availability of computers at peak times.	Noise, equipment.
Heating is erratic. Circulation of building labyrinthine – difficult to find people in maze. Sound isolation very poor – too noisy to teach groups in studio. Great when it's raining though!	Noise, thermal, planning.
Cold, noise. Computer problems. No library.	Noise, thermal, library, equipment.
Efficient use of space. Noise levels. Temperature levels.	Noise, thermal, planning.
More space to work in private. Good insulated space so it's not cold and noisy.	Noise, thermal, small spaces.
Noise from workshop. Temperature and ventilation.	Noise, thermal, ventilation.
Direct sunlight in the afternoon in the first year studio. Heating at night. Noise throughout the building.	Noise, thermal, sun
Mechanical services noises that make hearing hard, excessive glare, very cold mornings in a noisy studio space.	Noise, thermal, glare.
Noise, sun, cold.	Noise, thermal, sun.
Noise and lighting. Lighting at night in the large studios is poor. And it gets so cold!	Noise, thermal, artificial lighting.
Heat, lighting issues. Noise issues.	Noise, thermal, lighting.
The lecture theatre is too noisy when you're in there, can't hear. Poor lighting in studio at night, hurts your eyes. Cold, heating didn't work for 6 weeks in winter. It was very unpleasant.	Noise, thermal, artificial lighting.
Heating and cooling large spaces. Light and glare in 1st and 2nd year studio can be a problem. Noise from others in the large	Noise, thermal, lighting, glare.
Bright and glare from double height glazed curtain wall. Noisy so hard to concentrate. Very cold building.	Noise, thermal, natural lighting, glare.
Too cold, too hot, too light. Lots of ambient sound, no sense of ownership.	Noise, thermal, lighting, belonging.
No designated space for 2nd year students which is good for study. No ownership of space, noisy, others use it, sunlight glare,	Noise, thermal, natural lighting, glare, 2nd year studio,
Studio space- people fight for desks near windows. Currently there is a need for more desks in the 3rd and 4th year studio spaces	Lighting, ventilation, view, windows, equipment.
Excessive light (main curtain window), stuffy rooms, visual of student movement, constantly.	Natural lighting, ventilation, openness .
Insufficient number of rooms for discussion. Poor lighting qualities at night.	Artificial lighting, tute rooms.
The fact that the library is so far away is a problem, especially to those without cars.	Library
Library access fair way to go to get books.	Library.
Location of central library on another campus (minor complaint).	Library.
We do not have a specific working area, no sense of belonging, not enough space to work in.	2nd year studio.

HINDER EFFECTIVE WORKING 2007	
COMMENT	MAJOR ISSUES
As a second year our studio space is used by all other year groups. We cannot make this space our own and there are always	2nd year studio, library.
Lack of storage, study rooms.	Storage, small spaces
Lack of conducive working space.	Needs.
Lack of comfortable space to read and work.	Needs.
Problems with computers. Private study areas.	Equipment , small spaces.
More drawing desks for 2nd years would be great.	Equipment.
No drawing boards in 2nd year studio. No computers in the studios.	Equipment.
Not having the required elements close by eg scanners etc. Lack of tables.	Equipment.
Computers/printers not functioning. Little storage – having to lug large amounts of resources every day.	Equipment, storage.
Drawing tables. Power points.	Equipment.
Hard to find your own space when everyone is here, can be slightly cramped at desk. Also waiting for lectures, people block up	Overcrowding.
Large open space is great to look at and great as an atrium space but not so much as studio space.(*written as part of comment in*	Openness
Fourth years.	NA
Nil *(written as comment in things that work well).*	Non-specific

HINDER EFFECTIVE WORKING 2008	
COMMENT	MAJOR ISSUES
Acoustic.	Noise.
Acoustics and lack of sound barriers.	Noise.
Air conditioning in main lecture theatre can be noisy.	Noise.
Bad design, overall noise, excessive noise, noise.	Noise.
Noise.	Noise.
Noise.	Noise.
Noise – rain/building, workshop, wind.	Noise.
Noise, distractions.	Noise.
Noise in first year studio.	Noise.
Noise, can't concentrate with so much movement of people around.	Noise.
Loud roof in rainy times!	Noise.
Noise (other students), glare, heating, cooling.	Noise, glare, thermal.
Noise and heat or lack of.	Noise, thermal.
Noise levels, temperature.	Noise, thermal.
Noise, temperature.	Noise, thermal.
Noise. Floor boards are noisy and the heating isn't very good.	Noise, thermal.
Noisy floor surface, cold atmosphere.	Noise, thermal.
Noise, cold/heat, lighting.	Noise, thermal, lighting.
Noise, inefficient lighting. After hours especially, with heating as well (but less an issue with jackets on). Lights go off when working on computers after hours.	Noise, thermal, lighting.
Heating, noise, lighting – poor.	Noise, thermal, lighting.
Lighting, glaring from sun. Acoustics is very bad. Interior temperature control.	Noise, thermal, lighting, glare.
Noise from lower floors, or excessive noise from other groups of students. Unable to clean own space. Not enough rubbish bins and not emptied enough.	Noise, management..
Noise. Clutter of things left behind by others.	Noise, management.
Noise from workshop. Cold water. No sense of belonging for people who do not own a personal workspace there on the 3rd level.	Noise, personal space, cold water.
Noise surrounding, less enclosed space.	Noise, open plan.
Noise, open spaces, thermal comfort.	Noise, open plan, thermal.
Noise. Cold. Bad computer network. 1 printer?	Noise, thermal, poor network, insufficient computer eqpt.
Noise, heat, number of people, lack of privacy.	Noise, thermal, overcrowding, no privacy.
Noise, sunlight of an afternoon. Too much heat.	Noise, sun, thermal.
Noisy fan in back of lecture theatre. Orientation of lecture theatre wrong for use of communal area near front door.	Noise, planning.
Noisy lecture space/ventilation system, cold workspaces, poor external furniture.	Noise, thermal, external furniture.
Temperature – very difficult to heat some spaces and noise.	Thermal, noise.
Temp, sound.	Thermal, noise.
Too hot/cold in studios. Very noisy in wind.	Thermal, noise.
Cold, loud noise.	Thermal, noise.
Heat/cold, noise.	Thermal, noise.
Heating, sound.	Thermal, noise.

HINDER EFFECTIVE WORKING 2008	
COMMENT	MAJOR ISSUES
Heat-climate, noise.	Thermal, noise.
Loud and inefficient heating and cooling. Constantly buzzing lights.	Thermal, noise.
Temperature, glare into studio.	Thermal, glare.
Temperature and ventilation n lecture theatre. Light in studio.	Thermal, ventilation, light.
Sun in studio – very bright and direct. Cold in winter. When it rains it is very loud.	Glare, thermal, noise.
Sun through the windows in studio. Too cold/hot. Noise levels.	Glare, thermal, noise.
Sunlight on hot days in studio, glare , too cold in winter.	Thermal, glare.
Cold, sun glare.	Thermal, glare.
Glare from the sun, wide temperature changes.	Thermal, glare.
Louvres don't really work during summer causing overheating. 3rd floor gets really hot during sometime of each day. Glare at 3rd floor- a disastrous place for class.	Thermal, glare.
Coldness.	Thermal.
Cold.	Thermal.
The cold.	Thermal.
Too cold/hot.	Thermal.
Too cold.	Thermal.
Too cold inside the building.	Thermal.
It's cold if you're here late. Hot in summer.	Thermal.
Heat/cold in studios.	Thermal.
Probably heating system.	Thermal.
Being freezing cold or boiling hot.	Thermal.
After hours temp control.	Thermal.
Poor insulation. Heating/cooling in computer lab not changeable.	Thermal.
Temperature. Non access to library.	Thermal, library.
Too much afternoon sun. Too cold in winter.	Sun, thermal.
The sun in the first year studio. Too much.	Sun.
Drawing desks get too much sunlight.	Sun.
Direct sunlight in afternoon during summer.	Sun.
Glare downstairs at the studio.	Glare.
Lack of direct light at night, sun glare in afternoon, little after hours heating.	Glare, artificial lighting, thermal.
Lighting is an issue – can get quite cold at night time/weekends.	Thermal, lighting.
Low amount of light. Temp.	Thermal, lighting.
Very cold, very noise, not private.	Thermal, noise, privacy.
Better lighting. Warmth. More desk and storage space.	Thermal, lighting, desk space, storage.
Too dark/light, excess noise, too hot/cold.	Lighting, noise, thermal.
The cold. No storage spaces. Noise (especially if it's raining). Either too bright area or bad lighting altogether.	Thermal, noise, lighting, storage.
The lights always switch off in the only places that are quiet and private.	Artificial lighting.
Brighter light – detail work, heat issues at night, passive ventilation in lecture theatre.	Lighting, thermal, ventilation.
Too hot/cold in some areas. Not enough ventilation in most rooms (ie lecture theatre and computer lab). No proper outdoor area.	Thermal, ventilation, outdoor space.

