The Integration of Historic Preservation and Green Architecture and Design in Housing: a pragmatic approach to preservation in housing.

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Original Submission: May, 2003
Resubmitted: April, 2005
Corrections: October 2006

CONTAINS
PULLOUTS

Dedication

For my Dad.

Acknowledgements

It is very important for me to thank the numerous people who helped me finally to complete this work. It has been both an academic and spiritual journey. Never could I have imagined what I have learned and gained from this experience.

I would like to thank the Dean of Guild for their contribution that enabled me to pursue this work. Thank you, Patty Hutchins of the Wilson Museum for your insight and photographs. I would also like to thank the staff and regular members of the Barbados Historical Society for their "historic" enthusiasm. Mr. Phillip Goddard & Ms. Veronica Curry and Mr. & Mrs. Roger Gilmore for allowing me access to their homes. Their support and valuable information have been a generous contribution to the completion of this thesis.

Dr. Macaulay, you have been an inspiration to me throughout the course of this work. Initially I was intimidated by your brilliance, now I am most respectful of what you have taught me and shared with me. Dr. Hanna, thank you for helping me to see my vision and encouraging me to believe that some how it was going to work. Both of you are brilliant gentlemen with remarkable patience.

I would like to thank Hsu-jen Huang, Amnat (Chim) Ratanabanyat, and Mustafa Mezughi for their friendship and laughter. I value you as friends and colleagues. Thank you to Pauline, Catherine, Craig and the rest of the crowd who worked "behind the scenes". It is amazing what you can do with a little help.

Thank you John Duffy for opening your home to me and making me feel as though it were mine as well. Elizabeth Shaw you have been such a dear friend through all of this madness, thank you.

I am most indebted to my mother and father who have been along for the entire 'adventure'. What a long trip it has been! You are not just family but my friends and I never would have had the courage to find my voice without your support.

Finally to Driss, you are truly one in a million. I am the lucky one! I love you for your faith, laughter, joy, and all of the craziness that we share. Your loyalty and faithfulness have kept me going. I hope and pray that I can return what you have so generously given to me.

Simply put, thank you one and all.

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Abstract

Concepts such as historic preservation and modern building technology are mostly considered incompatible. Preservationists fear the loss of history and tradition, which is justified in some cases when the priorities of modern building technology are relatively insensitive to historical needs. This thesis argues that historic architectural structures can be modernised without destroying their historic significance or harming the environment. It aims to demonstrate that the architectural standards of the past can be successfully combined with present day technology, while exploring the possibilities of sympathetically integrating historic preservation with green architecture in housing.

An historic structure is often associated with large utility bills and inefficiency in energy consumption. Such deficiencies are generally accepted and balanced against the historic merit of the building. In order to save many of the buildings regarded as treasures of the past, new uses need to be recognised for them. Listed or historic buildings that are at risk can be renewed and given, if not another purpose, a new way of working, bearing in mind that each project has its own idiosyncrasies.

In this day and age new homes are eating up green belt space and devouring natural resources. Much of the Glasgow's historic housing stock is listed or included in conservation areas. Therefore, the relationship between building and the natural environment could have great relevance for that city. A notable recent example is the eighteenth-century Tobacco Merchant's House, Miller Street, where the heating, lighting and ventilation are energy efficient and sympathetic to the building and its new use as a conservation centre. The Tobacco Merchant's House in Glasgow is part of a growing international awareness of environmentally conscious building conservation and can be related, for example, to the Audubon House in New York, which will be an important part of the study. The integration of historic preservation and green architecture in historically significant

buildings could be an example of recycling, providing the public with the benefits of conserving a valuable part of their physical heritage while trying to secure a sustainable future.

Introduction

This research is concerned with providing a link between building conservation and improvements in the environment, through a process of ecologically responsible renovation and restoration. The study is involved with examining the following areas: the state of the global environment and what needs to be done to slow the halt of the destruction; the influence of the built environment on the natural environment; the historical development of the conservation movement; and finally, how green architectural methods and practices can be implemented in domestic structures. In addition, case studies have been explored to determine the originality of the research problems and to determine the key issues concerning the integration of building conservation with green materials and policies.

This study is aimed at showing how an historic architectural structure can be modernised without destroying its historical significance or harming the natural environment, and establishing that building conservation and green materials and policies can be successfully integrated in housing. The research will attempt to demonstrate that historical architectural standards can be successfully combined with modern technology, energy-efficiency and ecologically sensitive materials, consequently exploring the possibilities of sympathetically integrating building conservation with strict environmental standards. In addition, it is anticipated that the success of this cycle will provide municipalities with the opportunity to halt environmental degradation and to preserve their cultural heritage as it is expressed in their local architecture.

There are two anticipated results of this research. The first, is to provide a way to return to a human scale of manageability without the perpetual destruction of our natural environment. Second, by the promotion of the environmentally minded practice of architectural preservation while applying strict environmental standards. The hope is that this will result in a synthesis of modern environmental techniques with the appreciation for the preservation of cultural architectural heritage. The proposal has not been based on any one culture. It is based on the universal human desire for longevity, therefore preparing mankind for the preservation of self, while instilling in future generations a need for a more respectful and sympathetic relationship with the natural environment.

In the light of the proposal, the literature review has focused on three areas: an introduction to the environmental predicament; buildings and emissions; and the historical development of the conservation movement. The point of the literature review is to present these fields independently as well as to demonstrate the interaction and impacts of these fields upon each other. The purpose of chapter four, 'Integration: The Audubon House', is to provide a basis for the integration of building conservation and green architecture. While this particular case study does not directly demonstrate the integration of these fields in housing, it does provide a basis for the potential of the integration of these fields. It appears as though the Audubon Society's own account of their project is the only published example available. On the available published information and for the sake of laying out the case studies the Audubon Society's account provides the evidence, while Belmont House and the Stone Cottage provide examples of the possibilities in residential settings. Further by providing two very different case studies in two very different climatic and geographical locations it is hoped that the logic of the research can be applied to other buildings elsewhere, while taking into consideration the building's idiosyncrasies.

The hypothesis is directly driven by the perceived needs to save buildings and to provide solutions for the harmful changes in the global environment. The hypothesis implies that there could be a positive relationship between building conservation and the environment. This study will set out to establish that building conservation and green materials and policies can be successfully integrated into housing development.

Building conservation is the independent variable and can be manipulated according to building type, age, design, and so forth, in order to test the relationship with the dependent variable, the global environment. For a good result and in order to maintain the original integrity of the building, its character must remain intact. To do so it is necessary to assess fully the possibilities of wholly re-utilising the building through an effective and comprehensive building program.

The global environment is the dependent variable and is perceived to continue in the same manner as it has been set out in the literature until the independent and extraneous variables are applied. It is the influence of the independent and extraneous variables, building conservation and green architecture, which will determine the outcome of the study. It is anticipated that through the implementation of the proposed hypothesis the global environment should significantly improve given time. In addition, it is essential to lay out the environmental predicament, without exposure of the environmental crisis as it stands there would not be any rationale for pursuing green building preservation.

Green architecture and design is the extraneous variable and is designed to create a relationship between building conservation as the independent variable and the global environment as the dependent variable. The state of the global environment depends upon the status quo of the built environment. It is how the conserved built environment impacts upon the natural environment that is imperative. This relationship is crucial to the hypothesis and the success of the research.

The study will not enter into the debate of which buildings should be conserved and for what reason, but will aim to provide guidelines for those involved in the conservation or development process. Neither will the study decide which methods of green architecture are better than others, unless the benefits are directly linked to further success in the final outcome of any of the case studies.

For the study to be successful three assumptions are necessary. The first is that the global warming trend is not debatable. This is a trend directly influenced by human consumption and has the capability to be controlled. Both sides of the debate concerning the effects and outcome of the global warming trend will be discussed. The second assumption is that the market for green architecture techniques and energy saving devices will continue to grow. The third assumption is that there will be a continued interested in building conservation.

It is believed that the impact of energy modifications should greatly reduce the energy consumption of the building. Furthermore, there is a growing market for certain renewable alternative energy sources for the home, allowing the consumer direct control over emissions. Consideration will be given to the environmental impact of household appliances. It is expected that the environmental impact of household appliances will be greatly reduced when renewable sources of energy and highly efficient, ecologically sensitive appliances are utilised. The overall goal of the project is to recycle the building through a fully comprehensive plan, therefore salvaging history and building materials.

Chapter One
Introduction to the Environmental Predicament

1.1 INTRODUCTION

The activities of daily human life have become a catalyst for the disruption and destruction of the entire ecosystem. This is demonstrated by the depletion of renewable resources, pollution of the Earth, and the extinction of species. The natural balance between the human race and the environment is being shifted, perhaps irrevocably, and certainly to the detriment of the human species, which is acutely vulnerable to the types of changes taking place. By ignoring the maintenance of the ecological balance that applies to all other species we are confusing the evolutionary process, which will result in unknown consequences. In the physical man-made environment one challenge now is to set out to be creative while embracing "greenness" as a motivation for an architecture that is as humanly rewarding as that of the past.

1.2 THE EARTH'S NATURAL ABILITY TO REGULATE ITSELF

The earth's climate is multi-dimensional, complicated, and variable, not to mention massive and chaotic, and as such it is difficult to profile reliably. However, it seems as though the way in which the Earth has regulated itself suggests that life is creating optimal conditions for its continuance. This provides a basis from which to work, therefore providing a model to judge truly how detrimental human activity has been. It is important to remember that acids and alkalis have always been here, but are now occurring in greater concentrations as a result of man's addition of other combinations of the existing basic ingredients; chlorofluorocarbons, hydrochlorofluorocarbons, hydrofluorocarbons and chlorine, to name a few.

1.3 THE CRISIS

The first UN conference on the environment was in Stockholm in 1972 at which approximately 100 countries were represented. It was determined that the two major concerns of the environmental crisis were the depletion of non-renewable resources and pollution. However, it was not until the beginning of the oil embargo in October 1973 that the public became aware of the extensive dependency upon fossil fuels. Shortly thereafter resource exhaustion, the ozone dilemma, global hunger, and the population crisis topped the political agenda world-wide.

While the notion of energy efficiency and sustainability came to the fore during this crisis period, as soon as oil prices began to drop it became evident that old consumption habits died hard, evidenced by Americans reluctance to give up their cars. In reaction to the crisis of 1973 fossil fuel consumption was tried, however, the only significant reminder is the application of fuel consumption restrictions on motor vehicles and this could be vastly improved. Originally this measure was seen to save energy, but now it is seen as a measure to reduce pollution.

It appears as though most governments have at least acknowledged that there is an impending environmental crisis. Over 150 countries took part in the Framework Convention on Climate Change, otherwise known as the Earth Summit, in Rio de Janeiro in 1992. Of the Earth Summit participants only the industrial countries committed to reduce the output of greenhouse gases to 1990 levels by the end of this decade, yet the United States has been increasing their output of greenhouse gases by approximately 12% during the last decade.[1] (Figure 1.1) Few of the industrialised countries met even their minimal commitment for the year 2000. In the last five years world-wide emissions of global warming gases have risen even though climate scientists are telling governments that

reductions of more than 50% will be needed.[2] In 2000, the last year for which complete figures are available, global carbon emissions reached an all time high of 369.40ppm (the highest monthly level

PARTY	EMISSIONS (Gg)	%
Australia	288,965	2.1
Austria	59,200	0.4
Belgium	113,405	0.8
Bulgaria	82,990	0.6
Canada	457,441	3.3
Czech Republic	169,514	1.2
Denmark	52,100	0.4
Estonia	37,797	0.3
Finland	53,900	0.4
France	366,536	2.7
Germany	1,012,433	7.4
Greece	82,100	0.6
Hungary	71,673	0.5
Iceland	2,172	0
Ireland	30,719	0.2
Italy	428,941	3.1
Japan	1,173,360	8.5
Latvia	22,976	0.2
Liechtenstein	208	0
Luxembourg	11,343	0.1
Monaco	71	0
Netherlands	167,600	1.2
New Zealand	25,530	0.2
Norway	35,533	0.3
Poland	414,930	3
Portugal	42,148	0.3
Romania	171,103	1.2
Russian Federation	2,388,720	17.4
Slovakia	58,278	0.4
Spain	260,654	1.9
Sweden	61,256	0.4
Switzerland	43,600	0.3
United Kingdom	584,078	4.3
United States	4,957,022	36.1
TOTAL	**13,728,306**	**100**

Figure 1.1 Total carbon dioxide emissions for Annex I Parties, 1990.[i]

[i] KYOTO PROTOCOL, Total Carbon Emissions Of Annex I Parties in 1990.

was 371.62ppm and was recorded in May 2001).[3] (Figure 1.2) Industrial countries continue to consume a major share of the Earth's natural resources and release the most destructive chemicals.

The discovery of new reserves, recycling, and substitution of other materials has proven those first warnings about the depletion of non-renewable resources false. Unfortunately the failure of these early predictions has provided the sceptics with some of the ammunition they need to attack and attempt to disregard the environmental dilemma altogether.

The sceptics are prepared to disregard the climate change warnings and believe that carbon taxes and limits represent economic suicide. For the most part they are experts either from within the fossil fuel and chemical industries or they are scientists and researchers heavily funded by these industries. Both of these industries have set-up powerful lobbies and it is through these lobbies that they are able to court politicians, the media, as well as the public thereby skirting attempts to engage in scientific debate.

1.4 DISCOVERY OF THE OZONE PROBLEM

Thomas Midgley JR. invented chlorofluorocarbons (CFCs) coincidentally he also invented leaded gasoline. CFCs first became available during the early thirties and were initially used for small refrigeration applications. Because CFCs are thermally and chemically stable, non-flammable, have a low thermal conductivity, are low in toxicity, and are cost efficient they are ideally suited to modern day conveniences. In addition, because they are an efficient coolant, CFCs have become widely used in household refrigeration and air

conditioners. CFCs have also been used as propellants for aerosols, foam packaging, insulation, and their most recent adaptation as a cleaning solvent for computer manufacturing. Since their introduction, over 20 million tonnes of CFCs have been released into the atmosphere.[4] According to Robert and Brenda Vale, authors of *Green Architecture: Design for an Energy-Conscious Future,* "Roughly

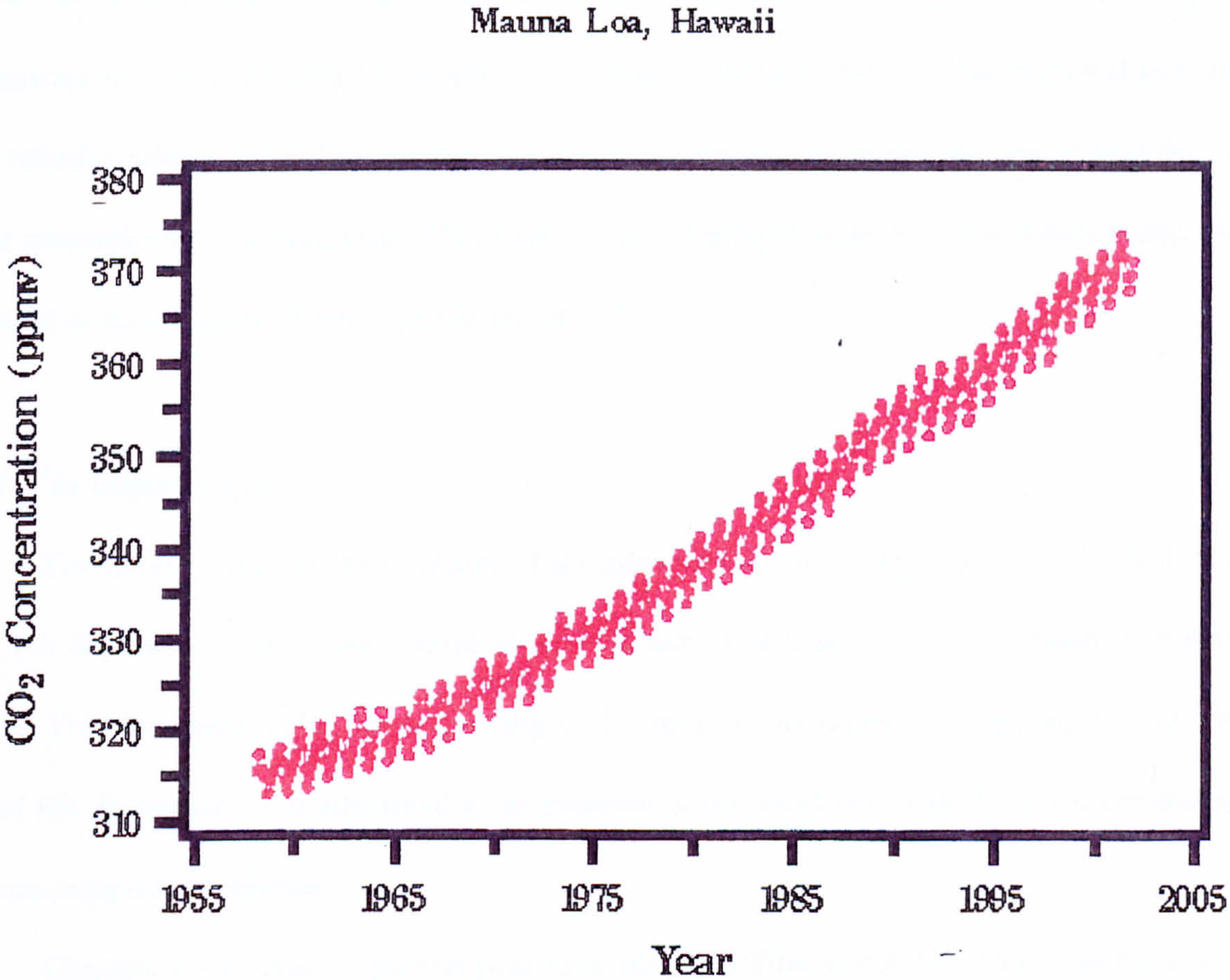

Figure 1.2 Atmospheric carbon dioxide record from Mauna Loa.[i]

[i] KEELING, C.D., and T.P. Whorf, Atmospheric CO2 records from sites in the SIO air sampling network. In Trends: A compendium of Data on Global Change. Carbon Dioxide Information Analysis Centre, Oak Ridge National Laboratory, U.S. Department of Energy, Oak Ridge, TN, USA, 2001.