HINDER EFFECTIVE WORKING 2008	
COMMENT	MAJOR ISSUES
Badly designed computer labs. Overheating on top level in summer and too cold in winter.	Thermal, computer labs.
Stairs, cold.	Thermal, stairs.
Drawing tables are all in open area, cold. Learning hub area cold and uninviting, photocopier at opposite end of school to computers/printers.	Thermal, management.
Stuffy/cold makes me ill/hard to concentrate; construction noise (at the moment only) prevents me from working in lab; mess left by students on desks (not cleaner's problem).	Ventilation, thermal, noise, management.
Task lighting.	Artificial lighting.
Lighting levels.	Lighting.
Lecture theatre lights a bit moody (IEQ), power points etc in ground floor. Mezzanine level tute rooms – no day light. Lux of work areas. Noise between spaces.	Lighting, artificial lighting, natural lighting, noise.
Bad heating (freezing in winter). More printers please, if it runs out of ink at night, how to print? The guy in charge is not around.	Thermal, eqpt.
Broken copier, scanner etc.	Eqpt.
Electronic problems.	Eqpt.
Computers hang all the time.	Eqpt.
Technological equipment (eg computers, software, phones) when they don't work properly. When staff members are hard to contact, catch/get hold of.	Computers malfunction, management.
Scanner and photocopier isn't enough.	Insufficient comp eqpt.
Not enough computers.	Insufficient comp eqpt.
Not enough computers available.	Insufficient computers.
More computers, sometimes they are full. Scanners only 1.	Insufficient comp eqpt.
Lack of printers.	Insufficient comp eqpt.
Not enough printer, scanner and photocopy machines. Poor networking – slow signal transfer.	Insufficient comp eqpt, comp network.
The photocopier. Full computers – PRINTER. The cold.	Insufficient comp eqpt, thermal.
Printer/scanner is so far away from computers.	Management.
Work room not accessible after hours. Computers – very slow and not user friendly re some programs not accessible unless one makes arrangements with IT personnel.	Eqpt, management.
Printer is forever out of ink and no-one to sort out problems with facilities on weekend.	Management.
Workshop hours at weekend.	Management.
Tutors assisting the same student every day without time for others.	Management.
Not having a specific studio for each year to work in eg out of class time, the 5th year space is now a communal (all years) teaching space.	Management
Sometimes not enough computers and cold.	Insufficient comp eqpt, thermal.
One lecture theatre is a constraint. Sometimes getting access to a computer is difficult. Printing facilities for computer work.	Lecture theatre, insufficient computers, comp eqpt.
Some places have no wireless internet signal. Lecture theatre lacks effective ventilation.	Comp network, ventilation.
Poor lighting, insufficient power points. Insufficient heating in some areas.	Lighting, thermal, insufficient power pts.
Not enough accessible power points.	Insufficient power pts.
Not enough work space, bad studio arrangement. Poor power management and not enough power supply outlets. Climatic response does not work very well. Noisy lecture room from mechanism.	Work space, planning, insufficient power pts, thermal, noise.
Lack of electrical points, amount of space available, heating system at weekends.	Insufficient power pts, amount of space, thermal.

HINDER EFFECTIVE WORKING 2008	
COMMENT	MAJOR ISSUES
Need additional power supply plugs. Every student uses a laptop with additional peripheral device (digital camera, scanner etc), table lamps etc.	Insufficient power pts.
Not enough space for drawing.	Insufficient desk space.
Desk (inbuilt) layout (dimensions). Acoustic noise from upper level.	Work space, noise.
Space/table space. Model building room.	Work space, desk space, model room
Crowded work spaces.	Overcrowding.
Too many people, too little working space available.	Overcrowding.
Seminar room is too small to fit the whole class.	Overcrowding.
Workspaces taken and temperatures.	Overcrowding, thermal.
Sometimes too many people on 3rd floor. Hard to get a computer during hours. Heating delay causes high heat at lunchtime, cold in mornings.	Overcrowding, eqpt, thermal.
The previous 3rd year lounge is occupied this year as personal studio. It limits the space for other students and blocks many of the great views.	Management.
Not enough lockers for students.	Storage.
Distances (but it is not a real issue).	Planning
Long way to walk to printer, always breaks. Large sun and glare through window.	Management, sun, glare.
Different facilities are far apart eg scanner/copier, computer rooms, drawing room.	Planning
Staff changed layout – ruined it.	Planning
Poor teaching flexibility and acoustics.	Management, noise.
Perhaps the lab is sterile and machines and unwarm materials everywhere, compared to the old computer lab where there were alcoves and timber!	Computer labs
Only problem is no library.	Library.
No private laptop spaces.	Privacy.
Insufficient private working space.	Privacy.
Lack of privacy and warmth.	Privacy, thermal.
No decent are to relax in.	Social spaces.
I am taking a bus to take or bring my work out, would be difficult as to travel through field.	Public transport.
Nothing, especially light in lecture room.	Lighting.
Good working environment, like the indoor temperature.	N/A, moved to ‘works well’

WORK WELL 2007	
COMMENT	MAJOR ISSUES
Access.	Access.
Accessibility to all spaces, having most major facilities in the one space works very well. Also makes interaction with	Access, needs, social interaction.
Computers and works areas have 24 hour access which is very convenient.	Access.
Facilities are good. Good access to everything we need.	Access, facilities.
Privacy.	Privacy.
Own office – can shut door to concentrate.	Privacy.
More space to accommodate private study.	Privacy.
Group rooms in learning hub are great for getting away and working quietly.	Privacy.
Social side. Working as a group together. Location is good! Being all together all of the architecture students.	Social interaction, location.
Spaces to interact and evolve a collection of ideas.	Social interaction.
Connection to people working around.	Social interaction.
Friends and people.	Social interaction.
It is an exciting space, always something going on.	Image, vibrancy.
Interaction with other students on circulation paths.	Social interaction, circulation.
Circulation, quality of space, amount of space, juxtaposition of areas.	Circulation, quality of space, amount of space, planning
Group work and meetings with staff! I think there is great staff and student communication! Computer labs are also effective,	Social interaction, computer labs, tute rooms.
Ventilation – not usually stuffy except for computer labs.	Ventilation.
Available space. Alternate space.	Amount of space, spatial variety.
Equal number of open/constricted spaces, overlap makes for interesting transition.	spatial variety.
Space.	Space.
Space.	Space.
Spaces.	Space.
Spaces.	Space.
Wireless. Massive spaces.	Amount of space, services.
Good light. Ample space.	Amount of space, light.
Lots of space, daylight.	Amount of space, natural light.
Open space, fresh air.	Openness, IAQ.
Open environment. Adequate photocopying and computer labs.	Openness, computer labs.
Working areas. Open space. Circulation.	Openness, circulation.
Large open spaces are flexible but not used to their potential.	Size of space, openness.
All other spaces are cosy to move around and have comfortable work spaces to use.	Needs, access.
Daylight is great.	Natural light.
Lighting (natural), sleeping in hidden places when overworked.	Natural light.

WORK WELL 2007	
COMMENT	MAJOR ISSUES
Lighting.	Light.
Nice light levels during the day.	Natural light.
Light, partitions, comfortable furniture.	Light, equipment
Lighting, computers.	Light, equipments.
Good lighting, adjustable furniture, easy access to toilets.	Light, equipment, planning.
Connection between spaces.	Planning
Proximity to admin staff and resources. Planning of my office. Excellent daylighting.	Planning, natural light.
Meeting space close to student lounge and toilets. Internet wireless, enclosed rooms.	Planning, privacy, services.
Overall arrangement.	Planning
Layout and feel of space. Flexibility. Natural light. Good to demonstrate design and ESD principles.	Planning, space-quality, flexibility, natural light, education.
Zoning of building: separation of staff admin facilities and offices in one zone with teaching spaces adjacent. Students can	Planning, accessibility, privacy.
Better computer labs this year.	Computer labs.
Computer lab space.	Computer labs.
The computer lab is nice and warm and bright 24/7.	Computer labs.
The computer labs – nice lights, heating and arrangement. I think as we learn to use the building better, more spaces will	Computer labs, adaptability.
Lab is well used but often full, but works well.	Computer labs.
The computers available are good in performance.	Equipment
Computer labs and tute rooms are good.	Computer labs, tutorial rooms.
Computer labs, tutorial rooms.	Computer labs, tutorial rooms.
Computer, furniture.	Computer labs, equipment.
The computer labs work well. The smaller tute rooms are warm to work in. Large open space is great to look at and great as	Computer labs, tutorial rooms, image.
The computer lab spaces are really good, the lecture theatre everyone likes and the workshop is a really great space.	Computer labs, lecture theatre, workshop.
Tutorial rooms.	Tutorial rooms.
Tute rooms along with open plan areas that can change their uses.	Tutorial rooms, flexibility.
Lecture theatre.	Lecture theatre.
Meeting spaces, viewing angles, computer lab layout.	Tute rooms, internal views, computer lab.
Discussion rooms with computer and accessible to internet.	Tute rooms, services.
Workshop.	Workshop.
The workshop and computer labs are great.. The lecture theatre is really well sized.	Workshop, computer labs, lecture theatre.
Third year studio.	Third year studio.
The studio when it is not full eg not at teaching times and you can sit near a window!	Studio, windows.
Studios. Workshop. Light.	Studios, workshop, light.
Shared working, computer labs, drafting boards, teacher access.	Equipment , social interaction

WORK WELL 2007	
COMMENT	MAJOR ISSUES
Ample storage /working space in my office.	Storage, office.
More power points at desirable areas.	Services.
Relocatable furniture.	Equipment
Sufficient table, chair and tools.	Equipment
Table arrangements and pin up spaces are adequate.	Equipment
Concentration.	?

WORK WELL 2008	
COMMENT	MAJOR ISSUES
Heating in smaller rooms.	Thermal.
Warm spaces.	Thermal.
Warmth, comfort.	Thermal, comfort.
Computer systems generally well put together. Computer rooms HEATED.	Thermal, eqpt.
Good access to natural light, healthy atmosphere.	Natural lighting, health.
Quality of light, connection between spaces/facilities in building.	Lighting, planning.
Lighting.	Lighting.
Lighting except at night.	Lighting.
Amount of light in upper level.	Lighting.
Good light, good ventilation.	Lighting, ventilation.
Fresh air. Seeing other people around school.	Ventilation, social interaction.
Spatial feel.	Image
24 hour access, open, nice.	Image, openness, management
Space – room to move and for yourself.	Amount of space.
Space.	Amount of space.
Space.	Amount of space.
Sufficient space.	Amount of space.
Amount of space.	Amount of space.
Space and movement between spaces.	Amount of space, circulation.
Plenty of space and variety.	Amount of space, spatial variety.
Enough space to work. Quiet when there are few people around.	Amount of space, quiet.

WORK WELL 2008	
COMMENT	MAJOR ISSUES
Large studio space.	Size of studio
Large work studios give heaps of room for study.	Size of studios.
Always people around, feel safe. Different types of work spaces and facilities.	Safety, spatial variety.
Every facility in one building.	Functionality.
Facilities.	Functionality.
Generally enough computers, spaces feel well used, despite comfort level.	Functionality, eqpt.
Flexibility of space after hours.	Flexibility.
Flexible space.	Flexibility.
Flexible space.	Flexibility.
Versatility of spaces.	Flexibility.
Able to utilize several areas, so can spread work out esp after hours when student numbers decrease.	Flexibility.
Layout, flexibility of spaces.	Flexibility, planning.
Tables are huge enough and can be arranged in a flexible way. Pin-up wall space is useful for presentation.	Flexibility, eqpt.
Big tables, free arrangement of space.	Flexibility, eqpt.
The allocated space arrangements for year groups.	Planning.
The readable and interconnecting traffic pathways.	Circulation, planning.
Arrangement of rooms and facilities.	Planning
Inter-connections and associations with other students.	Planning, social interaction.
Staff space off from studio spaces, common tea room.	Planning, staff room.
Openness.	Openness.
Large open spaces.	Openness, size of spaces.
Open and flexibility of studio spaces.	Openness, flexibility.
Open space, large working areas. Flexible spaces. Group areas.	Openness, amount of space, flexibility, tute rooms.
Open studio/circulation space so meet people easily and feels safe. Good 24 hour access.	Openness, planning, circulation, social interaction, safety,
Good big table, open space. Bright, sunny environment. Friends around on a table.	Openness, natural lighting, sun, social interaction, eqpt.
Ability to see and communicate with people in a large space, able to move in different sized spaces.	Openness, spatial variety.
Peers working together.	Social interaction.
People can mingle during study, between years, helps develop ideas and understanding of subject.	Social interaction.
Not too many people in rooms and comfortable.	Size of spaces, character.
Spacing of desks and areas. Positioning of office.	Work space, planning.
Individual privacy area is quite comfortable.	Work space.
Working with music and individually.	Work space.
The open space drawing area works much better than I expected.	Work space.

WORK WELL 2008	
COMMENT	MAJOR ISSUES
Have own space.	Work space.
Drawing area.	Work space.
The large working space and the computers with internet access.	Work space, eqpt.
Drawing space and lecture room.	Work space, lecture theatre.
1st year studio seems to work well.	Studio.
Studio spaces.	Studios.
The studio space – when we are allowed to use it!	Studio, management.
Upstairs studio space, access to building.	Studio, management.
Tute spaces, studio when conditions are ideal.	Studio, tute rooms.
Studio space. Lecture theatre. Social interaction on balcony.	Studio, lecture theatre, social interaction.
Studio. Tute rooms. After hours computer. Security. Required facilties.	Studio, tute rooms, functionality, management.
Computer lab.	Computer lab.
Good computer labs.	Computer labs.
Computer labs good – one for teaching as well as another one; drawing boards generally always available.	Computer labs, eqpt.
Computer rooms, tutorial rooms, studio spaces.	Computer labs, tute rooms, studio spaces.
Main lab works well. The only available studio. Meeting rooms.	Computer lab, studio, tute rooms.
Lecture room.	Lecture room.
Small tutorial rooms good for individual/small group work.	Tute rooms.
Group rooms, heating during the week.	Tute rooms, thermal.
Computer, workshop, printing.	Workshop, eqpt.
Water heater. Hot water.	Kitchenette.
Hot boiling water dispenser.	Kitchenette.
A student pantry (with microwave available).	Kitchenette.
Computers. Cooking facilities.	Kitchenette, eqpt.
The bathrooms.	WCs.
Most stuff.	Non specific.
Timber table top for cutting models.	Eqpt.
The drawing desks. Computers.	Eqpt.
Equipment.	Eqpt.
Computers, printing.	Eqpt.
Computers.	Eqpt.
Communication is pretty good here. The computers and software are modern and up to date.	Management, eqpt.
Communication.	Management.

WORK WELL 2008	
COMMENT	MAJOR ISSUES
Lots of tutors.	Management.
Uniprint.	Management.
24 hour access to computers good.	Management.
The new occupation of studio spaces is a wastage.	NA
Summertime ??? (illegible)	NA.