50% of the CFCs produced throughout the world are in buildings, as a part of the air-conditioning or refrigeration systems, in fire extinguisher systems, and in certain insulation materials."[5]

In 1974, Dr. Rowland and Dr. Molina, chemists at the University of California at Irvine, theorised that CFCs have the ability to harm the ozone layer. According to the two scientists, "These compounds are chemically inert and may remain in the atmosphere for 40-150 years and concentrations can be expected to reach 10 to 30 times present levels... The chemical inertness and high volatility which make these materials suitable for technological use also mean that they remain in the atmosphere for a long time. There are no obvious rapid sinks for their removal and they may be useful as inert tracers of atmospheric motions."[6]

1.4.1 The Ozone Layer

The ozone layer has the property of absorbing ultraviolet energy radiation from the sun. For each 1% depletion of the ozone there is an increase of at least 2% UV-B radiation reaching the Earth.[7] This increased radiation is proving to be harmful to human beings, vegetation, fish, and animal life. In humans it is attributed to an increase in the incidents of skin cancer, eye damage, and immune suppression disease.

Concern over ozone depletion peaked in the late 1970s, which led directly to bans on the use of CFCs in aerosols in the US. However, this ban did not result in a decline in the production and release of CFCs until approximately 1983. Production and release gained some ground after 1984 as chemical companies found new markets, such as foam blowing, car air-conditioning, and solvents for computer cleaning, for CFCs. (Figure 1.3)

It was not until the mid-1980s when ozone depletion became evident above Antarctica, that the potential for catastrophe was realised. The discovery of the rapidly depleting ozone layer also

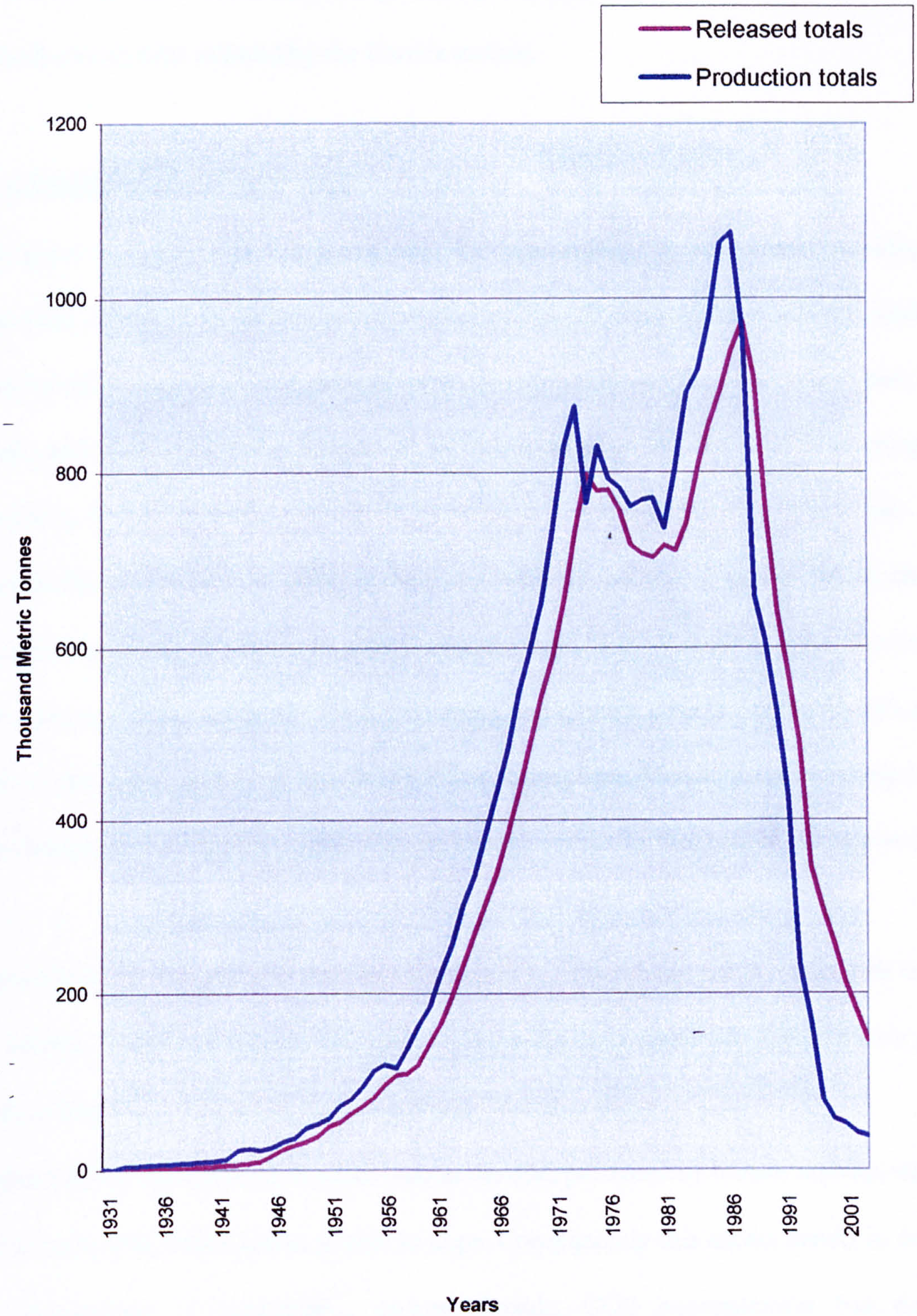

Figure 1.3 CFC Production and Release Totals 1931-2001 as reported by the Alternative Fluorocarbons Environmental Acceptability Study.[i]

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[i] AFEAS, Production, Sales, and Emissions Data.

revealed the link between CFCs and the greenhouse effect. CFCs react similarly to CO2 and methane which absorb heat radiated by the Earth's surface.

1.5 THE GREENHOUSE EFFECT

The gases that surround the Earth trap the heat radiated by the Earth resulting in the greenhouse effect. These gases include water vapour, carbon dioxide, methane, nitrous oxide, CFCs and other industrial chemicals. These gases allow short-wave radiation from the sun to pass through to the Earth and then collect the long-wave radiation reflected by the Earth, resulting in the collection of heat. The greenhouse effect itself, however, is a common occurrence in nature.

Specifically the greenhouse effect is the cause, while global warming and climate change are the consequences resulting in a threat to ecosystems, the extinction of species, an increase in storms, melting ice caps, and rising sea levels. Global warming and climate change are the Earth's regulated adjustments to the accumulation of heat in the lower atmosphere. Hence global warming is directly linked to a change in temperatures, while climate change results in fluctuations to regional climatic events.

Currently when the greenhouse effect is referred to, it is used in conjunction with the effects of human activity. There is a critical difference between the carbon dioxide (CO2) nature produces and the carbon dioxide produced by human activity. Critical to the delicate balance is the introduction of more carbon dioxide, produced by human activity, which is up and over the limits with which nature is able to cope. Consequently this excess results in an increase in the concentrations of atmospheric carbon dioxide. CO2 concentration has risen from 315.98ppmv in 1959 to 369.40ppmv in 2001 and currently it is rising at a rate of approximately 0.5% per year.[8] (Figure 1.2) While human activity has further increased the concentration of carbon dioxide, this activity has also increased other gases, such as water vapour, methane, and nitrous oxide. Human activity has also introduced some new man-made gases, such as CFCs, further disrupting the natural cycle.

Destruction of world-wide forests and an increase in the levels of radiation are rapidly reducing the environment's ability to effectively digest the increasing levels of carbon dioxide. Clear cutting contributes significantly to the amount of carbon dioxide released into the atmosphere and further destruction of the ozone by man-made chemicals increases the levels of radiation reaching the Earth's surface. Reduction in the densities of natural carbon sinks, forests and oceanic plankton for example, could result in less carbon dioxide being absorbed from the atmosphere, therefore exacerbating the problem of the greenhouse effect.

1.5.1 Adverse Changes

There is no question about the changes the greenhouse effect is having on our atmosphere. There are records of weather patterns over the last few years that have led to an increased speculation concerning climate changes. For 2001 the global average surface temperature was approximately 0.42°C above the average for 1961-90[9] and over the last century the global mean temperature has risen 0.6°C.[10]

The warmest year on record was 1998 and was 0.57°C higher than the 1961-90 average.[11] There appears to be a consensus that the major contributing factor to the 1998 increases was the 1997/98 El Niño Southern Oscillation warming event. In addition, according to the World Meteorological Organisation, the rise in temperatures over the last 100 years has not been continuous and instead there have been significant increases at a rate three times the norm since 1976.[12]

In addition, as the oceans gradually warm it is predicted that wind speeds will rise. Should circumstances go unchanged the sea level is expected to rise on average approximately 5cm per decade.[13] It has already risen by 25cm since the beginning of the 20th century and is expected to have risen by twice as much by the middle of the 21st century.[14] Given the current rate of warming and emissions we will experience a 2-6°F increase by the end of the next century equivalent to the increase of the last 10,000 years.[15]

As further evidence of the severity of the warming, over the last fifty years temperature records from the Faraday / Vernadsky and Rothera Antarctic Stations show that annual mean temperatures have increased by approximately 2.5°C.[16] The Polar Regions are the first places to show the effects of global warming because the ice is so sensitive to climatic change. Linked with the reported warming has been the disintegration of the Antarctic ice-sheets resulting in the unforeseen splitting of the Wordie ice shelf, Larsen ice shelf and the ice shelf in the Prince Gustav Channel. Further changes to the Polar Regions will become evident as patterns in other parts of the world evolve. The immediate affects of melting will not carry the same destructive possibilities as that of melting on a huge scale. However, melting on a huge scale, once started, will be impossible to stop.

Present day human societies are results of an evolutionary process that has spanned several centuries. Severe and abrupt environmental change to these societies is likely to cause immense disorder, if the predictions are correct. The disruptions would manifest themselves as changes to traditional ways of agricultural, technical, economic, and cultural wisdom. Unfortunately the consequences are expected to be felt most in developing nations, as they are not as well equipped to stave off the effects of widespread and catastrophic environmental losses.

A. Climate Modelling

Future climate predictions are based on computer models generated by various international meteorological organisations. These models and other collection and analysis centres are located in the United States, United Kingdom, France, Germany, China, and Australia, to name a few. The global interdisciplinary research effort is the Climate Variability and Predictability Program

(CLIVAR) which is an integral part of the World Climate Research Program and the World Meteorological Organisation.

The computer model plays an essential role in the prediction of global warming, although the process is as complex as it is lengthy. There are a variety of modelling systems which can be employed for climate prediction purposes. Generally the most complex models work in three dimensions and are known as atmosphere-ocean general circulation models (AOGCM). This modelling process encompasses atmospheric and oceanic conditions simultaneously. For example the Hadley Centre's (UK) HadCM3 which is an AOGCM, depicts the atmospheric component with 19 levels with a horizontal resolution of 2.5° of latitude by 3.75° of longitude.[17] This resolution produces a global three dimensional grid of 96 x 73 grid cells.[18] The oceanic component is represented by 20 levels with a horizontal resolution of 1.25° x 1.25°.[19]

There are many factors that can impact meteorological conditions and climate modelling, some of these include: the radiative effects of greenhouse gases, soil moisture, evaporation, large scale precipitation and cloud formation. HadCM3 attempts to incorporate a broader base of basic, but complex array of data needed to reliably profile climatic conditions, past, present and future. The HadCM3 model has a higher ocean resolution than HadCM2, which means that this model does not require data inputs to artificially adjust the heat and freshwater fluxes at the ocean's surface. Therefore there are no flux adjustments required in order to be able to produce an accurate simulation. According to the Met Office, "HadCM3 has been run for over a thousand years, showing little drift in its surface climate."[20]

Considering the complexity of climate modelling HadCM3 is reported to be largely accurate. However in a 1997 interview in the Sunday Times Magazine Dr. Geoff Jenkins, head of the Centre for Climate Prediction and Research at the Hadley Centre was noted as being uncertain. According to Dr. Jenkins, "The size of droplets in the clouds above us today, is about 10 microns, or onehundredth of a millimetre. If that decreased by two microns, the clouds would be a lot brighter. They would reflect more solar radiation and would cool the Earth. Day to day in the UK and around the world, differences of this magnitude are quite normal. A difference on this scale in the global average, however, could have the effect of completely cancelling global warming - or of doubling it."[21]

That statement reinforces that science can not categorically prove climate change. For the most part it is not a question of whether or not global warming and climate change are serious problems, but how the problems will develop, how they can best be detected and what measures can be taken to reduce the effects.

1.6 CONSEQUENCES OF THE GREENHOUSE EFFECT

> Human induced climate change represents an important additional stress, particularly to the many ecological and socio-economic systems already affected by pollution, increasing resource demands, and nonsustainable management practices. ~ IPCC Synthesis Report, Section 3.3

While some of the consequences of the greenhouse effect are positive they do not negate the overall negative impacts felt globally. Benefits realised by isolated regions do not compensate for the social, economic, and ecological disasters caused by global climatic change. Unfortunately, the developing world will realise the impact of global warming all too severely as they are perhaps less prepared than their wealthy developed neighbours. Developing countries represent only 24% of the world's energy consumption, but industrial countries consume 77% of the world's energy and contribute to 77% of the world's pollution.[22] In comparison with the US, the entire developing world, representing almost 80% of the world's population, is responsible for approximately the same amount of carbon dioxide.[23] By continuing to develop its industrial base, the developed world is responsible for the immense consumption of fossil fuels and in turn is the main cause of higher concentrations of carbon dioxide in the atmosphere. By delaying change it is possible that future changes could become unnecessarily difficult and perhaps even unobtainable.

The most recent measurements of the ozone layer over the Antarctic show that the ozone hole has grown larger and takes longer to recover. (Figure 1.4) In addition, according to the National Resource Defence Council (NRDC) global concentrations of carbon dioxide have increased by about 30% during the last century.[24] Furthermore, it can take up to a century for natural processes to remove pollutants, mainly carbon dioxide, from the atmosphere.

1.6.1 The Human Consequences

Human health is becoming directly affected by the increasingly pronounced effects of industrialisation. Only through an understanding of the risks associated with the overexposure to the sun will measures be taken to help reduce the potentially deadly affects. Skin cancer, eye damage, and immune suppression have been linked to overexposure to the sun. Two of the principal causes of premature death are skin cancer, which was initially linked to the shrinking ozone layer, and cardiopulmonary disease, which has been directly linked to an increase in particle pollution. It should be pointed out that while the studies sited are conducted and based in the United States, these health problems occur world-wide.

A. Skin Cancer

A 2001 report by the American Cancer Society predicts that there will be approximately 1.3 million new cases of basal cell and squamous cell carcinoma diagnosed, however, if detected and treated early there is a 95% cure rate.[25] There will be an estimated 51,400 new cases of malignant melanoma with an estimated 7,800 fatalities from this form of skin cancer alone.[26] In addition, another 2,000 fatalities are predicted from other forms of skin cancer.[27] Malignant melanoma is the

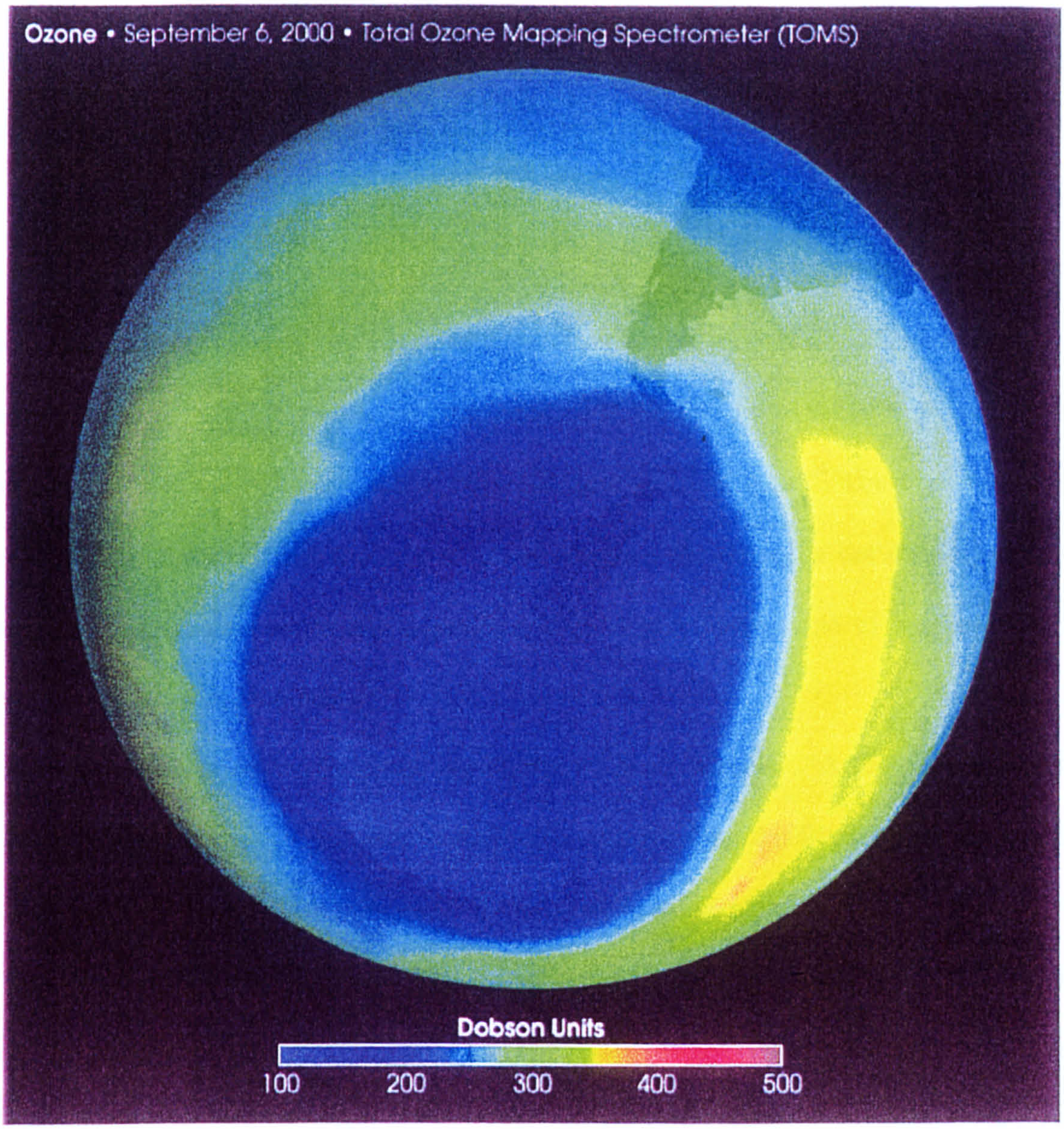

Figure 1.4 A TOMS image of the ozone hole on September 6, 2000. This ozone hole measured 28.3 million square kilometres and was roughly the same size September 2001.[i]

[i] NASA, Earth Observatory, September 6, 2000.

fastest growing reported type of skin cancer and accounts for 75% of all new cases.[28] If it is not treated early enough it usually spreads to the lungs and liver and leads to death.

These findings were initially correlated with the increasing levels of UV-B radiation reaching the surface of the Earth due to the ozone depletion in the stratosphere. Studies have linked an increase in nonmelanoma skin cancers to sun exposure. According to Joseph Scotto, of the National Cancer Institute, "It is possible to regulate one's exposure to sunlight hence the theory which directly links the increase of tropical overseas holidays with an increase in cases of skin cancer. Some sceptics may regard this lifestyle indicator as a more significant contributor than the decrease in global stratospheric ozone. Part of a growing concern is evidence that there is significant ozone destruction occurring over Argentina, Chile, New Zealand, and Australia."[29] There are some lifestyle choices which can directly effect the spread of this disease. However, as the ozone continues to disappear more and more over highly populated areas it may be possible to attribute this to an increase in the skin cancer epidemic.

According to a study conducted by the National Cancer Institute, "A 1% increase in solar U-VB exposure may result in a 2% increase in the incidence rate of basal cell carcinoma, a 4% increase in squamous cell carcinoma of the skin, and a 1% increase in skin melanoma."[30]

In October 1991 the United Nations Environment Programme (UNEP) found evidence of significant ozone destruction occurring over highly populated regions of both hemispheres in both the spring and summer.[31] This is when the sun's rays are strongest and pose the greatest risk for long term damage. The UNEP also predicted that the ozone depletion over mid-latitudes in the 1990s would be at least double that experienced in the 1980s.[32] Dr. Joseph Farman, the British scientist who discovered the Antarctic ozone hole, stated in October, 1991 that the ozone loss over the UK and Northern Europe could be as high as 30% by the year 2000.[33]

B. *Cardiopulmonary Disease*

Cardiopulmonary disease linked to particle pollution may be the premature cause of death for 64,000 people a year in the US alone.[34] In some of the most polluted cities, Los Angeles, New York City, Chicago, Philadelphia, and Detroit, lives can be shortened by an average of 1-2 years.[35]

The Clean Air Act 1990, mandates that the EPA is required to set air pollution standards to protect human health regardless of the cost. This is now being challenged in the US Supreme Court. Based on this mandate the EPA has proposed a tougher set of standards for pm2.5 and ozone. The cause for concern is the fine particulate matter (pm2.5) which can penetrate deep into lung tissue. The EPA suggests that the new rules will cost up to US$8.5 billion a year and when compared with benefits, such as fewer premature deaths, lower medical expenses, and fewer days off work, which cost industry up to US$120 billion a year, this is certainly advantageous.[36] However, industry spokesmen are sceptical and claim that the new standard could cost US$50 billion a year and not be as advantageous as suggested.[37] Clearly weighing the cost of a clean up against the cost of saving a life will always be controversial.

Since 1986 concentrations of carbon monoxide, sulphur dioxide, nitrogen dioxide, particulate matter, and lead have fallen. Studies have linked the fine particulate matter, pm2.5, to health problems, which include asthma, bronchitis, acute and chronic breathing problems, and premature death. Breathing pm2.5 can be especially detrimental to children's health. Because their immune and respiratory systems are not fully developed children are at a greater risk for developing asthma. According to the EPA, "40% of all asthma cases are children, however children make up only 25% of the population."[38] In addition pm2.5 contributes to problems in the United States associated with acid rain and therefore is also a significant environmental hazard. It is possible that the new legislation will save 20,000 lives a year and reduce the number of asthma cases by around 250,000.[39]

Industry lobbyists argue that the evidence used to regulate pm2.5 is based only on a series of studies which show a correlation between high concentrations of particles in the air and high rates of death and illness. For example, the NRDC used the findings of a 1995 study by the American Cancer Society and Harvard Medical School to examine regional data. This study is the longest running and most extensive study which demonstrates with epidemiological evidence the health risks of particulate air pollution. Researchers developed statistical techniques in order to be able to factor out other risks, such as smoking, body weight, and occupational exposures. The NRDC's analysis showed that 4,662 – 37,562 lives could be saved if the new standards set by the EPA were applied.[40] That is if controls were set to limit emissions to 12 – 20 micrograms per cubic meter on an annual average basis.[41]

1.6.2 The Environmental Consequences

While production of CFCs have been curtailed, the levels of CFCs released into the atmosphere have not diminished, so things will get worse for some time before a full recovery is realised. The 1994 Report by the UNEP, Scientific Assessment of the Ozone Depletion, has outlined that for the time being and in the projected short term, the rate of chlorine loading in the atmosphere has slowed. This reduction is directly linked to the reduction in global emissions of human-made compounds over recent years. However, there has been an increase in other amounts of industrial chlorine and bromine in the atmosphere and as a result of these increases record low levels of global ozone continue to be recorded. The 2001 ozone hole is the most severe on record. (Figure 1.4) Some believe that the requirements of the Montreal Protocol are not adequate and therefore the recovery will not be realised as quickly as is possible.

Climate models project that the global mean surface temperature will increase by 1-3.5°C by 2100 and that global mean sea level will rise by 15-95cm during the same period of time.[42] In addition the IPCC Working Group predicted in 1997 that, "The average rate of warming would probably be greater than any seen in the past 10,000 years, although the actual annual to decadal rate would include considerable natural variability, and regional changes could differ substantially from the global mean value."[43] This report also outlines potential crises concerning growing seasons, world agricultural patterns, extreme heat waves, and the spread of disease and floods. Additional predictions indicate that there will be changes not only in temperature, there are also changes anticipated in rainfall, wind speed, and sea level rise. In the light of all of these predications, the Alliance for Small Island States (AOSIS) has called for industrialised countries to cut their carbon dioxide emission by 20% from 1990 levels by 2005.[44]

1.6.3 The Economic Consequences

For a while the wealthy industrialised countries may be able to protect themselves from the effects of the changes, but this will be at the expense of the rest of the world. This can only happen when the necessary materials are expropriated in order to maintain an unnatural carrying capacity. As Jacobs has pointed out, "Any national economy can only be described as sustainable if its activities not only do not reduce environmental capacities within its own borders but do not cause their reduction elsewhere."[45]

The predicted regional effects of global warming imply both negative and positive results. As stated earlier global warming would ultimately affect temperature change, impacting most notably the length of growing seasons. Global warming is also likely to impact significantly the rise of sea-levels by further accelerating the melting of land ice and causing thermal expansion of sea water. This would greatly concern the half of the global population inhabiting coastal regions. On average the sea levels rose 10-25 cm during the last century and it is probable that a rise of 44cm can be expected by the 2080s.[46]

Because industrial countries have stable finances and advanced technical knowledge they are better equipped than developing nations to deal effectively with the predicted sea level increases, as well as any other unexpected natural disaster. Unfortunately less developed nations will be less able or even unable to cope and as a result will be adversely affected by the floods, tragically culminating in permanent dislocation and human loss and suffering. For example, among developing nations Southern Asia and Egypt would be severely threatened along their delta regions, by the increased probability of floods. According to the United Kingdom's Meteorological Office, "In absolute numbers, the southern Mediterranean, Africa, Southern Asia, and South-east Asia are the most vulnerable to the impacts of flooding. The islands of the Caribbean and the small islands of the Indian Ocean and Pacific Ocean are also vulnerable in terms of large relative increases in flood risk. In addition, coastal wetlands are expected to decline due to sea-level rise, with the largest losses around the Mediterranean and Baltic and on the Atlantic coast of Central and North America."[47]

Thus far, according to Robert Costanza, editor of *Ecological Economics: The Science and Management of Sustainability*, "Economic and political institutions have failed to provide proper incentives for sustaining ecosystems, because of five major, possibly interacting causes: short time horizons, failures in property rights, concentration of economic and political power, immeasurability, and institutional and scientific uncertainty."[48]

In order for the international programs to be effective a co-ordinated effort must be made locally, nationally, and regionally in order to implement solutions to rectify the environmental dilemmas caused by energy transformation and use, as this is the greatest determinant of the current status of the environment. Because energy, human health, the environment and the economy are so intricately involved it is imperative that international programs are examined and implemented at these levels.

1.7 INTERNATIONAL RESPONSIBILITIES

> The Parties to this Convention, ...*Determined* to protect human health and the environment against adverse effects resulting from the modifications of the ozone layer, *Have agreed* as follows:
> -Vienna Convention for the Protection of the Ozone Layer, 1985

There are two notable factors concerning global environment conferences led by the United Nations. First countries can almost unanimously count on each other not to meet their targets. The United States is notorious for not meeting targets set for greenhouse gas emissions by international treaties. Most recently the United States has moved away from ratifying the Kyoto Protocol. Secondly, representatives at these conferences are not senior level policymakers and therefore do not have the clout to make concrete decisions regarding environmental policy. Typically they are members of the department of the environment, not representatives of the departments of the treasury or industry. Therefore the people who make the real economic and political decisions that effect the environment are not present to agree to proposals and hence global policy tends to be seen as secondary within the domestic and foreign policy. This is especially the case with the current US administration.

Considering the state of things globally, it is becoming increasingly apparent that the world may have to adapt to be able to survive without the use of fossil fuels. We already possess the technology to provide humanity with clean and reliable sources of energy. Measures need to be implemented to promote the everyday use of renewable energy sources. A combination of renewable systems, such as solar photovoltaic power stations, solar hot water systems and wind turbines, in both individual and large-scale applications can be utilised to meet required energy levels. Renewable sources will prove to be cheaper, economically and environmentally, than conventional fuels. Once all energy systems have a built-in accounting system environmental and financial gains and losses can effectively be measured.

1.7.1 The Vienna Convention and Montreal Protocol

Originally the motive of the Vienna Convention, which was convened in 1985 and in 1987 became the Montreal Protocol, was to address the destructive nature of modern living on the environment. Fifty-seven industrialised countries signed the Protocol which put initiatives in place to encourage and enforce the phaseout of ozone depleting chemicals, including CFCs. Production of all CFCs, in industrialised countries, was scheduled to halt by 1 January, 1996 and all other countries are scheduled to follow by 2006.[49] Furthermore, the Montreal Protocol called for a 50% cut in CFC consumption by 1992.[50] Over the years, the scope of the Protocol has been broadened to include additional ozone depleters such as methyl chloroform, carbon tetrachloride and HCFCs. It has been strengthened periodically as science has determined that the standards set forth are not sufficient. Even so, for all of its successes, the Montreal Protocol still allows the production and use of ozone destroying chemicals.

While the Montreal Protocol does not directly address the issue of global warming, the report does concur that deliberation of ozone change will be essential to understanding the climate change question. In addition it also implies that human activity has had an impact on the ozone since pre-industrial times, which is believed to have a significant impact into the foreseeable future.

1.7.2 The Framework Convention on Climate Change

In 1992 the Framework Convention on Climate Change, The Earth Summit, was originally signed by 167 countries in Rio de Janeiro. As of June 2002 there have been 186 governments who have ratified the Framework Convention on Climate Change (the Convention). These countries pledged to a stabilisation of carbon emissions to pre1990 levels by 2000. Shortly thereafter it was discovered that these levels continued to contribute to the greenhouse effect, therefore the 1992 agreement was deemed inadequate. In the ten years since the Convention first convened the Parties have met annually. The next step for the international community is to reassess any further agreements and to ensure that future agreements become legally binding.

> 'Global mean surface temperature has increased by between about 0.3 and 0.6 degrees centigrade since the late 19th century, a change that is unlikely to be entirely natural in origin. The balance of evidence, from changes in global mean surface air temperature and from changes in geographical, seasonal and vertical patterns of atmospheric temperature, suggests a discernible human influence on global climate. There are uncertainties in key factors, including the magnitude and patterns of long-term natural variability. Global sea level has risen by between 10 and 25 cm over the past 100 years and much of the rise may be related to the increase in global mean temperature. ~ IPCC, Synthesis Report, 2.4

1.7.3 KYOTO PROTOCOL

The Kyoto Protocol was adopted by the United Nations Framework Convention on Climate Change on 11 December 1997 and is the first legally binding treatise to place constraints on greenhouse gas emissions for Annex I Parties to the Convention. Nevertheless, in some measure all parties of the Protocol are subject to the general commitments outlined. Of the 186 signatories of the Convention 84 Parties have signed the Kyoto Protocol and 74 Parties have ratified or acceded the Kyoto Protocol.[51] In order for this treatise to be legally binding signatories must ratify the treatise within the framework of their national government. To date the United States has signed the Protocol, however, since President George W. Bush's inauguration, the United States has backed away from any commitments to the Kyoto Protocol, moving further away from ratifying it. (Appendix A)

The primary objective of the Convention is to prevent further dangerous anthropogenic interference with the environment by stabilising atmospheric concentrations of greenhouse gases.[52] This is clearly an attempt to limit emissions. However, the Convention does not define dangerous which in effect leaves the door open for broad interpretation. This kind of definitive debate requires economic, social, and scientific judgements which appear to be too controversial to deal with in this forum. Furthermore, the Convention attempts to recognise the dilemmas presented by equity, common but differentiated responsibilities, and the precautionary principle which the Convention believes "responds to the dilemma that, although many uncertainties still surround climate change waiting for full scientific certainty before taking action will almost certainly be too late to avert its worst impacts."[53]

The Kyoto Protocol acknowledges that historically the industrialised world have contributed the most to the environmental dilemma and as a result have the resources, both financial and technical, to effectively deal with the problem. The Convention outlines a global framework in order to deal with climate change. It directs the industrial west to assume responsibility by reducing long-term emissions as well as shouldering the financial and technological burden to assist the developing world to reduce emissions and adapt to the adverse effects of the climate problems. In addition, it calls on an implementation of precautionary measures in order to change the status quo for the least developed countries. Energy consumption, land use, and demographic growth are issues which inextricably link the progress of development to climate change in the developing world. According to the Convention, "Tackling climate change must be compatible with advancing the aspirations of the world's poor, as part of their efforts to achieve sustainable development."[54]

Industrial countries are overwhelmingly concerned with the associated costs of unmitigated climate change, in many instances at the expense of the world's poor. For the developing world, two areas which go hand in hand are development and poverty alleviation. It must be realised that development created to alleviate poverty is possible without further environmental degradation. For example, renewable sources of energy, such as solar cells implemented in isolated rural areas, can help alleviate the burden of the poor. A perceived failing of the Convention is that it calls for policies and measures to deal with climate change to be cost-effective, so to ensure global benefits at the lowest possible cost. However, it is believed that this could be a loophole for industrial countries and could provide a way to abandon such policies because they are perceived as 'too expensive' in financial terms. This would not be the case if the criteria for a triple bottom line were applied.