NOISE 2007		
COMMENT	MAJOR ISSUE	-/o/+
Open plan produce noise the most!	Openness.	-
Open spaces equal too much noise.	Openness	-
Bad planning. I can hear everyone talking even though they are 2 floors below.	Openness	-
All open plan and hard surfaces bounce and distract you.	Openness, materials	-
Open plan learning spaces without anything that attempts to absorb sound makes the whole building loud.	Openness, materials.	-
Big open space + circulation = too much noise. Football oval on weekends is too loud.	Openness, large space, noise from circulation, external noise.	-
Sources and causes: large open atrium space, hard surfaces, no control over ambient noise.	Openness, large spaces, materials, ambient noise	-
Noise is a huge issue. We have lectures in our studio which is situated above the computer room and workshop that is just a stupid idea, you can't hear a thing from the lecturer. School is maybe too open.	Openness, planning, noise between floors, noise from workshop.	-
Due to such large working spaces, it becomes hard to barrier noise from surrounding spaces especially with open	Openness, large spaces	-
Large spaces echo.	Large spaces.	
Noise interruptions affect my concentration and with little individual isolated work stations/area, personal productivity is	Small spaces	-
Open bridges and floor surfaces (especially stair) amplifies sound too much.	Circulation, materials.	-

Walls between services and served spaces (lecture room, seminar room, tutorial, computer labs) are thin and provide	Noise from services	-
Poor sound insulation.	Acoustic insulation.	-
Acoustically needs to be more controlled between spaces.	Acoustic insulation.	-
Due to uncarpeted cement floor, much noise produced and reflected through the whole building.	Materials	-
Noise can be heard anywhere in the building.	Extent of noise.	-

NOISE 2007		
COMMENT	MAJOR ISSUE	-/o/+
1st year students in adjacent studio make a lot of noise, play music etc. Students in other levels use adjoining spaces	Noise from1st year studio, noise from workshop, external	-
1st year studio, door opening from workshop. Shoes, high heels especially from floor above.	Noise from 1st year studio, noise from workshop, noise	-
1st year studio very noisy as is workshop. Its very hard to concentrate when 4th years are giving presentations in OUR	Noise from 1st year studio, noise from workshop,	-
Very hard to hear instructions during a tutorial in 2nd year area if the 1st year studio is being used.	Noise from 1st year studio.	-
The noise from the first year studio is quite disruptive, cannot hear teachers and other students talking in our class.	Noise from 1st year studio.	
Too much noise from first years, can't hear teachers speaking to the whole class.	Noise from 1st year studio.	-
Others/different user groups encroach on space. 1st year studio noise carries over 4th year presentations during tutorial	Noise from 1st year studio.	-
When in studio we can hear anyone else within the building.	Extent of noise	-
Studios too loud. Noise from other students and workshop.	Noise from studios, noise from workshop.	-
Noise from other studios enters my studio and makes it very difficult to hear tutors and peers. Cannot hear anything in	Noise from studios, noise from weather.	-
Second year studio is open to every noise possible. We need to huddle around lecturers to hear what our task is, then	Noise in 2nd year studio	-
Noise levels in 2nd year studio too high.	Noise in 2nd year studio.	-
In the 4th year studio, the acoustics are very bad. There is noise from the computer lab below and the plant room. The	Noise in 4th year studio, noise from computer lab, noise	-
Noises from workshop sometimes is annoying.	Noise from workshop	-
Noises from workshop, from other seniors, chatting.	Noise from workshop.	-
Workshop, evident in northern half of building. Noises from other students in studios tends to filter through the building	Noise form workshop, noise from studios.	-
Can hear lots of movement between floors. Group work spaces too close to teaching space, makes both ineffective.	Noise between floors	-
Other classes, the computer lab.	Noise from other classes, noise from computer lab.	-
Kids on motor bikes. Aurora stadium horn and music. Air conditioning hum. General LOUD electrical and heating	External noise, noise from services, noise from weather	-
Wind blowing the buildings cladding and rattling things.	Noise from weather	-
Can hear everything from all levels.	Extent of noise	-
Poor acoustic.	Non-specific	-
Travels from different studios.	Noise from studios	-
Other classes, the computer lab.	Noise from computer lab, noise from studios	-
Often excessive noise is from several classes running concurrently and othe r people outside the studios using the	Noise in studios, management.	-
Open area too loud. Good space but can't hear anything when other classes are on.	Openness (-), spatial quality (+).	o
Open mezzanine areas great concept but doesn't work when studio used as teaching/learning space. Would be better	Openness (-), spatial quality (+), social space (-)	o
The noise in my office (normal work area) is fine. However teaching in some parts of the building is more challenging.	Office(+), non-specific(-)	o
Background noise is quite OK now. Moving of furniture and students (on floor) above is very annoying.	Ambient noise (+), noise between floors (-)	o
Noise from air ducts under my floor. However insulation added recently has improved the situation.	Noise from services (-), acoustic insulation (+).	
Need to be able to fill this out for both offices and studios as this is different for both	NA	

NOISE 2008		
COMMENT	MAJOR ISSUE	-/o/+
Adjoining offices and in teaching areas.	Noise from adjacent spaces.	-
The walls between offices must be quite thin because in my office I can *(hear)* everything that's going on in adjacent offices very clearly and sometimes this makes it a bit hard to concentrate.	Noise from adjacent spaces, impact of noise.	-
From levels above or below due to mezzanines. From adjacent rooms esp if not working in open spaces.	Noise from adjacent spaces, noise between floors.	-
Aurora.	External noise.	-
Building construction annoying.	External noise.	-
Building projects in and around building.	External noise.	-
Building sites.	External noise.	-
Difficult with things like football, construction work, trains occasionally.	External noise.	-
Noise from the construction site always affects the progress of work.	External noise.	-
From the adjacent construction sites and Aurora stadium. When it rains it is as if the whole roof flaps.	External noise, noise from weather.	-
Too open.	Open plan.	-
Because spaces are so open, you can't selectively block out noise that is undesirable. Things tend to echo.	Open plan, echo.	-
Open nature of the space- no sound insulation between floors.	Open plan, noise between floors.	-
The building is too open and because some of the studios are also teaching spaces so there is a lot of noise from workshop and GF studios.	Open plan, internal noise, noise from workshop.	-
Arch teaching spaces.	Noise within spaces.	-
Can get very noisy in main studios.	Noise within spaces.	-
Studio spaces.	Noise within spaces.	-
Very noise, sometime we share studio together.	Noise within space.	-
Noise in lecture theatre, from other levels, from workshop, from table tennis.	Noise within spaces, noise between floors, noise from workshop, noise from social activity.	-
Noise from floor surface. People scuffing their feet.	Noise between floors	-
Noise travels through levels. Hard to hear person next to you.	Noise between floors	-
The round insulation between the upper floor is lack.	Noise between floors	-
Lower floors, ping pong table and construction noises are a big disruption. Student noise is not as much of a disruption.	Noise between floors, social activity, noise from workshop.	-
Noise from workshop-construction. High heels when people walking on timber floor above seminar room.	Noise between floors, workshop.	-
Can't concentrate, too noisy.	Impact of noise.	-
Echos - large spaces, hard surfaces, noise travels.	Echoes, size of space, surfaces, noise travels.	-
Noise echoes from all levels. Unable to work in storms/heavy rain.	Echoes, noise from weather, impact of noise.	-
Noise tends to carry.	Extent of noise.	-
Noise through the building carries.	Extent of noise.	-
The studio area is just too large and exposed. Sound could reach almost anywhere.	Large spaces, extent of noise.	-
Major problem: buzzing lights in lecture theatre.	Noisy services.	-

NOISE 2008		
COMMENT	MAJOR ISSUE	-/o/+
Too much noise from building climate control mechanism and low frequency lighting fixture especially in lecture when dimmed and in normal setting.	Noisy services.	-
Noise from workshop.	Noise from workshop.	-
The workshop.	Noise from workshop.	-
Work shop upstairs.	Noise from workshop.	-
Workshop and construction site. Alarms. Wind, rain. Football stadium.	Noise from workshop, noise from weather, external noise.	-
Workshop area can get quite distracting when in the computer labs.	Noise from workshop.	-
Workshop is extremely loud.	Noise from workshop.	-
Workshop not insulated. Toilets not sound proofed.	Noise from workshop, noise from toilets.	-
Horrible sound during rainy day.	Noise from weather.	-
Noise from outside too much during windy days.	Noise from weather.	-
Only really becomes noisy when it rains.	Noise from weather.	-
Poor sound insulation from weather.	Noise from weather.	-
Roof!	Noise from weather.	-
Especially during rain and windy days on the top level. And people walking above tutorial rooms, lecture theatre and seminar room (or even moving furniture).	Noise from weather, noise between floors.	-
Noise from weather in studio is LOUD. Mechanical noses in lecture theatre very intrusive.	Noise from weather, noise from services.	-
People in computer lab are often too noisy and distracting. Sometimes on the weekend people bring their children to the computer lab and this creates a lot of noise. Rain in the upper studio is noisy on the roof.	Noise from weather, behaviour management.	-
Rain drops annoying. Floor noise (footsteps) ridiculous.	Noise from weather, noise between floors.	-
Rain, wind, workshop, upstairs stomps.	Noise from weather, noise between floors, noise from workshop.	-
Very noisy from the wind and walking steps.	Noise from weather, noise between floors.	-
You can't hear if it rains, the workshop noise fills the building, the noise from top level to lab travels.	Noise from weather, noise between floors, noise from workshop.	-
Bad acoustic systems.	Non specific.	-
Noises.	Non specific.	-
Noise seems to be okay.	Non specific.	O
Carpet has helped.	Adaptation.	O
Better now the carpet is in studio but still can get noisy.	Adaptation.	O
Better now with carpet on ground floor.	Adaptation.	O
Probably good/got used to ignoring the noises around.	Adaptation	+
Air con way too cold in lecture theatres.	N/A	