The Kyoto Protocol sets out to receive commitments from members of the Convention; implement the treatise; minimise impacts on developing countries; set out guidelines for accounting, reporting, and review procedures; and finally ensure signatory compliance. The Marrakech Accords which are recognised as the rulebook and implementation strategy for the Kyoto Protocol, require Annex I Parties to annually report the actions being taken to protect the least developed countries from adverse impacts related to the implementation of emissions targets by Annex I Parties. The strategies for emissions reductions are outlined as: the removal of subsidies for environmentally unfriendly technologies; development of non-energy uses of fossil fuels; advanced fossil fuel technologies; carbon capture / storage technologies; capacity buildings to improve efficiency; and assisting developing countries that are highly dependent on fossil fuels to diversify their economies.[55] In order to effectively meet their targets, Annex I Parties must set-up domestic policies and measures which will cut their greenhouse gas emissions. They can do this by setting out joint implementation policies, participating in emissions trading, and implementing clean development mechanisms. Rigorous monitoring systems have been outlined. They include an accounting system, regular reporting by parties, and an in-depth review by expert review teams co-ordinated by the secretariat. Each Annex I Party is responsible for a national registry and the implementation of a national regulatory system. They must submit, to the secretariat an annual inventory of greenhouse gas emissions and removals following IPCC guidelines, who will then publish a compilation and accounting report.

Of particular interest, the Protocol has addressed the issues facing developing countries. The Marrakesh Accords set up an adaptation fund which is financed by Annex I Parties and a levy on clean development mechanism projects. It is designed to promote the issues concerning developing countries, in particular those which are most vulnerable to the adverse effects of climate change. The fund is designed to finance concrete adaptation projects and programmes in developing countries, along with such activities as supporting building capacity. Non-Annex I Parties are also requested to provide information on their specific needs and concerns.

1.8 FUTURE OF THE OZONE

As stated earlier, more than two decades have passed since Dr. Rowland and Dr. Molina first theorised that CFCs in the atmosphere were destroying the Earth's ozone layer. Response to the crisis has varied since that time as a result of the imperfection of atmospheric science, the effects of the efforts of the lobbyists, and a varying degree of political and public concern. Current estimates are that ozone depletion will continue to worsen for at least the next decade in the northern hemisphere and the Antarctic ozone hole is expect to exist until at least 2061, only after reaching peak chlorine loading in the atmosphere, which is predicted to be more than double the level at which the ozone hole first appeared.[56]

The political leadership does not seem to understand that policies which sanction continued use of ozone depleting substances in an effort to sustain growth do not account for the possibilities of triggering further threshold effects in the environment. We are already faced with coping with the consequences of the Antarctic ozone hole that manifested itself in 1984 under atmospheric chlorine concentrations of 2ppb. We can not control the peak concentration loads of these chemicals nor can we prevent the resulting losses. However we can prevent further production and release.

1.9 DEVELOPING ECONOMIES AND THE ENVIRONMENT

Primarily the tendency to delay a complete ban of ozone depleting chemicals appears to be an economically motivated one. Continuously there are trade-offs made between the ozone layer and costs. Who is to say that the money spent on a complete phase-out is too much? In an ideal world industrialised countries would have learned their lesson by now albeit an expensive one, financially and environmentally. Having learned the lessons and consequences of modern living, industrialised nations should step up to their responsibility to prevent further destruction of the global environment.

What handicaps the international programs, the Montreal and Kyoto Protocols in particular, is that negotiations do not highlight the value environmental or equity issues have in obtainable and fair policymaking. Rather the debate is almost exclusively driven by economic viability, international market competitiveness, and technology exposure in an effort to support sustainable growth, not sustainability. These profit driven policies serve to disrupt local, national, and global economies thereby preventing sustainable and equitable growth.

The environmental watchdog, Greenpeace noted that a deal was signed in Paris in March 1997 that allowed Western companies the right to lower the environmental and health standards when they invest in developing nations. This deal was drawn up by the Organisation for Economic Co-operation and Development (OECD) whose members are the world's twenty-nine wealthiest countries.

However, according to Charles Arden Clark, former trade and policy co-ordinator for the World Wide Fund for Nature, "This agreement is the ultimate betrayal of the Rio Earth Summit and earlier OECD commitments to put the environment and development issues at the heart of economic policy. It will weaken developing nations power to insist on high environmental and health standards and give Western companies *carte blanche* to apply lower standards in the developing world than in their own countries."[57] It should be obvious that in order for any sort of real successes to be realised these sorts of double standards need to be addressed.

1.10 LOCAL RESPONSE

The deteriorating state of the environment is clear, and while most governments have recognised this decline, they have failed to adhere to the global agreements. There appears to be a notable absence of real ecological issues from politics. During the course of environmental and economic planning, the pursuit of sustainable environmental policy is altered and emerges as sustainable growth. By coming to grips with the true process of a sustainable global economy a healthy natural environment becomes obtainable. In order for this to be achieved linear thinking processes need to evolve to cyclical ones in all sectors of society. By reinventing these processes society becomes realigned with the balanced cycles of nature.

It is possible to demonstrate that the practicalities of an economic recovery do not differentiate between environmentally sound practices and investment and a recovery based on linear processes of consumption. There is a growing consensus that in the long run a cyclical economic recovery plan will cost less than the current economic method of consumption. Now is the time to alter the traditional perception of a division of sound environmental policies and economic well-being. The development of an environmentally based economic system would include the development of environmental taxation and the incorporation of a sustainability index. Perhaps the greatest challenge facing the political leadership is to successfully manage the transition to an environmentally based economy. Until then, communities seeking ways to prevent local economic disaster should consider the advantages of not only investing locally in goods and services, but also in energy efficiency and alternative energy technologies for the community as well. By doing so it is possible to improve the economic health of the community, not to mention its environmental well-being. By becoming increasingly self-sufficient the community becomes responsible for the direct impact on their future. Self-sufficiency provides the basis for a more cohesive community and establishes within the community a sense of pride through increased ability, stability and independence.

1.11 SUMMARY

It is not yet exactly clear how the environmental predicament will manifest itself. The literature demonstrates and scientific evidence strongly suggests, but does not prove, that man-made emissions of greenhouse gases have warmed the Earth this century and if emissions continue the warming will increase. Indeed, it is necessary to remember that all science is inconclusive and is forever subject to modifications in the light of new evidence. For this reason this chapter has attempted to set out the complexities of the global warming debate. It does not try to represent wholly the argument set forth by the sceptics because this argument is skewed to the advantage of the fossil fuel and chemical industries.

Because of the complex nature of atmospheric science we will never have predictions which are 100% correct. What we face are decisions based on the information at hand, much of which has been gathered since the deterioration of our planet became apparent. We can choose to ignore the warning signs or we can elect to identify that there is a serious problem which will not correct itself without our intervention. Man has successfully developed technology that fosters a comfortable lifestyle. It is now time to figure out and implement the systems which will lessen the destructive natures of our lifestyle. We now lead lifestyles, which could be labelled disposable, in some societies more so than in others. Certainly the industrialised world surpasses the developing world in this, and for this reason the industrial world should bear the brunt of the responsibility to solve the painful lessons being learnt globally of a primarily disposable society.

The fossil fuel industry is one of the most heavily subsidised by government funds, therefore in essence creating a monopoly in the energy market, with fossil fuels versus renewables. It is clear that the playing field is not level. While some companies have shown moderate interest in the possibilities of the renewable field it is feared that the multinational corporations will buy the budding renewable companies and merge with them, slowly losing the renewable fuel industry in the complexities of fossil fuel politics. This being the case it is important and certainly possible for communities and individuals to pursue their own program of suitable renewable energy sources.

The purpose of this research is to demonstrate that there is a problem with the excessive consumption levels of the building industry and to demonstrate that these problems can be solved. For example in the US the built environment is responsible for approximately 54% of total US energy use, with the residential sector using approximately 26% of that total, a figure that is similar in all industrialised countries.[58] Likewise, 50% of world fossil fuel consumption is used in relation to the servicing of buildings.[59] This being the case building professionals, owners, and occupiers have the capability to reduce the required amounts of energy for the residential environment, as it pertains to the building and its infrastructure. Because energy use and conservation in housing stock are technically well understood it is hard to believe that large reductions in energy use and carbon emissions in connection with housing have not become an integral part of building codes in the same way as water efficiency has.

It appears as though it will become necessary to change forcibly market forces at some point in order to level the energy playing field. The change must be made and the legislation must be enacted by politicians who are committed and recognise that renewable energy sources will become the sustenance for the future. The only way to reach politicians with this message is through grassroots movements. By developing grassroots based organisations, national governments and multinational companies will need to take note in order to guarantee successful and profitable futures. Perhaps in light of the recent terrorist strike in the United States, these public and private entities will be compelled to seek renewable solutions in response to the political tension continued reliance on fossil fuels is sure to foster.

Global warming will probably not result in the apocalypse some environmentalists are predicting. Nevertheless it is not a matter to be taken lightly. Scientific evidence strongly suggests, but does not prove, that man-made emissions of greenhouse gases have increased the Earth's temperature this century and if emissions continue to increase the warming will continue. Not only will the consequences of warming result in environmental chaos, but they will be detrimental to human health.

There is some debate concerning the validity and accuracy of the scientific evidence. For example it is not quite clear how much of the recent warming is due to the natural variability of the climate and whether clouds dampen or aggravate the rise in temperatures. Given this scientific uncertainty it would appear to be foolish to impose tremendous economic costs to avert global warming. It would be equally as foolish not to impose measures to reduce greenhouse gas emissions. Nine-tenths of the world's commercial energy comes from fossil fuels and as a result renewable sources of energy are still more expensive. Estimates for the subsidies to the fossil fuel industry range from $5 billion (USD) annually to the United States alone[60] to $600 billion (USD) annually world-wide.[61] Most of these subsidies force down the price of fossil fuels, providing the public with widespread availability of cheap fuel. However, they do not improve the readiness of renewable sources of energy.

Obviously governments prefer to avoid unpopular political decisions when it comes to cutting subsidies. However, the withdrawal of subsidies for the fossil fuels would force firms in the one trillion dollars a year fossil fuel industry to invest in reducing the costs of alternative sources of energy. Only when these subsidies are reduced and withdrawn can real progress be made concerning the reduction of greenhouse emissions.

If fossil fuel consumption is not changed repairing the environmental damage will prove to be far more expensive than making an attempt to stop the damage before it occurs. If we reduce our demand on non-renewable resources then we can reduce our negative impact on the environment and in turn the Earth. Western society needs to change the criteria for success. Instead of defining a successful life in monetary terms and as a consumer, it should be defined by the quality of life fulfilled.

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Chapter Two
The Built Environment

2.1 INTRODUCTION

The way in which buildings are utilised world-wide is a major cause of global pollution, therefore developing renewable sources of energy which is one way to help tackle the pollution problem should be a priority. However, the short-term strategy should be to use less energy. In the last ten years there have been remarkable advances relating to renewable technologies – old ones being rediscovered and refined and new ones being developed.

In addition to an improvement in the efficiencies of the building stock the increase of toxic substances being introduced into the home also needs to be addressed. Certainly contamination levels of toxins in the home can vary according to a number of factors. Of course there are environmental consequences for continued release of these toxins, but alarmingly there is also a direct threat to human health due to the widespread and increased use of the household toxins. Again, there are traditional methods which were shunned with the advent of modern miracles, touted to make the chores of a housewife effortless. As it has turned out these so-called miracles are highly toxic and are allergens which are routinely introduced into our homes.

2.2 SUSTAINABILITY

According to the Bruntland Commission, a sustainable society is one which uses resources without compromising future generations.[1] As discussed earlier sustainability evolves according to the nature of the political debate and in most instances represents the balance of natural resources needed to maintain the urban population.

Because buildings are part of the human environment and greatly influence the quality and way of life, choices determining building technology should be made carefully. The building should not be perceived to violently disturb the environment during construction or final use. In order to be successful, sustainable architecture must use materials in an ecologically responsible way and must be aesthetically pleasing. This does not require sustainable architecture to be exclusively new buildings or design. On the contrary, existing buildings can be made sustainable and may provide a better opportunity of achieving sustainability and have a better chance of being successful overall. Fundamentally buildings are required to provide shelter and improve the environment to best serve human needs. Often during the design process sustainability is sacrificed in order to accomplish the final design. Building preservation provides a unique opportunity to maintain a commitment to sustainability as it pertains to the built environment.

Friends of the Earth, based in the Netherlands, are one of the groups which have identified several factors crucial for establishing lasting sustainability. Their ideology is the most comprehensive and clear. The components are: (i) closing process cycles so that all materials, as far as possible, stay in a closed loop thus minimising the supply of unprocessed raw materials (ii) limiting the use of renewable raw materials to levels that can be extracted without causing serious environmental damage (iii) providing a recycling infrastructure which will ensure the collection, sorting and processing of discarded materials (iv) halving the use of fossil fuels for energy through demand management and efficiency gains (v) maximising the life span of materials and products (vi) making producers responsible for a product through its entire life cycle, from production to disposal and finally,(vii) limiting the amount of pollution that people produce to levels with which the environment can cope.[2] Two factors that might be considered for addition to the preceding list are the inclusion of the polluter pays principle and the adherence to the triple bottom line. The preceding ideology may be viewed as providing a basis for initiating the process of sustainable business practices which in turn is expected to initiate the overall growth of sustainability as not just a living notion, but as a requirement for survival.

According to Colin Clark, a contributor to *Ecological Economics*, "The existence and severity of the problem must be recognised, the societal forces responsible for nonsustainablity must be clearly understood, and effective strategies for reversing the trend must be devised and applied. This is essential to understanding that the earth is finite and depletable; understanding everyday economic incentives are in many ways aligned against sustainability; and understanding that poverty is incompatible with sustainable development."[3]

For modern societies sustainability is the key to reducing consumption at every level of the process involved in construction, use and maintenance of the built environment. It is becoming evident that in order to engage in sustainability the future needs to be defined in terms not only of alternative technology, but also alternative social, economic and political strategies. Clearly the strategy of sustainability must cross all boundaries in order to be successful. In essence there is not any part of the mechanisms in place which can not benefit from the application of sustainable practices. Sustainability is not a one-time application, it is an ongoing commitment. Sustainable planning needs to be based upon the application of "think globally and act locally" at every level of the living process. The built environment is only part of the process yet it is an integral one. Sustainability is inextricably linked to the construction, use and maintenance of the built environment.

2.3 ENERGY CONSERVATION

Energy use in buildings is responsible for half of the UK[A] annual production of greenhouse gases, two-thirds of which is from domestic building.[4] Energy use in housing accounts for over a quarter of the UK's CO2 emissions and energy efficiency improvements offer the potential for savings of 20%, representing a highly cost-effective option for reducing consumption of fossil fuels.[5]

[A] The UK is used as an example. The data provided directly correlates with all industrialised countries.