LIGHTING 2007		
COMMENT	MAJOR ISSUES	-/o/+
Glaring is an issue.	Glare.	-
Glare affects safety in the workshop when using power tools making models.	Glare	-
Glarey in first year studio on sunny days.	Glare in 1st year studio.	-
Glare from large windows in afternoon.	Glare	-
Lots of glare midday to afternoon, particularly in summer. Limited artificial light early evening and night.	Glare, artificial light.	-
I work with task light and overhead light and blind down because of glare.	Glare	-
Dark spaces suddenly open into light open spaces.	Light variation	-
Some computers in main lab receive too much glare from outside.	Glare.	-
Western glazed wall gives lots of glare in spring and autumn.	Glare	-
Western wall gives off a LOT of glare, corridors very dark in winter when natural light is low.	Glare, natural light.	-
Window opening very large – can be too glarey or sunny, need to close blind then so dark, need to put light on! Studios also quite glarey at times in summer.	Glare.	-
2nd year studio can become uncomfortable in the afternoon due to afternoon sun glare.	Glare	-
Afternoon glare really bad, sun shades needed. Lights not strong enough for working on overcast days or at night.	Glare, artificial light.	-
Afternoon sun a problem. Bright, glarey, hot.	Glare, natural light	-
Both sunlight and daylight in studio is excessive.	Natural light.	-
Huge areas of glazing and clearstorey lighting make for too bright studio spaces on all floors except the first floor (eg ground and second).	Natural light.	-
In the first year studio the sun is too bright in the afternoon.	Natural light.	-
Need some sun shades.	Natural light.	-
Too much summer sun into studio, need sunglasses.	Natural light.	-
When direct sunlight hits windows, the studio becomes unbearable – we all move into the shadows.	Natural light.	-
Too little in the morning studio, too much in the afternoon.	Natural light.	-
Too much sun in the day time, too little at night.	Natural light, artificial light	-
There is way too much sunlight into studio. In summer we wore sunglasses to see our paper. At night the artificial light is too dark for drawing.	Natural light, artificial light	-
4th year studio only has lights half way into room and only 1 small window.	Natural light, artificial light	-
Some tutorial and meeting rooms (learning space) having not enough of natural lighting.	Natural light.	-
More artificial lighting needed.	Artificial light	-
At night the studio is really too dark. If you use the spot lights, its too glarey.	Artificial light	-
Can be quite dark at night, need more artificial lighting in some areas.	Artificial light	-
Hard to get good lighting after hours (2nd year studio). Relocation to tute rooms and upper floor studio instead.	Artificial light	-
Lightings aren't enough at night.	Artificial light	-
The lighting and ventilation/heating options need to be labelled so that you don't turn on the top level louvers instead of lights.	Artificial lighting controls.	-
The sensors are not sensitive enough and always turn off.	Sensors.	-
Very satisfactory though early morning sun can produce glare.	Glare in morning (-), non specific (+).	O
Lighting is good apart from in the studio where there are no shading devices.	Natural light (-), non –specific (+).	O

LIGHTING 2007		
COMMENT	MAJOR ISSUES	-/o/+
Lighting during the day is pleasant and at night it is quite poor. Feels a little scarey at times.	Natural light (+),artificial light (-).	O
Good normally. At night its crap.	Non-specific (+), artificial light (-)	O
Good lighting conditions. Sometimes too glarey in 2nd year studio due to glazed wall.	Non-specific (+), glare (-).	O
Flexible light fitting is good but difficult to adjust glare and angle.	Lighting control (-), light fitting (+).	O
Aside from needing sunglasses in the later afternoon (in the lower studios), the great amount of natural light is fantastic.	Natural light (+, -)	O
Comfortable level.	Non specific.	+
The task lighting in the 3rd and 4th year studios is a great idea at night. During the day most people prefer to be near a window for better light.	Natural light, artificial light	+
Lighting is able to be controlled well with blind.	Adaptation (+).	+
None.	NA	

LIGHTING 2008		
COMMENT	MAJOR ISSUES	-/o/+
At night, the lighting is not sufficient.	Artificial light at night	-
At night, work spaces are not well lit.	Artificial light at night	-
Bad lighting at night in studio.	Artificial light at night	-
Lighting conditions at night are very poor.	Artificial light at night	-
Lighting to work during night time in the studio is not enough.	Artificial light at night	-
More light tables. At night hard to see work as lights are above and cast shadow.	Artificial light at night	-
Not enough artificial light at night or on dark days.	Artificial light at night	-
Really bad at night.	Artificial light at night	-
Some parts aren't lit well at night.	Artificial light at night	-
Lecture theatre.	Lecture theatre	-
No light (natural) in lecture theatre (curtains). Too much glare and heat from sun in tutorial room in summer.	Natural light in lecture theatre, glare	-
Flashing light in lecture theatre above me keeps flashing.	Artificial light in lecture theatre	-
Lights in lecture theatre flicker, hard to draw because it strains eyes.	Artificial light in lecture theatre	-
Major problem:buzzing lights in lecture theatre.	Artificial light in lecture theatre	-
Lights in lecture theatre flash and buzz through the speakers. Ground floor too much light.	Artificial light in lecture theatre, GF studio	-
First year studio can be very uncomfortable in the afternoon.	Natural light 1st year studio	-

LIGHTING 2008		
COMMENT	MAJOR ISSUES	-/o/+
First year studio.	1st year studio	-
Glazed curtain walls can be a problem.	GF studio	-
Glazed façade in afternoons an absolute killer.	GF studio	-
Late pm sun very intrusive in studio area.	GF studio	-
In the first year studio the light is terrible.	1st year studio	-
Poor high bay lights in studios.	Artificial light in GF studio	-
Need more spot lights for individual studies.	Artificial light	-
Need personal table lamp at tables away from general lighting.	Artificial light	-
Should use high frequency ballast lighting.	Artificial light	-
Lighting upstairs is minimal.	Top floor	-
Not enough light on the top floor for desk work.	Top floor	-
Glare at 3rd floor-difficult for classes/presentation. Hard to concentrate.	Glare top floor	-
Glare in lecture theatre as curtains don't close properly.	Glare in lecture theatre	-
Hard to work in tutorial areas in summer, real hot and glarey.	Glare	-
Studio glare is terrible.	Glare in studio	-
Summer - too much glare.	Glare	-
The glare from skylight too glaring for powerpoint presentation.	Glare	-
Too bright in studio area.	Glare in studio	-
Too much glare from window wall.	Glare in GF studio	-
Often if the afternoon sun is not there the lighting is barely sufficient.	Natural light	-
Tutorial room - natural lighting is poor.	Natural lighting in tute rooms	-
Studio area have too much daylight and sunlight.	Natural light in studio	-
Studio ground floor afternoon is terrible; lights turn off too frequently in labs in evening.	Natural light in GF studio, artificial light in computer labs	-
Shading required - 4 hours in sun in summer - skin CANCER.	Sun, health	-
Too much afternoon sun.	Sun	-
Way too much afternoon solar access in studio.	Sun in GF studio	-
Way too much sun in studio area.	Sun in studio	-
Not really enough light at working plane.	Non-specific	-
Depends on the space. Some are great, some are poor.	Non-specific (+, -)	O
Some spaces are good, some lack or have too much light.	Non- specific (+,-)	O
Fair enough.	Neutral, non-specific	O
Generally OK, except for internal rooms.	Non-specific (+), tute rooms (-)	O
Haven't found this to be a significant problem. Lights in studio are moveable (near wall) however are a hazard as very hot to touch.	Non-specific (O), artificial lighting in studio (-)	O
My office is fine but the corridor is very dark because it gets no natural light.	Office (+), natural light in staff circulation (-)	O
Natural light from glazed wall is good - but then it gets glarey in summer - actually leads to sunburn!	Natural light (+), glare (-), health (-)	O
Plenty of light through the day. Hard to light studio area at night as there are very high ceilings.	Natural light (+),Artificial light in GF studio (-)	O