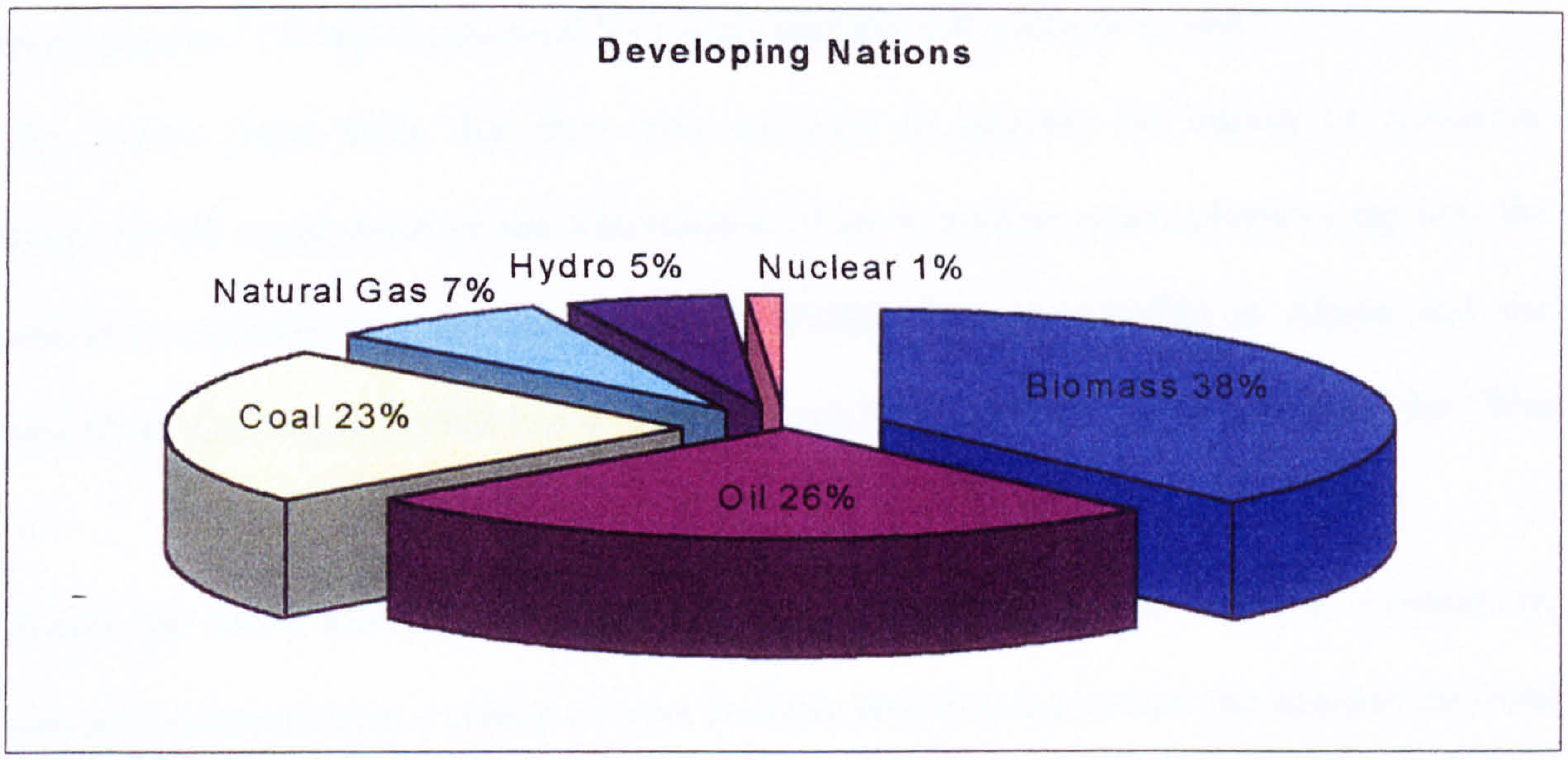
These figures correlate to consumption levels in other European countries. However, in the United States the residential and commercial sectors consume over 65% of energy sold.[6] Individuals can practically take responsibility for making simple changes in everyday energy consumption initially through a reduction in the demand for electricity. This does not necessarily mean that individuals must give up the conveniences of modern day living. It means that a change in the efficiency of these conveniences and their sources of their energy are necessary.

Energy conservation has the ability to provide more benefits than just the reduction of carbon dioxide. With proper support, energy conservation in the domestic sector could provide a painless approach with significant results: the reduction of negative environmental impacts. Concern about the global environment and particularly CO2 emissions has led to a greater awareness of the value of energy efficient improvements. One of the most cost effective ways to limit carbon dioxide emissions is to improve energy efficiency in housing. Initially this can be implemented by simply changing a lightbulb, adding or increasing insulation, adjusting the temperature for the hot water heater, or even drawing the curtains. These remain among the simplest and most cost-effective ways to reduce energy consumption. Overall the cost of incorporating energy efficient strategies in existing housing does not need to be high, particularly if there is a system in place for, regular maintenance, periodic replacement, or major refurbishment.

2.3.1 Conventional Energy Sources

With the global environmental crisis becoming increasingly serious, each transfer of energy needs to be considered to determine its implications and whether or not it is truly necessary.

Comparatively industrial nations consume most of the world's energy. (Figure 2.1) In 1989 commercial energy consumption in industrialised countries was nearly three times greater than that of developing countries.[7] The UNDP estimates that by 2020 energy consumption levels of



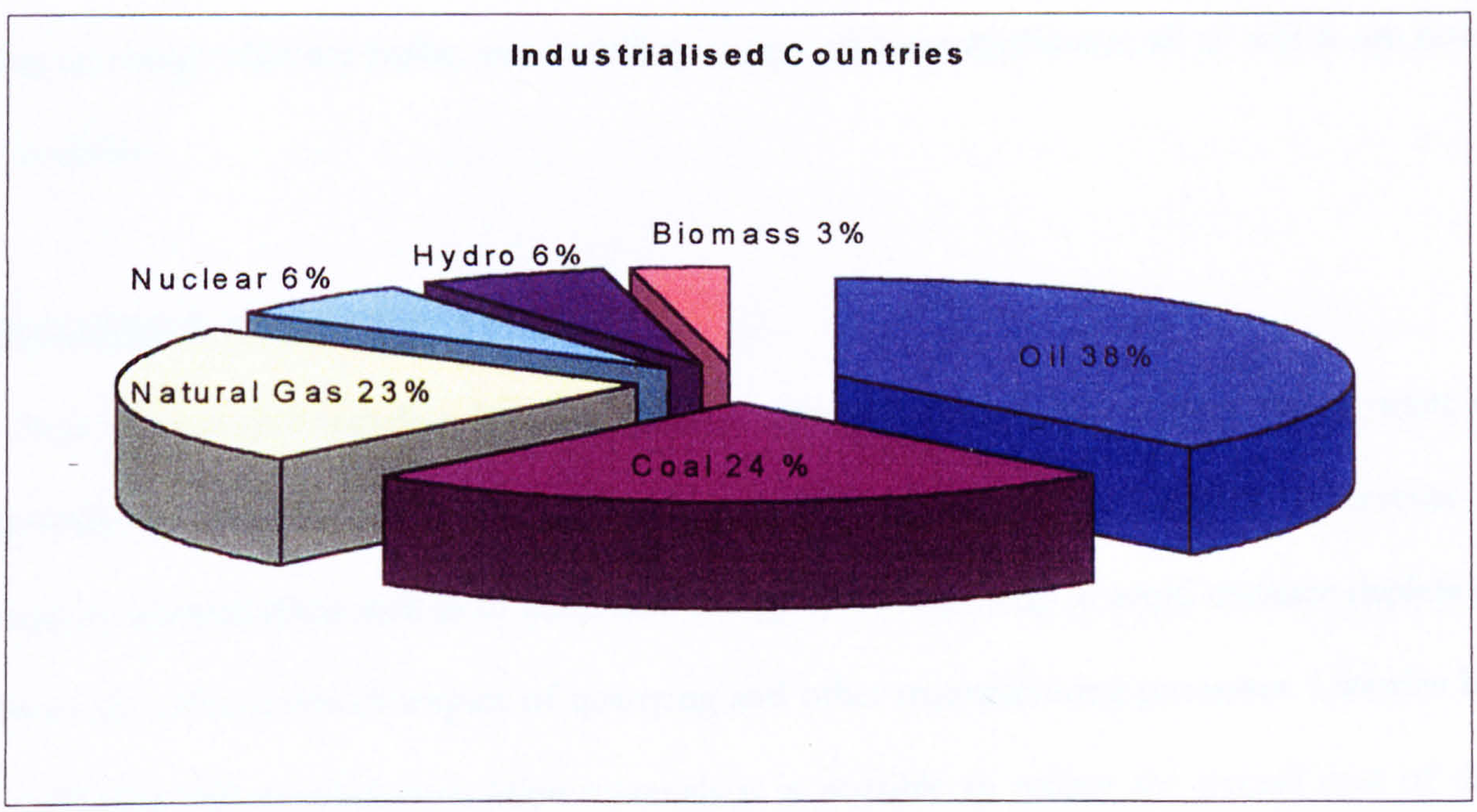


Figure 2.1 Global Fuel Consumption[i]

[i] Figures from the World Resources Institute, 1996 Centre for Alternative Energy, What are biofuels?

developing countries will have risen to 49% of global totals as a result of significant growth and development patterns.[8] Clearly the demand for energy globally will continue to rise.

The United States finds that they must continue to increase the import of resources. Alternatively, the US could promote the construction of more nuclear power plants or tap into the energy resources available in the Arctic National Wildlife Refuge (ANWR) in Alaska and the Continental Shelf. Drilling in ANWR has recently become hotly a debated topic in light of the "War on Terror".

Senses are local, while the experience is regional and the impact is global. Consumers, developers, and architects have a variety of ways available that they can reduce the demand on fossil fuel supplies. This can be done through a variety of energy efficient measures, which can be implemented from the construction stage through to the occupancy stage. Saving electricity in the home does not have to be complicated. Initially it can be done by turning off unnecessary lights, switching to energy efficient bulbs, and installing energy efficient appliances, all of which are now readily available.

2.4 RESOURCE CONSERVATION

It is obvious that recycling building materials can save on building energy content, while it also extends the lifecycle of materials. The preservation of an existing building represents a conservation of materials as well as of embodied energy. It will also help to avoid resource depletion and reduce the environmental impact of quarrying and other manufacturing processes. Likewise by using reclaimed and recycled demolition materials it is possible to reduce the overall cost of the building project, as well as providing a market for reclaimed goods and generally encouraging the recycling of demolition materials within the industry. In many instances it is possible to recycle demolition materials from a building and in some instances this is cheaper than dumping, as is discussed in Chapter Four, 'Integration: The Audubon House'. Unfortunately the number of receptive recycling dealers are limited, but this field is slowly growing. Inevitably, however, the market for recycling demolition material will increase as demand for this service increases. A successful green approach to building preservation would consider the overall performance of the building fabric and each transfer of energy involved so that building components can be recycled to their maximum potential.

2.4.1 Water

A. Conservation

On average three-percent of the Earth's water is fresh of which two-thirds is frozen in the polar ice caps and glaciers; of the remaining third, less than 1% is available in rivers, lakes, and streams. According to the World Resources Institute (WRI), from 1995 onward at least 40% of the world's population were plagued by water stress or water scarcity.[9] The WRI defines water stress as access to less than 1,700m^3 of water per person per year and water scarcity access to less than 1,000m^3 of water available per person per year.[10]

Average annual per capita consumption of water was 1798m^3 in 1991 for North America.[11] This stands in stark contrast to an average of 625m^3 for Europe, 202m^3 for Africa, and 645m^3 globally.[12] It is anticipated that the already diminishing supply of freshwater is also under threat by increasing amounts of pollution. Clearly there is room for improvement in terms of required water consumption.

B. Contamination

In addition to the growing need to conserve water is the need to keep our freshwater sources clean from chemical and bacterial contamination. Industrial and municipal waste and runoff have contaminated freshwater supplies. The EPA has identified 700 pollutants in our water supplies.[13] This represents only a fraction, approximately 10%, of the contaminants believed to be present in municipal water supplies.[14]

Water contamination can occur at the source, the municipal supply, and in the pipes. Two of the most common pollutants are trihalomethanes (chloroform) which are found in municipal supplies, and fluoride which is added to water supplies to reduce cavities in children. Metal pipes can leach cadmium, copper, iron, zinc and lead into household water supplies. Asbestos can leach from asbestos cement pipes.[15] Polyvinyl chloride pipes (PVC) which the plastics industry has declared safe have been shown to leach methyl ethyl ketone, dimethyl-formamide, cyclohexanone, tetrahydrofuran, carbon tetrachloride, tetrachloroethene, trichloroethane, di-(2-ethylhexyl) phthalate, and dibutyl phthalate to name a few.[16] Any water left standing in PVC pipes can become contaminated with vinyl chloride.

There are far too many contaminants to name here, suffice it to say that this issue alone is complex, but not without large and small-scale solutions, both mechanical and preventative. It is important to recognise that every water supply and building will have different sources for contamination. Addressing both water resource management and contamination will help to meet the growing demands placed on freshwater resources.

2.5 ALTERNATIVE ENERGY FOR THE HOME

Significant advances have been made in the field of renewable sources of energy; wind energy, biofuel, solar energy and so forth. While all of these sources are suitable for large scale applications only solar energy can be effectively applied directly to homes in urban areas. Both wind and solar applications may be applied to rural areas.

One particular advantage of wind turbines is that unlike conventional power stations, turbines can be in operation while the land is simultaneously being farmed, therefore wind turbines can diversify the productive use of the land. Biofuel is an inappropriate direct fuel source for widespread individual applications in the home. In their favour, all biofuels have two fundamental advantages. First the fuel source is usually sustainable forever. Second the carbon dioxide released during combustion is reabsorbed somewhere else at the beginning of the growth process. This process does not contribute to CO_2 in excess of the limits naturally digested by the environment and therefore does not exacerbate the greenhouse effect. Finally, solar energy is an effective power source and in some instances is capable of making a building independent of conventional sources of energy. Costs aside, practically speaking solar power is perhaps the most appropriate source in direct energy applications.

2.5.1 Solar Energy

The amount of solar energy reaching the Earth in one hour is enough to supply the human population with power for a year. The established standard for determining the intensity of the energy delivered is based on the solar energy delivered at noon on a clear day at sea level and is classified as full sun. The base measurement is equivalent to 1000 watts (1 kilowatt) per square metre. However, full sun is affected by the amount of dust, vapour, and pollution in the earth's atmosphere, as well as on the distance the energy has to travel through the atmosphere among other things. This, in turn, determines how much sunlight is converted into energy by the solar energy modules. On average solar sites will be exposed to about 85% of full sun, however, exposure will be greater for those sites located above 7,000 feet.[17]

A. Space heating

There are two ways that a building can have its heating needs met by the sun; passive or active solar heating. Passive solar heating is employed when the building design takes advantage of maximum solar contribution. This can be done by maximising natural convection, conduction and radiation, as well as incorporating measures to admit, store and distribute solar heat.

It has been noted that solar energy was put to use by ancient civilisations. There is a tradition of building techniques which are capable of providing dwellers with opportunities to take full advantage of the environment for their benefit. For example, the ancient Greeks employed passive methods for a variety of purposes. These techniques were used to heat their homes in the winter, therefore reducing their need for firewood, and cooling them in the summer. Southfacing porticoes were exposed to the winter sun, to warm the main living rooms, and the summer shade to cool.

World-wide there is evidence of the application and refinement of passive solar heating designs suited to individual needs and conditions. In particular solar hot water heating systems have experienced the most growth in many countries. For example, at the end of the 19th century, in Southern California and Florida many as 80% of all homes used solar hot water panels.[18] This market continues to grow.

Alternatively active solar energy heating uses collectors and transfers the heat from the sun to a medium such as oil or water, which will move the heat to where it is required or into storage where it will be used later. Overall it is more prudent to plan to incorporate passive techniques rather than be plagued by the expensive maintenance of an active solar system. This type of system is complex and has the potential to be expensive and high maintenance.

B. Electricity

There are two ways of generating electricity from the sun. First, heat is produced at very high temperatures therefore powering a conventional steam turbine and thus producing electricity. The second option is to employ photovoltaic (PV) technology, where sunlight, not heat, generates electricity. For the purposes of this research only PV technology is addressed. For practical reasons PV technology is the most appropriate for individual applications.

2.5.2 Photovoltaics – A Brief Introduction

The PV effect was first discovered at the beginning of this century. Werner von Siemens was the first scientist to believe that the photoelectric effect had potential. The French scientist Becquerel discovered that directing light onto one side of a battery cell increased current generation.[19] During the 1870s William Grylls Adams and Richard Evans Day discovered the significance of selenium's ability to conduct electricity.[20] Charles Fritts, Thomas Edison, Werner von Siemens, James Clerk Maxwell, and George M. Minchin all prominent scientists of their day believed that this process was revolutionary. Nevertheless, it was Western Electric who first put PV technology to practical use in the field. The Bell solar cell was used by Western Electric to operate telephone lines in rural areas. From there it was only up to the imagination and intuitive nature of engineers as to how this technology could be used.