LIGHTING 2008		
COMMENT	MAJOR ISSUES	-/o/+
Considered comfortable.	Non specific	+
In top floor lighting is generally fine.	Non-specific in top floor	+
Lighting is fine.	Non-specific	+
Too much noise in lower studio.	Noise in GF studio	NA

OVERALL COMFORT 2007		
COMMENT	**MAJOR ISSUE**	**-/o/+**
Heating wasn't working for a few weeks.	Heating.	-
Under desk heating is uncomfortable – produces hot dry draft in face.	Heating.	-
Just thermal problems, sun, heating.	Heating, thermal, sun.	-
Sun penetration into offices makes spaces very hot in summer and heating to offices seems inadequate in winter.	Heating, thermal.	-
Major issues with natural light and heating.	Heating, nat lighting.	-
Too cold, especially on ground floor.	Thermal	-
Too hot in summer, too cold in winter.	Thermal	-
Very uncomfortable in computer labs makes one perspire (varying conditions).	Thermal in computer labs.	-
Hot and cold. Never what you expect.	Thermal, unpredictability.	-
Too noisy.	Noise.	-
Noises caused by timber floor, staircase and workshop causes nuisance.	Noise.	-
More user controls required.	Control.	-
Unpredictable and out of control.	Control, unpredictability.	-
The building has won awards and we really don't know why.	Architecture awards.	-
Need to fix that glass wall.	Glass wall.	-
Not good! Rather go back to old uni.	Non specific.	-
It has its days. Depends on what you're doing.	Non specific.	o
It is definitely improving.	Non specific.	o
GREAT computer rooms, offices, tute rooms. 1st and 2nd year studio POOR.	Computer rooms (+), offices(+), tute rooms(+), GF studio (-)	o
Good that not too much energy is used to heat/cool the building.	Energy efficiency.	+
Good when you have layers on and shade provided.	Adaptation.	+

OVERALL COMFORT 2007		
COMMENT	**MAJOR ISSUE**	**-/o/+**
Part of the challenges of working in this type of building – benefits outweigh problems.	Non specific	+
Comfy.	Non specific.	+
Felt comfortable so far since the first time I were here.	Non specific.	+
Meets our needs.	Non specific.	+
Nice.	Non specific.	+
It is satisfactory as I don't mind being in the environment.	Non specific.	+
I enjoy working in the building.	Non specific.	+
I think it is a top building.	Non specific.	+
It's a good building to look at.	Image	NA

OVERALL COMFORT 2008		
COMMENT	MAJOR ISSUE	-/o/+
Climate control non-existent.	Thermal comfort	-
Its about the same as working outside.	Thermal comfort.	-
Need to regulate temperature.	Thermal comfort.	-
The building may be sustainable but it is too cold in winter and too hot in summer.	Thermal comfort.	-
Very cold in winter.	Thermal comfort.	-
Would be a lot more comfortable with more warmth.	Thermal comfort.	-
Studio - cold, glarey.	Thermal comfort, glare.	-
Too cold in winter especially night and evening.	Thermal comfort, thermal comfort at night.	-
Too cold. Natural light in ground floor studio too high.	Thermal comfort, natural light.	-
Try working here at night. COLD!	Thermal comfort at night.	-
During winter, heaters on during the day are too hot. After hours, heaters consistently fail. Too hot in the day, too cold at night and this in most work areas in the building.	Thermal comfort, thermal comfort at night.	-
Being in the building for long periods is very uncomfortable mainly because of lack of fresh air.	Air quality	-
I find the rooms are quite stuffy.	Air quality.	-
Could be more lounge space.	Social space.	-
Turn skylounge into student common room - sofas, table tennis.	Social space.	-
Feels very 'hard' in the building.	Image.	-
I think that it just needs a little warmth (still has an industrial feel).	Image.	-
Freezing in the morning, really hot in the afternoon.	Variation in temp.	-
Huge temperature swings and light variation.	Variation in temp and light.	-
Temp - not stable - add heaters used. Including puffy jackets and gloves. Too many people in office - becomes meeting point.	Variation in temp, adaptation, management.	-
I prefer not to work here due to a combination of my comments so far.	Changed behaviour.	-
Lecture theatre is uncomfortable and ?? (illegible).	Lecture theatre.	-
More bean bags.	Furniture.	-
No university life.	Culture.	-
Get used to it. But the old archi school in Newnham is still better.	Adaptation (+), non-specific (-).	O
At the middle of the day it is fine. Morning and afternoon are when the temperature is uncomfortable.	Thermal comfort (+,-), variation (-).	O
Cold, noisy. Sometimes satisfactory.	Thermal comfort (-), noise (-), non-specific (+).	O
All OK except varying temperatures, even if wear more clothing.	Thermal comfort (-), adaptation (-), non-specific (+)	O
The building is very cold but my office has been equipped with an extra heater so it is fine now.	Thermal comfort (-), adaptation (+)	o
Not as cosy as could be, but pretty good to work in.	Image (-), needs (+).	o
Varied during day/season.	Variation.	O
It's improving.	Non-specific (-, +).	O
Its quite freezing around 6 am in the winter, but once the heating kicks in, its fine. Then on warmer days the heating overloads at lunchtime. All bearable, don't have a problem with it.	Variation in temp, adaptation.	+
It mostly is an ideal environment.	Non-specific.	+

PERCEIVED PRODUCTIVITY 2007		
COMMENT	MAJOR ISSUES	-/o/+
In winter hard to work when it is very cold. Summer, presents difficulties when too hot.	Thermal.	-
It's hard to work when it's too cold or hot.	Thermal.	-
Either too cold, too hot, too bright.	Thermal light.	-
Temperature and sun effects need to be moderated.	Thermal, sun.	-
It's difficult to find spaces to do your work and sometimes too cold.	Thermal, needs.	-
When the building is cold you don't want to be here. When it's hot and stuffy, you just feel sleepy.	Thermal, ventilation.	-
Noise and temperature variations/extremes can affect productivity.	Thermal, noise.	-
Sometimes when it's really glarey, I get headaches.	Glare.	-
Glare and noise have a strong negative impact on my productivity.	Glare, noise.	-
Noise-distractions.	Noise.	-
If lectures are on and we are in a stuffy room, no concentration can happen.	Ventilation.	-
Distraction and interruption.	Interruption.	-
Too much interruption.	Interruption.	-
There are limited spaces in the building where I can work at 100% comfortably. If those spaces are occupied, I don't	Spatial quality.	-
Being here harshly decreases my productivity as opposed to being anywhere else.	Non specific.	-
Avoid working at school during normal hours. This is a bit weird!	Non specific.	-
I prefer to work at home usually.	Work at home	-
I do things differently now compared to last year. More tasks are now done at home.	Work at home	-
Often I can work at home with the same utilities. Thus when I am no longer required….	Work at home	-
Work from home more often now.	Work at home.	-
Never had good mood in doing or listening to talks.	Non specific.	-
More comfort=better efficiency. More airflow during summer.	Ventilation, comfort.	-
Ample natural light, fresh air and privacy when I need it allow for good productivity.	Light, ventilation, privacy.	+
Is accessed by warmth and good light conditions.	Light, thermal.	+
Quiet so I can concentrate on my work.	Quiet.	+
Separation of staff areas and well appointed office makes a great and convenient place to work. Studio spaces also	Planning, equipment.	+
Working environment is good. Facilities help.	Needs	+
Computers are efficient along with plenty of space for working in groups at intervals.	Spatial amount, equipment.	+
Feel like a better place to work in.	Non-specific	+
Good vibe all round.	Non-specific.	+
Great environment.	Non-specific	+
Space reminds me of primary school. I feel comfortable within the space (personal and subjective).	Psychological comfort.	+

PERCEIVED PRODUCTIVITY 2007		
COMMENT	MAJOR ISSUES	-/o/+
Comfortability can bring me to school and do work productively.	Comfort.	+
I become more creative!	Non specific.	+
I get things done.	Non specific.	+
Work heaps better here than at home.	Non specific.	+
More inclined to work in studio so more work completed at uni.	Non specific.	+
Sometimes good, sometimes bad, some rooms stuffy, some glarey, some cold.	Non-specific (+), glare (-), thermal(-), ventilation (-)	O
When it is quiet, I often work better at uni than at home. However, when it is noisy, working becomes a lot more	Noise (-), quiet (+)	O
Dependent on different parts of the building.	Nonspecific	O
Work differently around new building.	Non specific.	O
Closer to home.	Non specific.	O
I work better at home, but not because of the building.	Non specific.	O
None.	?	?

PERCEIVED PRODUCTIVITY 2008		
COMMENT	MAJOR ISSUES	-/o/+
Air conditioning in computer labs blows directly on students working - uncomfortable.	IAQ	-
I think it is air quality in tutorial and lecture rooms that cause the (lack of) productivity of work.	IAQ	-
Cannot concentrate to do designing.	Concentration	-
Cold and noisy.	Thermal, noise	-
Cold at night slows your productivity.	Thermal	-
When its cold productivity is decreased because you are trying to keep warm.	Thermal	-
When its cold, it decreases.	Thermal	-
Temperature affects how much time I want to spend here.	Thermal	-
On late nights and weekends it is difficult to work here because of the temperatures and ineffective heating.	Thermal at night	-
The colder it gets, the harder it is to study and work of a night.	Thermal at night	-
Try to work at home in superior climatic conditions.	Thermal, prefer home	-
Headphones are needed at times. Proofing reading/report writing is very difficult at times.	Noise	-
Require a quieter environment when thinking.	Noise	-
I work mostly from home as noise, temperature and constant interruptions are too disruptive.	Noise, thermal, interruptions, prefer home	-
Interruptions of noise (incl football and Launceston Show) and too cold make it hard to work. I now work at home.	Thermal, noise, prefer home	-
My productivity is dramatically reduced in winter when the building is freezing. It makes me not want to be here. Because spaces are so open it can be hard to concentrate.	Thermal, distraction from openness	-
Distractions.	Distractions	-

PERCEIVED PRODUCTIVITY 2008		
COMMENT	MAJOR ISSUES	-/o/+
Environment distractions.	Distractions from environment	-
Students are too distracting, no private study areas for one!	Privacy	-
Productivity is affected by surrounding people, not physical environment.	Interruptions	-
Too many people to talk to.	Distractions	-
Interruptions.	Interruptions	-
Less disturbing sunlight and glare.	Natural lighting, glare	-
Facilities widely distributed.	Planning	-
Hard to access library on other campus, so don't really bother to get books anymore due to location.	Library	-
I usually work at home because I am not productive at uni.	Prefer home	-
When its down I work at home.	Prefer home	-
Work at home.	Prefer home	-
Uncomfortable.	Non-specific	-
It does not facilitate being productive but its hard to estimate.	Non-specific	
Can move around building to get most comfortable space. Would be nice not to have to move!	Adaptation (+,-)	O
Good environment to work in apart from temperature.	Thermal (-), non-specific (+)	O
Upstairs studio is comfortable and a productive space. I like to use the computer lab after hours, but find it too hot/cold and gets stuffy when warm.	Top floor (+), thermal in computer lab (-), IAQ in computer lab (-)	O
Good to work around other students, however working at home suits me better.	Social interaction (+), prefer home (-)	O
I think that it is fine. The main issue I think is the temperature issue.	Non-specific (+), thermal (-)	O
		O
Day light at loft level is excellent.	Natural lighting top floor	+
For me, this is a learning environment. There is great value in interacting with others which the building facilitates well.	Social interaction	+
Having an office with only one other person and being able to keep it warm and utilise natural light increases productivity.	Privacy, thermal, natural light	+
I work well at school.	Non-specific	+
Generally good place to work.	Non-specific	+
No distractions.	Distractions	?
It affects how much work I do.	Non-specific	?
If I'm comfortable I work better. Less distracted.	Non-specific	?
Didn't occupy original.	NA	NA

HEALTH 2007		
COMMENT	MAJOR ISSUES	-/o/+
When the building is cold and draughty (even with my coat and scarf) which it is in some places, I feel like I could get sick from working in it. At these times I would rather work from home.	Temperature, draughts, colds.	-
Cold and sniffly in winter.	Temperature, colds.	-
I feel about the same, no different. But the school is draughty so you do go home and fell like you're getting a cold sometimes.	Draughts, colds, non-specific (o)	-
Temperature, particularly in winter, too cold and in summer upstairs, too hot.	Temperature.	-
Headaches are common in the afternoons.	Headaches.	-
Computer lab odours, smells.	Odours.	-
Lots of rooms smell of glue, toxic smells.	Odours.	-
Lecture theatre smells musty and I feel I'm ingesting dust.	Odours, dust.	-
Could be too much coffee and biscuits though……	Non specific.	-
Importantly I do not feel unhealthy in the building. However, noise from air flow in underfloor ducts not ideal.	Noise (-), non-specific .	O
Despite hot and cold I feel healthy.	Temperature (-), non-specific (o).	O
Tutorial rooms very stuffy and airless. Rest of spaces, good.	Ventilation (-), non-specific (+)	O
Psychologically good, although everyone had bad flu – cold be the drafty building or just a bad year.	Draughts, flu, non-specific (+).	O
Neutral, feel healthy when good ventilation and natural light.	Good ventilation (+), natural light (+), non-specific	O
I prefer to be outside, but it doesn't affect my health really.	Non specific.	O
I'm not sure if I feel less healthy. But I do not feel more healthy.	Non specific.	O
I haven't really considered how my health is affected as such.	Non specific.	O
Don't particularly notice, so it mustn't be bad.	Non specific.	O
Didn't affect my health.	Non specific.	O
My health isn't affected by the building. Possibly better because I'm in an open space.	Non specific, openness (+)	O
Feels as if you're outside, but protected by the walls and the roof.	Non specific.	O
No change. It doesn't make me feel sick if that's what you mean.	Non specific.	O
Not affected.	Non specific.	O
Normal.	Non specific.	O
Same.	Non specific.	O
None.	Non specific.	O
None.	Non specific.	O
Better than my small bedroom.	Non specific.	O
I feel good/average/the same.	Non specific.	O
Air condition is good.	Air quality.	+
Healthy building, clean air and good lighting.	Air quality, good lighting.	+
The formal and extensive architecture makes a professional and serious atmosphere that gives me confidence and is art to me.	*Not related to health.*	NA

HEALTH 2008		
COMMENT	MAJOR ISSUES	-/o/+
Air, fluctuations in temperature sometimes too drastic. Very hot upstairs and very cold downstairs.	Thermal, IAQ	-
Cold.	Thermal	-
Just cold.	Thermal	-
Very cold.	Thermal	-
Hay fever - dust.	IAQ - hayfever	-
Odours from workshop - sometimes strong.	IAQ odours from workshop	-
Ventilation not good.	Ventilation	-
Lecture theatre seems to exacerbate colds.	Colds from lecture theatre	-
Less healthy, usually a headache in winter, probably lights in lecture theatre.	Headache from lighting in lecture theatre	-
Lots of headaches. May be a side effect to architecture!	Headaches	-
Maybe just bad SAD in winter.	Well-being	-
Needs café or canteen! Students eat.	Food outlet	-
I would like more indoor/outdoor spaces. No openable areas.	Access to outside	-
Usually good air circulation, no overcrowding, however if feeling unwell (cold etc) above issues mean lower tolerance and increased time off from school.	Ventilation (+), colds (-)	O
You know you're alive because its so cold.	Thermal (+, -)	O
I like the natural light and open areas. However, I have to be careful about glare as I suffer from migraine.	Natural light (+), openness (+), glare (-)	O
Good interaction better for mental wellbeing than old school, but physically worse.	Non-specific (-), social interaction (+), well-being (+)	O
I don't feel unhealthy, just dehydrated sometimes.	Non-specific, neutral (O), dehydration (-)	O
Average - haven't noticed any difference.	Non-specific neutral	O
Depends on situation.	Non-specific	O
Nothing different.	Non-specific	O
Because the temperature relates so much to the outside we do have a good connection to the seasons.	Connection to external temperature	+
Good fresh air, bright environment.	IAQ, natural lighting	+
Open space good for air flow and positivity.	Ventilation and well-being from openness	+
That's hard. I'm healthy when my work is done because I'm happy and I get my work done a lot quicker at the building.	Productivity, well-being	+
I don't spend enough time here to give an accurate comment.	Non-specific	NA
The smell of timber.	Odour (?)	?
Are you joking.	Non-specific	NA