Bell Laboratories had a few scientists dedicated to developing the solar cell. Initially the development process was slow. To complicate matters RCA, a rival of Bell Lab, announced that they were developing a nuclear powered silicon cell which was in essence powered by strontium-90. In addition, the US government was sponsoring the RCA technology with a program called "Atoms for Peace".

To kick-off this new government program, David Sarnoff, the president of RCA, used an atomic battery powered telegraph to signal "Atoms for Peace". This demonstration received extensive press coverage. However, it was later discovered that had the silicon device been exposed to sunlight the PV process would have overpowered the atomic battery. In addition had the battery failed the PV process would have kept the battery running. Apparently the director of RCA Labs told his scientists, "Who cares about solar energy? Look, what we really have is his radioactive waste converter. That's the big thing that's going to catch the attention of the public, press, the scientific community."[21]

It was NASA who first put PV technology to practical use. NASA used the technology to provide successfully lightweight and reliable power systems for satellite instrumentation and have initiated further development of this technology. Interest in PV technology was further boosted during the 1970s oil crisis and since then more durable systems have been developed and manufactured at increasingly reduced costs. Photovoltaic technology basically works through the reaction of sunlight on certain materials, such as silicon. It should be noted that this technology could work without moving parts, noise or pollution.

A. PV Technology – Efficient And Reliable

Currently PV modules do not convert 100% of the energy available into electricity.[22] In fact single and mono-crystalline cells average about 15% and amorphous cells about 5% conversion rates.[23] Higher conversion rates have been achieved in laboratory conditions using experimental cells made with obscure and rare elements. For obvious reasons, this technology is cost prohibitive for commercial production.

In general PV modules carry warranties of 10-25 years.[24] Because PV technology is a cousin of transistor technology one may initially think that PV module life expectancy would be similar.

Transistors with constant use have a 20-year life expectancy. This is not so for PV modules. In general because modules are actively used for at most eight hours a day it is possible that their life expectancy may be as long as 80 years. Based on information provided by module manufacturers, PV modules payback the energy investment in 1.4 to 10 years, although this does depend upon factors such as module type, installation climate. However, studies conducted by the National Renewable Energy Labs have found that an energy payback of three to four years is attainable.

Of the alternative renewable technologies, photovoltaics offer the best possibility for mounting close to the load. The domestic sector, particularly in the US, is unlikely to disconnect from the grid, but this could provide an interesting experiment as a new source of energy for utility companies. This would provide PV owners with the opportunity to sell their excess energy. Depending upon their location, overall PVs are not intrusive in the design of a building. In some instances, when the facility is located on the roof, it may just be a matter of getting used to the look of something new.

PV technology is currently used in a range of applications, from powering telecommunications equipment to supplying remote villages with electricity. The decreasing costs of PV applications means that this clean technology can now compete competitively with a range of applications, most of which are heavily subsidised. This has been particularly evident in remote locations where other power options were either impractical or cost prohibitive.

B. New developments, bringing the cost down

During the 1990s the PV industry grew by 17% annually, compared with a modest 1% annual increase for the coal, oil, and nuclear based industries.[25] In addition, according to John Schaeffer, founder and CEO of the Real Goods Trading Company, "Between 1975 and 1999 the price of a photovoltaic module (in large wholesale quantities) dropped from nearly $100 per watt to below $4 per watt. During the same period, production of PVs worldwide went from virtually non-existent to more than 140 megawatts. When the price drops to $1 per watt (without incentives or rebates), the threshold for competitiveness with subsidised coal, oil, and natural gas generated electricity will have been crossed. It cannot be long now. Historically PV's, like electronics, have dropped in price by 20% - 30% for every doubling in cumulative sales."[26] (Figure 2.2)

Solar energy is in the process of being transformed from an environmental experiment to widespread use. Home Depot, an American building supply company, began selling residential PV systems in 1999 and a growing number of mortgage lenders are offering mortgages which incorporate financing for efficiency improvements. The cost of the improvements are off set by the benefits of the efficiency upgrade. World-wide production of PV cells continues to grow at about 30% per year.[27] In addition, the California Energy Commission sponsors a program to offer PV systems at a 50% reduction. California is already facing an energy crisis of catastrophic proportions. The rebate program for this state is unusually generous. In addition, corporate energy companies are beginning to recognise the threat that global warming brings their business growth. Shell Oil, British Petroleum, and Dutch Shell have all begun investing in sizeable programs in the renewable energy sector. Optimism has increased in the future of PV technology in industrialised countries, as some utility companies in the US are starting to install solar equipment: Sacramento Municipal Utility District, Austin Electric Utility and the New York Power Authority, being three. In addition, PV technology is capable of providing significant changes to rural communities and the developing world.

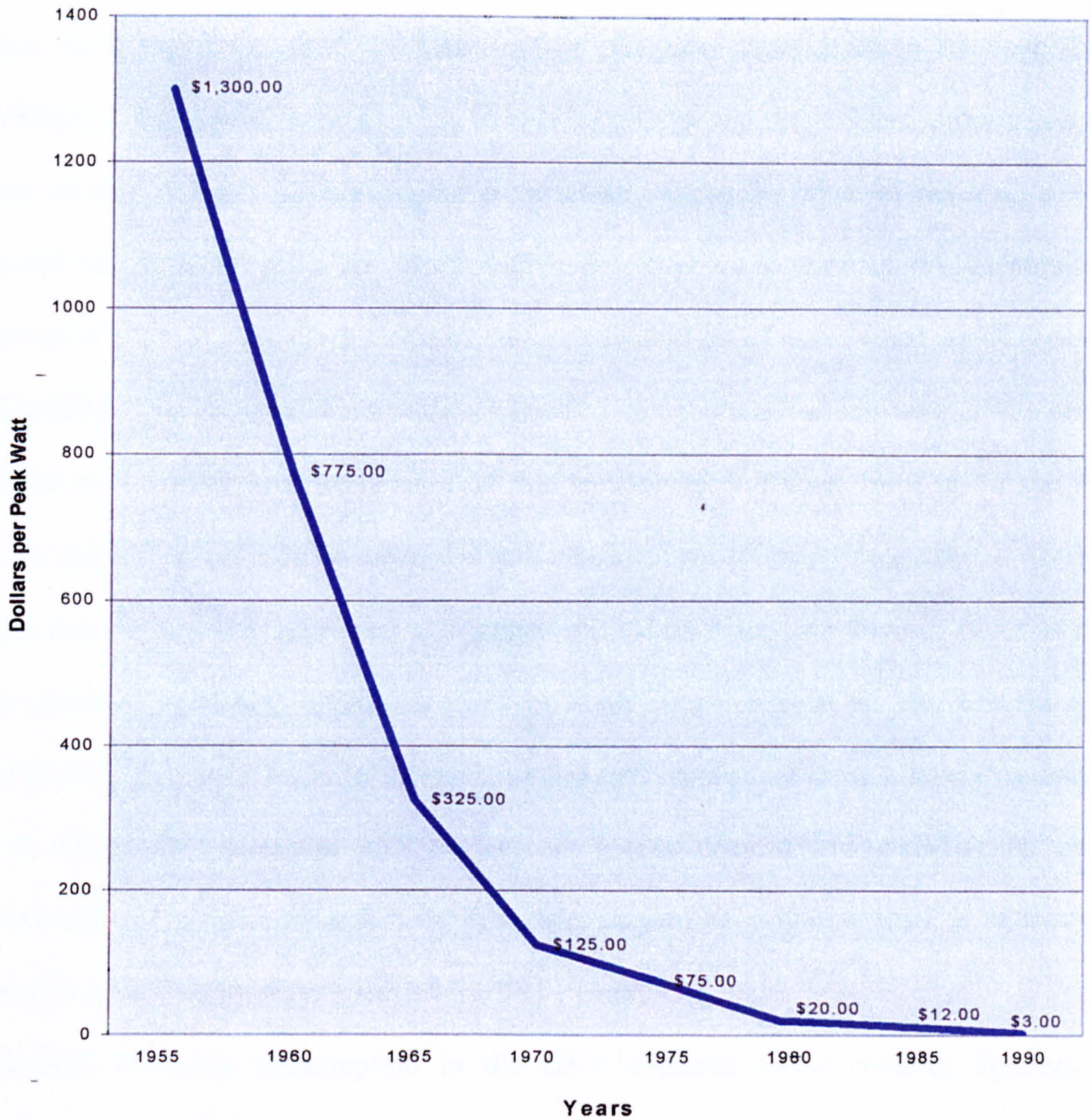


Figure 2.2 Photovoltaic prices[i]

[i] Figures from the Solar Living Source Book, Chelsea Green Publishing Co., Vermont, 2001.

2.6 LOW IMPACT & EFFICIENT APPLIANCES

While energy efficient appliances are available there are notable obstacles to their introduction on a widespread level. In terms of the consumer there seem to be three major obstacles. Firstly, there appears to be a certain lack of knowledge and disconnection associated with the impacts of daily lifestyle choices on the environment. Secondly, while in the long run the environmental and financial gains are significant, in the short term some of the technology is financially out of reach. Finally, there seems to be a certain amount of distrust and unwillingness to believe manufacturer's claims; an 'if it sounds too good to be true then it is' mentality. There may be other barriers to the widespread acceptance of this technology, but these seem to be the most prevalent. In addition, in order to be successful with a mainstream efficiency program it is necessary to recognise that the domestic appliances and gadgets of modern living have become necessities. To encourage increased efficiency, appliances must be made more efficient so that less energy is consumed so that once users begin to replace their domestic appliances more efficient models will be used. In recent years there has been evidence of greater demand and availability of energy efficient and resource conscious appliances. A certain amount of common sense is necessary in order to run these appliances at optimum levels of efficiency.

Currently electricity consumption in the UK's domestic sector cooking, lighting, and appliances accounts for 25% of energy sales.[28] There have been considerable improvements in the energy efficiency of typical household appliances. Based on the UK market, replacement of the current stock of appliances (based on the market best) would result in a 40% saving.[29] Based on the world market, and again based on the market best, savings are 45%.[30]

2.6.1 Lighting

Obviously the best and most practical way to reduce non-renewable energy consumption is to not use it at all. Therefore use of natural daylight should be maximised. With this in mind it is simple to design new buildings around this premise. However, it is more difficult to maximise natural daylight in existing buildings. For this reason it makes environmental and economic sense to make the switch to new low energy lightbulbs. The introduction and use of these low energy bulbs has impacts which reach outside of the home or office. Residential lighting in the US accounts for 10-15% of total residential electricity use.[31] If there is indeed a minimum 60W saving per bulb and the use of these bulbs became more widespread, not only can the consumer expect the price of these bulbs to decrease, but eventually there would be a significant decrease in the need for electricity.

Standard incandescent light bulbs are the least efficient of all. Less than 10% of the electrical energy is converted to light and the rest is wasted as heat which may have indirect consequences such as the increase in the running costs of cooling and air conditioning systems.[32] Low voltage tungsten halogen bulbs (50W-300W) are approximately twice as efficient as standard incandescent bulbs.[33] Both use tungsten filaments and the halogen bulbs have longer lifetimes than the standard incandescent bulbs.

Fluorescent lights last approximately 10 – 13 times longer and use 75% less electricity than other bulbs, therefore they are cooler because very little energy is lost as heat.[34] The average lifetime for a compact fluorescent light is approximately 10,000 hours.[35] The average lifetime of a standard incandescent bulb is around 1,000 – 2,500 hours.[36] (Figure 2.3)

The new low energy bulbs cost on average 40 times more than the standard incandescent bulb. Each of the low energy bulbs has a lifespan of almost five years. During this period each low energy bulb uses 25% of the electricity of a standard incandescent bulb.[37] By replacing standard

Lumens per watt	Lifetime in hours	Lamp type and power
8.4	2500	Incandescent - 25w
14	1000	Incandescent bulb - 60w
14.2	2000	Halogen bulb - 50w
16.9	750	Incandesecnt bulb - 100w
17.6	2000	Halogen bulb -90w
19.8	2000	Halogen floodlight - 300w
53	10,000	G-16, compact fluorescent - 16w
60	10,000	SLS 20, compact fluorescent - 20w
60	10,000	Metal Halide, floodlight - 150w
71	10,000	D lamp, compact fluorescent - 39w
86	20,000	T8, 4 ft fluorsecent tube - 32w
96	24,000	High pressure sodium light - 150w
142	16,000	Low pressure sodium light - 135w

Figure 2.3 Efficiency And Lifetime Of Light Bulbs[i]

[i] Figures from the Solar Living Source Book, Chelsea Green Publishing Co., Vermont, 2001.

incandescent bulbs with the low energy bulbs the consumer can expect a 50% savings, including the original expenditure.[38] By replacing tungsten bulbs with low energy bulbs electricity is saved which has implications further reaching than in terms of lower energy bills. The reduction in energy used will result in a reduction of pollution and will accordingly conserve finite fuel reserves.

2.6.2 Refrigerators & Freezers

According to the US Department of Energy (DOE) information regarding the efficiency standards to be implemented, the efficiency of both refrigerators and freezers are based on the annual energy consumption. The DOE sets maximum allowable energy consumption levels for these appliances. Of all kitchen appliances the refrigerator uses the most electricity and can use as much as 15% of a home's total energy use.[39]

There are a number of tactics that consumers can implement to reduce energy consumption without replacing their refrigerator or freezer. Temperatures should be kept between 37-40°F for refrigerators and 0-5°F for freezers for optimum performance.[40] Door seals and gaskets should be kept clean and should fit tightly. The 2001 DOE standards for refrigeration are expected to cut consumers energy costs by 30% compared to the previous standards set in 1993.[41] It should be noted that these standards are the minimum requirements set for manufacturers. It is possible that these standards could be exceeded in order to improve the appliance's efficiency. In many instances common sense should prevail in terms maximising the efficiency of refrigerators and freezers, i.e. let food cool before putting it away, don't overfill, don't leave the door open for a prolonged period of time, and so forth.

When replacing these appliances consumers should consider the DOE Energy Star guidelines. Models which are in the 16-20 square foot range are noted to be the most efficient.[42] Add-ons, such as automatic icemakers and through the door dispensers increase energy use by 14-

20% and increase the purchase price by as much as $250.[43] According to the DOE chest freezers are 10-25% more efficient than upright freezers and manual defrost models consume less energy, 35-40%, but require more vigilant maintenance in order to maintain their efficiency.[44]

A. Greenfreeze technology

Hydrocarbons (HCs) were a commonly used refrigerant until CFCs usurped them in the 1930s. HCs have zero impact on the ozone layer and contribute negligibly to global warming. HCs have a factor of 3 while HFCs are approximately 1800 – 3200 times more powerful as a greenhouse gas. Prices of HC fridges are compatible with HCFC or HFC fridges or, at most, around US$75 (UK£50) extra and if the most energy efficient appliance is bought rather than the least, the lower running cost would pay the difference within 18 months.[45]

Greenfreeze technology uses either pure isobutane or a mixture of isobutane and propane for the refrigerant and cyclopentane for blowing the insulation foam. Minimum efficiency standards have proven to be comparable to those cooled with CFCs or HFC-134a. In addition the efficiency of the cyclopentane blown insulation equals that of HFCs.

Greenpeace entered into an agreement to produce and market this technology initially in Germany, where Greenfreeze technology accounts for nearly 100% of the domestic refrigeration market. Then as news of this clean, efficient, green technology spread other companies expressed interesting in manufacturing and marketing it in their own countries. Greenfreeze technology is manufactured and marketed to consumers in China, Australia, Argentina, Cuba, Turkey, and Russia. Initially Greenpeace facilitated the manufacturing and marketing of Greenfreeze technology. However, they are no longer linked to any of the manufacturers, instead they solely advocate the use of this technology.

2.6.3 Air-conditioning: Central & Room Units

Consumers should initially work to reduce heat penetration and optimise alternate cooling methods before resorting to air conditioning. If mechanical cooling is used steps should be taken to improve the overall efficiency of the unit. The system should be checked for leaks in the ductwork. On average 20% of the cooled air is lost through leaky distribution joints, this will also help increase the efficiency of a heating system[46] Ducts can be mended with duct tape or mastic and should be insulated with foil-faced fibreglass insulation where possible. There are a number of things which should be attended to by way of regular maintenance. Among them are checking the refrigerant charge; oiling motors and blowers; removing dirt; and cleaning filters and coils.