REQUESTS FOR CHANGES 2008	
COMMENT	MAJOR ISSUES
Asked for better heating and the request was granted.	Thermal
Asked for heating, but they were broken.	Thermal
Because everyone in the school knows its cold.	Thermal
Have complained that it is too cold to work at night. Hence the heating got fixed and we have a tropical studio environment.	Thermal
Heat up.	Thermal
Heaters in winter - only in main studio though.	Thermal
Heaters in winter (in studio) are insufficient. In the lecture theatre it gets way too hot.	Thermal
Heating to be available over the weekends.	Thermal
Heating.	Thermal
Let us turn heaters ON!	Thermal
Nothing changed-problem is at night when building is too cold, highlighted by students bringing in their own heaters. Need more personal control.	Thermal
Only the heating in the main studio.	Thermal
Requested more heating in winter especially after hours and weekends when the building is extremely cold.	Thermal
Too cold at night to work anywhere but labs.	Thermal
Too cold, need to turn on heater.	Thermal
Turn the heaters on.	Thermal
Winter is cold.	Thermal
Yes about heating. Told to bring in a thermometer and measure temperature.	Thermal
Better after hours heating.	Thermal at night
Heating. Lighting (stay on) and how to turn it off. Sun burn from west.	Thermal, artificial lighting, sun
After hours lighting in car park, fixed successfully. After hours heating was chased up by Roger within reasonable time frame. Both complaints were on behalf of students.	Thermal at night, external lighting in car park
Additional lights to work area, rearrangement of furniture, brought own desk lamps, heating for night turned on.	Thermal at night, artificial lighting, equipment
Just open doors when it gets hot. But then it gets noisy.	Thermal, noise
Rubbish, heating, noise.	Thermal, noise, cleaning
More heating, sunshades for ground floor windows.	Thermal, shading
Window screening (blinds) to stop heat and glare. More heating in big spaces.	Thermal, shading
No heating, sensor lights switch off in computer labs, warm tap water.	Thermal, sensors, water temp
Shading in studio. Temporary at night.	Shading in studio
Talked to architect last year. Proposed blinds in studio.	Shading in studio
Better car park lighting.	External lighting in car park
Lighting at night in studio.	Artificial lighting at night in studio
Lights removed, disconnected, task lamps purchased, new window (opening) added, use add heating and cooling app.	Artificial lighting, window, thermal
Toilet timers for lighting - 6 months to change.	Lighting sensors
Move the architecture school to Newnham campus or Hobart.	Relocate school
Upstairs automatic ventilation wasn't working, but has been resolved.	Ventilation
Attempts for lecture theatre.	Lecture theatre

REQUESTS FOR CHANGES 2008	
COMMENT	MAJOR ISSUES
Feel I have no control.	Lack of control
I've really wanted to, though.	Desired change
I have heard that people who work here every day have complained to the appropriate people - I don't know if anything was changed.	Requests from others
Please fix, not working.	Non specific
Nothing ever done about them.	Lack of response
When possible.	NA
Because I usually work at home outside of class times.	NA

CHANGED BEHAVIOUR BECAUSE OF CONDITIONS IN BUILDING 2008		
COMMENT	MAJOR ISSUES	-/o/+
Maybe less concentration.	Concentration	-
If the AC or lights are particularly noisy, I refuse to pay attention to lectures.	Concentration - noise	-
Difficult to concentrate if lecture theatre is hot.	Concentration - thermal	-
Find it hard to concentrate at night especially and in day when its too hot and stuffy.	Concentration – thermal, IAQ	-
I am less social because I work at home now because I am not comfortable working here.	Work at home, less social.	-
I work at home more often due to noise and distraction from others.	Work at home – noise, distraction	-
Less active when building is cold, tends to make one want to reduce activity. Noise and disruptions mean bulk of work done at home.	Work at home, less activity - thermal	-
If it's busy I'm distracted really easily.	Distraction - activity	-
Less productive or become distracted due to uncomfortable conditions.	Distraction, less producitve	-
I become reclusive and keep the door shut - NOISE is a huge issue.	Shut door, less social - noise	-
I come in only when it is quiet. I don't do much work at lunchtime due to heat and light.	Choose work times – noise, thermal, light	-
I find noise from outside very annoying especially when the tutor/lecturer's giving powerpoint slides talk.	Frustration - noise	-
Lack of fresh air if lecture in closed room for too long. Need to replenish lots of water.	Drink - IAQ	-
Bring extra clothes, lighting etc.	Clothes, equipment - light	-
Don't stay as long in winter. Wear clothing to suit. Have to move frequently to avoid sun in summer in studio.	Clothes, change location, leave building,- thermal	-
Increased clothing amounts. Angry. Frustrated. Tired.	Clothes, frustration, tiredness, anger	-
Headphones and warm clothes in winter.	Clothes	-
How I dress - warmer clothing in winter.	Clothes	-
I wear a coat inside - very hard to work in.	Clothes	-
If it's cold, wear different clothes.	Clothes	-
More jumpers and thongs/skirts.	Clothes	
More/less clothing.	Clothes	-

CHANGED BEHAVIOUR BECAUSE OF CONDITIONS IN BUILDING 2008		
COMMENT	MAJOR ISSUES	-/o/+
Put on a jumper if cold.	Clothes - thermal	-
Put on jacket inside in winter.	Clothes - thermal	-
Wear jumper.	Clothes - thermal	-
Wear warmer clothes.	Clothes - thermal	-
Move around more often to seek fresh air.	Change location - IAQ	-
Move to smaller, easier to heat rooms when cold.	Change location - thermal	-
Selection of spaces, for thermal comfort and acoustics.	Change location – thermal, noise	-
Tried to bring heater in without being noticed once.	Add eqpt - thermal	-
Change drawing tables around because of bad light.	Move furniture - light	-
Cranky - too warm. Sleepy - too cold.	Mood change - thermal	-
Frustrations occur when uncomfortable.	Mood change	-
Get frustrated easily, 'cause environment is too loud, stuffy or bright (only on lightbox).	Mood change – noise, IAQ, light	-
Poor conditions (heat) in combination with deadlines exaggerate grumpiness.	Mood change - thermal	-
If too cold/too hot behaviour changes. Less patience.	Mood change - thermal	-
Sound insulation not good, sometimes feel frustrated when someone making noise, and feel irritated when someone walking at the studio.	Mood change - noise	-
Stressful, sometimes bad mood because of the noise.	Stress, mood change - noise	-
I get cranky when can't deal with temperature and it affects my ability to work with others and concentrate.	Mood change , concentration, productivity- thermal	-
Lethargic if its too hot/stuffy then creates crabbiness.	Tiredness, mood change - thermal	-
Makes me feel drowsy and difficult to work.	Tiredness, motivation	-
I get sleepy in lecture theatre.	Tiredness	-
I get tired in lectures when it is stuffy.	Tiredness - IAQ	-
Sleepy or freezing.	Tiredness - thermal	-
The cold causes fatigue.	Tiredness - thermal	-
Depending on the comfort of the building if I stay or not.	Leave building	-
I always want to leave as quickly as possible.	Leave building	-
If it's too cold, or hot, I leave.	Leave building - thermal	-
Leave.	Leave building	-
Leave.	Leave building	-
Try not to work here.	Leave building	-
Try to not work in this building!	Leave building	-
Drink more water. Go out of building to take in fresh air.	Leave building, drink	
Choose work space carefully.	Choose space	O
Social behaviour.	Social interraction	O
Temp effects how I work and interact.	Work and social interraction - thermal	O
Temperature.	Non-specific -thermal	O
Become very social and excited to work.	Social interaction, motivation	+

CHANGED BEHAVIOUR BECAUSE OF CONDITIONS IN BUILDING 2008		
COMMENT	MAJOR ISSUES	-/o/+
Work rate and positive improvements.	Productivity	+
Good shower facilities lets me shower more often here.	Use showers	+
Student don't have own computer, have to stay overnight doing assignment in architecture school. I suggest that the campus move to Newnham again.	NA	NA
Movement cycles, time spent working.	Work time	NA
When its too hot or cold I get no fresh air or can't really look outside.	Thermal, stay inside	NA
As I'm overseas student, no choice. This is our destiny.	NA	NA
Sometimes.	?	NA