Set the thermostat at 78°F; for each degree the thermostat is raised 3-5% will be saved in cooling costs.[47] Shading the unit will increase efficiency by 5-10%.[48] Common sense will help to maintain an efficient unit. Things such as turning the unit off when no one is home, setting the unit to recalculate cooled air, and keeping the unit free and clear of trees and shrubs will all contribute to the air conditioning unit operating efficiently. According to the Energy Efficiency and Renewable Energy Network (EREN), "In an average air-conditioned home, air-conditioning consumes more than 2,000 kilowatt-hours of electricity per year, causing about 3,500 pounds of carbon dioxide and 31 pounds of sulphur dioxide to be emitted at the power plant."[49] At average electricity prices it costs about $150 to run.[50]

2.6.4 Dishwashers

Newer dishwasher models use 7-10 gallons of water compared to the 8-14 gallons required by older models.[51] These newer models incorporate improved spray mechanisms and filtering systems that provide better washing, therefore the need for hot water is reduced. Some of the newer models feature an air dry cycle which does not require hot air and therefore requires less electricity.

Most new models feature a booster heater that boosts the hot water temperature to 140°F, killing germs and cutting grease.[52] This feature also enables the household hot water heater to be reduced to 120°F.[53] For each 10°F reduction in temperature the consumer will realise a 13% savings for hot water heating.[54]

The energy factor for dishwashers is measured by cycles per kilowatt hour of electricity. The minimum allowed energy factor in the US for standard capacity dishwashers is 0.46.[55] Approximately 80% of the total energy required by dishwashers is used to heat the hot water.[56] There are two types of dishwashers available to the consumer, standard and compact. In general the compact version uses less energy than the standard. Ideally the consumer wants a model with an energy saver or light wash option, as well as a heat-drying or air drying option. If the machine does not have an air-drying option then the cycle can be stopped and the machine opened to allow the dishes to air dry.

In an effort to save money it is not necessary to pre-rinse, soak, or prewash the dishes. This is only necessary when food has been dried or burned on. Again, it is important to maintain the dishwasher by checking to make sure that drains and filters are clean and clear.

2.6.5 Washing Machines

Most of the energy required by a washing machine is used to heat the water. Approximately 10% of the energy used by a washing machine is actually used to wash the clothes.[57] High efficiency washers can save up to 35% in energy costs over a standard washing machine and can cut water use in half.[58] Other methods to lower the washing machines energy use include; washing in warm or cold water and rinsing in cold water; avoiding overloading; and running a full load rather than under filling the machine. Finally, these high efficiency machines have higher spin speeds than standard machines. This translates into shorter drying time and lower energy costs associated with drying.

2.6.6 Clothes Dryers

According to EREN clothes dryers are typically the second most expensive household appliance to run, costing on average $85 per year and $1100 over its lifetime. Clothes dryers are not required to carry an energy label. A machine with a temperature sensing control can save approximately 10%. A machine with a moisture sensing control can save approximately 15%.

The dryer should be in a heated space and should be properly vented. The vent and vent hoods should be well sealed and kept free of lint, in order to prevent outside air from leaking in. The lint filter should be cleaned regularly in order to maintain good air flow during the drying cycle. Only full loads should be dried, but the machine should not be overloaded. For optimum efficiency clothes of similar fabrics should be dried together when possible.

2.6.7 Ovens, Ranges, and Stoves

New ovens, ranges, and stoves have added insulation, tighter fitting doors, and hinges, all of which contribute to saving energy. According to EREN, "About 58% of Americans cook with electricity."[59] Electric cook-tops are available in a variety of burner styles. Solid disk and radiant elements are easier to clean but they take longer to heat up and therefore use more energy than halogen and induction elements. Although cooking by electricity requires less delivered energy than cooking by gas carbon dioxide emissions from electricity are 2.4 times greater than gas.[60]

Gas cooking appliances use less energy than electric ones because the energy is used solely for cooking (there are not any elements to heat up prior to cooking). In addition, a gas appliance equipped with an electric ignition uses less than half the energy of an electric appliance.[61] When cooking with a gas stove a blue flame will indicate efficient burning while a yellow tinged flame will indicate an inefficient flame. For safety reasons the ventilation hood should expel the air outside and not recirculated filtered cooking fumes. This is particularly important when cooking with gas.

Finally, using a pressure cooker, ensuring that air can flow freely in the oven, keeping the range top clean, and using glass and ceramic pans in the oven can help to improve the efficiency of these cooking appliances.

2.6.8 Furnaces & Boilers

In cold climates heating expenses can account for up to two-thirds of annual energy bills. In the US heating systems are responsible for emitting a billion tonnes of carbon dioxide and 12% of the sulphur dioxide and nitrogen oxides emitted.[62] According to EREN conservation and upgrading to a new high efficiency heating system from an annual fuel utilisation efficiency of 56% to 90% could save 1.5 tonnes of carbon dioxide if using gas and 2.5 tonnes if using oil.[63]

Using a programmable thermostat is a wise choice as it allows for automatic day and night-time regulation. Regularly cleaning filters, registers, and radiators will help maintain heating efficiency. Using drapes in the evening and maximising exposure to the south will help to decrease the load placed on the furnace. Vigilance about use of kitchen and bathroom exhaust fans will also help maintain comfort levels. It is possible for exhaust fans to "ventilate" a warm house in as little as one hour.[64]

2.6.9 Water Heaters

Water heating can account for approximately 14% of a household utility bill. Bearing this in mind it is probably most advantageous to install a tankless hot water heater. Usually these units do not have storage tanks as they supply hot water on demand. These units can also be sited closer to the source of demand. However, since water is not immediately hot there is some wastage. This is not ideal for those consumers concerned with water conservation in regard to their water bills or a drought.

For some consumers solar water heating is a good choice. Employing this method could drastically reduce and in some areas eliminate the need for an outside source of energy. Another method is to attach a desuperheater to the air conditioner or heat pump. Recycling the waste heat to heat water is an effective way to reduce and perhaps eliminate this portion of the energy bill. Nevertheless, gas is the most cost-efficient way to heat water. On average electric heaters will cost 2-3 times more than gas heaters.[65] (Figure 2.4)

2.7 TOXIC SUBSTANCES AND HARMFUL HOUSEHOLD PRODUCTS

Toxins in the home originate from many different sources. They can enter the body as gases, vapours, solid particles, liquids, or radiation. They can be inhaled, ingested or absorbed through the skin. There will be large variations in the extent of contamination present in existing housing, depending on geographical location, the age of a building, the type of construction, and the kind of finishes used. It will also depend on how often the house was redecorated, frequency and method of cleaning, types of furnishings, and the types of paints and chemicals used. It should be noted that the toxins listed are not the only ones to be wary of although these are possibly some of the most noticeable, widely used, and harmful. It can be difficult to detect toxins as most of them are not regulated and will turn up in the least obvious places. It should also be noted that there are toxins that pose an environmental threat and those that pose a threat to human health.

2.7.1 Solvents

Solvents can be found in a large number of domestic and commercial products. Paints, adhesives, cleaning agents, de-icers and lacquers all contain solvents, which evaporate after application of the parent material. It is during this process (evaporation) that solvents do the most damage. The toxicity of the vapour can cause health problems and some solvents are carcinogens and are highly flammable. Some solvent products, such as methyl chloroform, are greenhouse gases and contribute to the destruction of the ozone layer.

2.7.2 Aerosols

Alternative application methods, such as solid stick and roll-on dispensers, mechanical pump sprays, brushes and pads are among the wide variety of alternatives in commercial use.[66] Alternative spray propellants include hydrocarbons, dimethyl ether, and other compressed gases such as air and CO2.[67] Many developing nations have switched to or have always employed propellants such as pentane and butane in industrial uses.

2.7.3 Foams

There are a number of non-CFC and non-HCFC compounds for blowing rigid polyurethane foams which can be used in insulation for domestic refrigerator-freezers, among the least toxic are water and carbon dioxide.[68] Other less used methods, which can be substituted for rigid foam are fibreglass, rock wool, and cellulose.

2.7.4 Fire fighting

Alternative extinguishing agents, such as CO2, water, foam, and powder are already widely used. Inergen, a mixture of natural gases like nitrogen, carbon dioxide and argon, is another halon alternative.[69] Good fire prevention practices and the use of fire and smoke resistant materials are significantly reducing the need for halon systems.

2.7.5 Formaldehyde

Formaldehyde can be released from many building materials including chipboard, adhesives, wood preservatives and urea-formaldehyde foam, a type of cavity wall insulation. Symptoms of formaldehyde irritation include eye and throat irritation and while there is not an estimated risk, formaldehyde is classified as cancer causing.[70]

2.7.6 Asbestos

Asbestos is used as an insulation material, building materials, paper products, asbestos-cement products, and friction products, to name a few. There are six different types of asbestos differentiated by their colour. This product is a proven human carcinogen and exposure to high levels of airborne white asbestos in particular can cause lung cancer.[71]

2.7.7 Lead

Lead based paint was used for many years primarily as a whitener. It is the exposure to lead through flaking and deteriorating paint that poses a significant health risk, primarily in children and animals. Death can occur from exposure and poisoning. Great care must be taken when removing lead because inhalation or ingestion may occur.

In addition, lead can be used for roof flashing. It is unlikely ingestion will occur and leaching into the soil will be minimal. However, copper can be used as an alternative although there may be problems with staining and malleability. It would make a suitable alternative if used for flashings or roof coverings. Aluminium, zinc, and stainless steel can also be substituted for lead.

Lead water pipes and storage tanks are no longer used in new construction, but can still be found when doing alteration or conservation work. It can be found in old pipes, solder, and even fixtures. The plumbing should be replaced if it is found to carry drinking water.

2.8 SUMMARY

This chapter aims to provide an overview of renewable alternative energy sources, energy saving appliances, and toxic substances within the context of domestic applications and uses. Concentration has been placed on renewable alternative energy sources, primarily solar, as it has become apparent in the scientific community that the best way to move forward is with a decrease in the use of fossil fuels and this application provides immediate results. The focus is to provide industrial societies with a way to maintain their modern luxuries and necessities. It is believed that in doing so there would be less resistance to a change to renewable energy sources. By changing the source of the energy rather than the lifestyle there will be some resistance, although it will not be as great as if the modern accoutrements were forcibly discarded all together.

The replacement systems, materials and products discussed in this chapter are meant to be readily available. Certainly there are always technologies in development, but the focus of the research at this point is to provide immediate solutions with the available technology. It should be noted that there are far too many traditional and new technologies to address here. By no means have all of the possibilities been represented in detail. The market is constantly changing and needs to be carefully scrutinised in an effort to discover the truly green technologies and materials. Far too often the words green, environmentally friendly, ecologically sound, and the like are used as marketing ploys for products which may not meet any sound environmental criteria. Therefore it is critical to not immediately accept these claims as true. It is at this point that the details of the green market can be difficult for the consumer to identify.

The deeper the pockets of the owner the more leeway there is for complete success, although, with a little ingenuity and creativity lower end projects can be just as successful. Therefore overall the success of individual projects would not necessarily depend upon the amount of financing. The success of a project depends upon the amount of risk the consumer is willing to take with the available new technology. It is unfortunate that there is a perceived notion that 'green technology' is ugly and not compatible with a renovation project. For the most part this modern technology is incorporated into new building design and projects, while the building preservation projects go relatively unnoticed as possible avenues for the modern technology. Perhaps this is a result of the West's disposable society mentality combined with a puritanical notion that the only successful preservation project is one that restores the building to its original condition, regardless of the needs of the consumer. The Audubon project disproves this notion; although, until very recently this was the only project of its kind.

It is hard to determine who should bear the responsibility for having the required knowledge – in other words who should spearhead the movement to push the incorporation of green technology into our offices and homes? If it is going to be a grassroots effort then it becomes the responsibility of the developers, architects, designers, and consumers. In order to be successful there needs to be a growing awareness about the evolving nature of the environmental debate. By joining this community the gap between the built environment and natural environment is bridged.

A serious shortcoming in the plan to decrease the use of fossil fuels is the availability of cheap fossil fuels. It is difficult for the American public at large to sit up and take notice unless American consumers are required to pay the real price for fuel. Initially, there will be talk of more subsidies to reduce the cost of fuel. However in the long run the need would be for western society to find ways to reduce their usage or to use the alternative methods mentioned. Only when the environmental problem poses an economic problem will the efforts of the grassroots community be taken seriously. In addition the push for change must be sustained. If this drive to provide environmentally and economically viable alternatives is not sustained the effort will go the way of past efforts, such as the fuel crisis of the seventies. If, when this happens, we have the alternative technology in place will we be able to push forward with the alternative renewable resources.

However, the change must be one that the public will be able to cope with. If the public is denied their luxuries and perceived conveniences then the change will never take place. The change, which we wish to happen, must be compatible and sustain modern day living.

The overall view after reviewing the progress and status of domestic energy technologies is that there is a way to reduce energy use in every area of consumption. It is also possible to meet the structural, furnishing and decorative needs of a home using recycled, natural, and non-toxic materials. Currently many products are not readily available at the local hardware or building supply store, although with a little bit of investigation less threatening building and decorating materials can be found. As with the supply and demand economic market force, as the demand increases for these products they should become more readily available. With the increased use of these alternative energy services and ecologically sensitive materials a positive outlook may be possible regarding the future of energy use in the domestic sector and the ensuing environmental impacts.

One finds that new construction involving sustainable technologies is becoming increasingly popular. This is evidenced in the United States by the formation of the U.S. Green Building Council (USGBC), and other non-profit groups that encourage the use of green technologies. The USGBC has emerged as the forerunner in the U.S. They have established a set of guidelines called the Leadership in Energy and Environmental Design Green Building Rating System® (LEED) for a variety of building types and uses. It is important to note that the registration and certification of projects is entirely voluntary. Membership, which is also voluntary, also includes a wide variety of professionals involved with the building industry. According to the USGBC website, membership has grown to include over 5500 organisations. Until recently the USGBC has been at the forefront of developing and encouraging the implementation of strategies for green buildings technologies in commercial buildings. Mostly recently the USGBC has established LEED guidelines for Existing Buildings. Currently the USGBC is in the process of rolling out a pilot package and have put a call out for projects for the test pilot phase of the LEED Home program. It is important to note that the LEED Home program targets new construction. Leaving the LEED Existing Building program to fill the gap for homeowners of preservation projects who wish to seek certification for their projects. The LEED program in its entirety does offer encouragement for those who wish to pursue a core list of fundamental environmental strategies that have been implemented in a specific project. We have yet to see another program that requires this level of environmental consideration in every phase of the project. And while membership, registration and certification are voluntary the creation and evolution of this program offers some encouragement. At present commercial buildings have received far more exposure to this certification process.

For the long term, the difficulty lies in convincing the public and governments that the development of alternative energy sources would provide the global population with a guarantee of a tenable future. Unfortunately in most cases governments, private companies, and the public while they agree with the theory of sustainability if in the long run it means a possibility of not maximising profitability then the process of sustainability is given up. Purely profit driven motives need to be replaced with an ideology based on the recognition of positive development of our communities, fundamentally focusing on the preservation of the Earth rather than financial gains. It appears as though the predicament in the existing housing sector comes with its own set of complications, as the situation in Glasgow has demonstrated. There is a real solution to this environmental crisis and it lies within the parameters of cultural invention and transformation. The process engages the relationship between buildings and their surroundings. Addressing the needs of the public by considering neighbourhoods and their local history, microclimate and local ecology, while assessing reuse, efficiency, toxicity, and therefore total life-cycle implications.

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Chapter Three
Historical Development of the Conservation Movement

3.1 HISTORIC FOUNDATIONS IN THE UNITED KINGDOM

The official origins of the conservation movement in Britain can be traced back to Samuel Johnson's 1755 definition of restoration in his *Dictionary of the English Language* as 'the act of replacing in a former state; to give back what has been lost or taken away'.[1] This was the generally accepted definition and is reflected in *Murray's Oxford English Dictionary* published in 1903.[2] However, the great debate on restoration would not formally begin until one hundred years after Johnson's definition. Until *c.*1850 restoration had been largely confined to ecclesiastical buildings. All too often, those ordering the repairs were unconcerned with historical continuity of style. However, as those involved in the restoration movement became more conscious and tolerant of history, new critical attitudes towards restoration began to emerge. These new attitudes were based on emerging divergent principles and theories, which aided the advancement of the restoration cause.

The Ecclesiological Society, renamed in 1846 the Cambridge Camden Society, began as a liturgical movement inspired by the Middle Ages, using mediaeval liturgy as a guide. Its purpose was twofold; first, to assist with the building of neo-Gothic structures; and, second, the restoration of mediaeval churches. The latter purpose meant removing all alterations in an attempt to reconstruct the original building. In 1842, it was declared in *The Ecclesiologist*, that, 'We must, either from existing evidences or from supposition, recover the original scheme of the edifice as conceived by the first builder, or as begun by him and developed by his immediate successors.'[3] During 1841-43, the Society was given the opportunity to put its ideas into practice in the restoration of the Church of the Holy Sepulchre, Cambridge.[4] (Figure 3.1)

Figure 3.1 Church of the Holy Sepulchre, Cambridge[i]

[i] Archaeology Review 1996-97, English Heritage.

3.1.1 John Ruskin

The restoration of the Holy Sepulchre, Cambridge, led John Ruskin to write *The Seven Lamps of Architecture.* Perceived as the forefather of conservation's purists, he believed that architecture was the cornerstone of history, which he revered as all but sacred and not to be changed or falsified. Replication, if attempted, could not effectively and properly be made unless it directly used nature as its model. He also held the view that repairs are destructive maintaining that the originality of the craftsmen's methods or the traces left by his tools could not be replicated thereby concluding that accurate replication by modern man is completely impossible. "Emulation of the spirit of the craftsmen is unmistakably impossible", according to Ruskin.[5] In many restoration projects, surfaces had partially worn away or had completely disintegrated, so that attempting to make repairs would be subject to speculation. According to Ruskin, "Structures gain in richness when their details are partially worn away. Do not let us deceive ourselves in this important matter; it is impossible as impossible to raise the dead, to restore anything that has ever been great or beautiful in architecture."[6] Ruskin, somewhat rightly, regarded restoration as a lie from beginning to end. The challenge for modern man was to make the repairs honestly. New is new: old is old and the two should not be confused.

Ruskin was the first to acknowledge the impending division of modern historical consciousness from the continuity of tradition. As far as he was concerned the age of a building was important in determining value and a building did not reach its prime until it was four to five hundred years old. Consequently, in the process of ageing and, by becoming a memorial or monument, architecture reaches its true perfection. According to Ruskin, "And if indeed there be any profit in our knowledge of the past, or any joy in the thought of being remembered hereafter which can give strength to present exertion, or patience to present endurance, there are two duties respecting national architecture whose importance it is impossible to overate: the first, to render the architecture of the day, historical; and the second to preserve, as the most precious of inheritance, that of past ages."[7] Ruskin concluded that the historical significance of public buildings should be made more definite and saw in this an advantage for Gothic architecture.

Ruskin went on to address the issue concerning modern man and his place in history, by pointing out that neither his generation nor the ones to follow had the right to disturb or destroy those monuments that had an impact on history. "They are not ours. They belong partly to those who built them, and partly to all the generations of mankind who are to follow us."[8]

The Palazzo Contarini-Fasan, one of the buildings at the head of the Grand Canal in Venice, was recorded by Ruskin as the most elaborate piece of domestic architecture. (Figure 3.2) How one very small and unimportant building can have so much beauty was a marvel to him. It is thought that because this building is decorated in the flamboyant Venetian Gothic style it appealed to Ruskin. Also in Venice the Casa Pigafetta was regarded by Ruskin as one of the most interesting pieces of fifteenth century architecture in Northern Italy. (Figure 3.3) Built in 1481 this small house is in a back street behind the Vicenza marketplace.[9] It was the house of the navigator to Magellan, Antonio Pigafetta, and in 1903 the family still lived in the area. Placing great importance on the architecture of the everyday man Ruskin declared, "To this day the interest of the fairest cities depends, not on the isolated richness of palaces, but on the cherished and exquisite decoration of even the smallest tenements of their proud periods. The ordinary dwelling is built to last and the legacy of the lasting belongs to the original builder."[10] These ordinary buildings were built to withstand the test of time and the rights to these structures belong to the original circumstance.

It is important to note that Ruskin regarded architecture as not merely a science of the rule and compass. It 'does not consist only in the observation of just rule or of fair proportion: it is or ought to be a science of feeling more than of rule, a ministry to the mind, more than to the eye.'[11] He drew the conclusion that humanism corresponded with romanticism as there is an inherent link

Figure 3.2 The Palazzo Contarini-Fasan, Venice, Italy[i]

Figure 3.3 Casa Pigafetta, Venice, Italy[ii]

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[i] Ross Warner, 1998.
[ii] In Italy, World in Pictures, Inc. 1993-2003.

between the human soul and beauty. According to Ruskin, "God has appointed beauty as one of the elements that sustain the human soul."[12] Ruskin, like Morris after him, had developed an opinion about the impact of man on future generations, which was forward thinking and would be pertinent to modern life.

Ruskin's impact on future architects and historians was great. He helped shape the conservative future of restoration in Britain during the nineteenth century. While he may have considered the impacts of architecture and ancestry for his immediate future, the same convictions have crossed the generations and continue to be valid arguments for contemporary life. It is best to tread lightly, allowing future generations, our grandchildren and great-grandchildren, to benefit from our social blips; 'better to be nobly remembered than nobly born.'[13] 'Ought we to be seeking honour from our descendants rather than our ancestors?'[14] These nineteenth century convictions and foresight are remarkably relevant and will continue to be so far into the twenty-first century.

3.1.2 Edward August Freeman

After coming under criticism from Ruskin subsequent to publishing his works, *The Principles of Church Restoration* and *The Preservation and Restoration of Ancient Monuments*, Edward August Freeman redeveloped his own hypotheses of restoration.[15] Freeman's initial theories concluded that monuments ought to be safeguarded against renewal and destruction. However, following the setback by Ruskin, Freeman redeveloped his theories, but continued to disagree with Ruskin, reasoning that restoration was a necessary evil, ultimately concluding that sometimes it is necessary to carry out structural repairs to prevent the building from falling completely into ruin.[16]

Originally Freeman pointed out that every restoration requires its own approach.[17] Freeman classified restoration into three different schemes; Destructive, Conservative, and Eclectic. The destructive method refers to the first stages of restoration where restoration of a building was carried out in the prevailing architectural style, rather than in keeping with its historical context. The conservative approach would undertake the diligent effort of reproducing every detail associated with the original structure. Repairs would only be made if necessary, as it was not common practice to remove original details and replace them with modern reproductions. Finally, the eclectic manner should be viewed as a middle ground where consideration was given to the distinctive quality and history of each building. The process should be executed in a way that the architecture is perfected, extracting any details that hinder the ideal beauty or function of the building. This, however, would be subjective from one architectural period to the next and even from one individual to another.

3.1.3 Gilbert Scott

Gilbert Scott's conclusions were similar to the initial hypotheses of Edward Freeman. Scott analysed the causes of deterioration and categorised them into three parts; Nature's destruction, Destruction by alterations, and Destruction by over restoring. In 1850 in *A Plea for the Faithful Restoration of our Ancient Churches,* he concluded that, "Gothic architecture has suffered more from modern restorations than from centuries of destruction and neglect."[18] Scott noted that the nineteenth century restorer most often preserved what was in keeping with his taste and altered what he, the restorer, deemed to be in bad taste.[19] The restorer projects his artistic prejudice onto the building project allowing, therefore, the preserved architectural style to fall victim to a style of arrogance. This is artistic prejudice of the current period to periods past, most likely concerning the immediate preceding generation.

3.1.4 William Morris and The Society for the Protection of Ancient Buildings

Gilbert Scott may take partial credit for William Morris establishing the Society for the Protection of Ancient Buildings (SPAB). Although Scott was the one who initially spurred Morris into action, it was the writings of John Ruskin that Morris found inspirational. Morris and Ruskin were both of the belief that the protection of the past was an imperative social duty of the present.

Just as Ruskin had determined that the freedom of the craftsman was inherent in mediaeval architecture, so did Morris. However, Morris argued that modern mediaevalism was impossible. The loss of confidence Morris had in the Gothic revival changed his attitude to the treatment of old buildings, making him aware of the dangers of ignorant restoration and the senseless destruction of old work. Coincidentally, many Gothic revivalists were coming to the same conclusions.

Scott, himself, specified in 1864 that there was a need for a watchdog group to oversee restoration projects and to prevent acts of brutality befalling every community.[20] The call was ignored although there was a growing need and concern for repairs to be made in a tentative and gradual manner.

It was not until 1877, when Scott and Morris clashed over proposed restorations at Tewkesbury Abbey, that Morris sprang into action, forming what would be known as The Society for the Protection of Ancient Buildings (SPAB).[21] (Figure 3.4)
Morris viewed the SPAB as part of his campaign for a changed society. The aim of the society was to cherish and save the traditional life of the building. Morris was determined to make sure that beauty in daily life would once again become a common pleasure.

According to Aymer Vallance, *The Life and Work of William Morris*, Morris's own views are based on those of John Ruskin's, *The Seven Lamps of Architecture*, and more precisely *The Lamp of Memory*.[22] In these writings Ruskin equivocated restoration with destruction and falsification of the original object. Lectures given by Morris from 1878-1891 show clear influences from Ruskin's *The Stones of Venice*, particularly from the chapter, *On the Nature of Gothic*, as well as from mediaeval romance.[23] The foundations of Morris's socialist claims were laid on the claims Ruskin had made in these writings. Morris carried the writings of Ruskin through to their complete and literal end, taking

Figure 3.4 Tewkesbury Abbey[i]

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[i] Fassoc, 2000.

what Ruskin had been preaching one step further by becoming an enabler rather than just the philosopher, becoming a vocal opponent to the additions and changes at Westminster Abbey and actively intervening in the proposed alterations at St. Mark's, Venice.

The SPAB's position regarding restoration of the built environment was a conservative one considering the so-called restorations of the nineteenth century. The building fabric was to be disturbed as little as possible. If, however, repairs were to be made they should be carried out in a manner sympathetic to the original structure and not disguised, so that one should be able to tell the difference between the original structure and the repair. As the patina of age was to be left alone, the Society got the nickname 'Anti-scrape'.[24]

Sensitive and honest repair was to be much more accepted than the destruction of restoration. Daily maintenance was perceived to be the best way to upkeep a building and avoid unnecessary repairs, thereby preventing decay and decreasing the expense for future generations. According to Morris, "...worthwhile spending a little care, forethought, and money in preserving the art of bygone ages, of which (woe worth the while!) so little is left, and of which we can never have any more, whatever good help the world may attain to."[25] Although there were few rules in the purist perception of preservation there appear to have been two absolutes. Both can be summarised by 'Thou shalt not fake'. The first regards the quality of restoration work so that speculative restoration must be avoided as should the faking of new construction to make the new look old. The second requires that all alterations must be reversible.

It was not just bad restoration but restoration in its entirety that Morris objected to. According to Morris, "If a revival of Gothic architecture was impossible without changing Victorian society it followed that any attempts to reconstruct or restore mediaeval buildings must fail for the same reasons."[26] He felt that as nineteenth century architects and builders had no living or working knowledge of church architecture, therefore all of their restoration work was a complete forgery.

From the lack of present day style came the obligation of men to save and restore what already existed; working from a style and knowledge of centuries past.

Although considered one of the most important influences of the last one hundred years in architectural history, Morris never designed a building and spent less than a year as a pupil of architecture. He regarded architecture as the basis and crowning point of every other art - the standard by which everything else should be upheld and apprised. "So looked on, a work of architecture is a harmonious, co-operative work of art, inclusive of all the serious arts, all those which are not engaged in the production of mere toys or of ephemeral prettiness."[27] A Victorian mediaevalist, he did have a profound influence on the future. Morris approached architecture as the foundation of all the arts and approached restoration as if it was the worst of the commercial and social forces of the period. While it was the Gothic revival tradition that Morris preferred, there is evidence of his influence on Walter Gropius and twentieth century functionalism.[28]

A. Morris's Rationale For The Garden City

Morris believed that a socialist society would produce a new healthy architecture. He felt that the individual should take responsibility and '... learn to love the narrow spot that surrounds our daily life for what of beauty and sympathy there is in it. For surely there is no square mile of earth's inhabitable surface that is not beautiful in its own way, if we men will only abstain from wilfully destroying that beauty.'[29]

He developed a series of proposals for the improvement of urban life. Basically there are six sections to his proposals: protect the countryside, restrict bill postings, protect ancient buildings, introduce a clean air act, control litter, and promote garden cities. Primarily the proposal refers to the preservation of nature and in the case of man dealing with nature itself, man needs to take responsibility for preventing the destruction of nature. Morris wanted limits placed on urban growth into 'fields and natural features of the country; nay, I demand even that there be left waste places and wilds in it.'[30] Protection of ancient buildings was the pursuit of the SPAB and was the basis for all that was to be good in the enlightened world. Furthermore Morris hoped with the increased use of electrical power the smoke bellowing out of the factory chimneys would become criminal, therefore ridding towns of smoke pollution. Little did he know that the opposite would become true! Open parks or spaces for the public should be kept clear, rather than left strewn with litter. The Socialist League's acceptance of the Garden City vision, partly because of Morris, helped in time to produce post-war towns – establishing them as a new part of the rural landscape.

3.2 BRIDGING THE GAP: BRITAIN'S INFLUENCE ON THE UNITED STATES

Initially, there does not seem to be a direct correlation between John Ruskin, William Morris and the conservation efforts in the United States. However, Morris did have a direct influence on American architecture and design. It was John Ruskin's philosophy, *The Seven Lamps of Architecture* and more specifically *The Lamp of Truth* that encouraged American artists, architects and craftsmen to pursue 'honesty in purpose, materials and manufacture'.[31] It is this dynamic that was immediately evident within architecture in Britain and on the continent. While Ruskin is credited as being the spiritual force behind the American Arts & Crafts Movement, Morris is credited as being the dynamic physical presence that vocalised Ruskin's spiritual force. Morris's influence in the United States can be credited to the proliferation of journals and books. An increase in overseas travel can also be attributed to the philosophy that was becoming increasingly prominent in Britain and overseas.

The increasing popularity of journals such as *The Ladies Home Journal, House Beautiful, Country Life, International Studio* and *The Craftsman*, contributed to the growth in popularity of Morris's work. This is readily apparent in the first issue of *The Craftsman*, published in October of 1901 by the

United Crafts of Eastwood, New York, which was Gustav Stickley's furnishing company. The entire issue was dedicated to the philosophy of William Morris, which was actively being pursued by Stickley himself.

> The new association is a guild of cabinetworkers, metal and leather workers, which has been recently formed for the production of household furnishings.... The United Crafts endeavour to promote and to extend the principles established by Morris, in both the artistic and socialist sense.
> - G. Stickley's foreword to the first issue of *The Craftsman*, October, 1901

3.2.1 Initial Influences on The American Educational System

It was this vivid example of Stickley's work in accord with the principles set out by William Morris which inspired the likes of Henry and Charles Greene and Frank Lloyd Wright. In the case of the Greene brothers, they had been trained according to these principles at the Manual Training School.

The Manual Training School of Washington University, St Louis, Missouri, was founded in 1880 by Professor Calvin Milton Woodward. Woodward, who himself was trained as a civil engineer, based his teaching on 'the dignity of craftsmanship and he is credited with introducing handcrafts into American secondary education.'[32] In addition to a regular high school curriculum, each student spent two hours a day pursuing manual training.[33] During the three year course this two hour session was devoted to the mastering of woodworking and carving in the first year; metal work in the second; and toolmaking in the third.[34] Students 'were taught that design determinants stemmed from function and from the appropriate analysis of materials handled in a direct manner. This was essentially a craftsman approach where form results from the nature of materials and the tools employed'.[35] Ultimately this was where students were first introduced to Ruskin and Morris.

A relatively early example of the battle to preserve private buildings was Frank Lloyd Wright's display of anger at the Chicago Theological Seminary's plan to raze the Robie House and build a dormitory in its place. (Figure 3.5) Wright's well publicised tirade sparked world-wide support to save the Robie House, so that The Chicago Commission on Architectural Landmarks, established in April 1957, declared the Robie House the city's first landmark.[36] Although the Commission did not have any legal authority all of this was enough to stop the demolition plans. Ultimately the Robie House was donated to the city, by the Seminary, and moved to the nearby Midway, an open plot of green land.[37]

3.3 AN AMERICAN HISTORY OF HISTORIC PRESERVATION

The United States did not begin to pass legislation regarding the preservation of the country's heritage until 1906, with the enactment of the Antiquities Act, which authorised the president to declare as national monuments, buildings and landmarks on federal property.[38] Until 1906, structures of merit were only designated as national monuments or landmarks if they were the source of Revolutionary events. At the time the legislation was enacted places such as the Old South Meeting House in Boston, Independence Hall in Philadelphia, and President Washington's Mount Vernon home in Virginia were among the buildings that were nationally recognised. The Antiquities Act stemmed from a growing interest in the preservation of the natural wonders of the picturesque American West and structures of the early Native American cultures. The Act authorised the President, "... to declare by public proclamation historic landmarks, historic and prehistoric structures, and other objects of historic or scientific interest."[39]

In 1916, the National Park Service was founded to provide a national conservation agency which was primarily responsible for promoting and regulating federally owned properties. The National Park Service was charged to operate the properties in a manner that would "leave them unimpaired for the enjoyment of future generations."[40] With the addition of the Historic Sites Act of 1935, the National Park Service was given a broader scope, which was to include historic properties

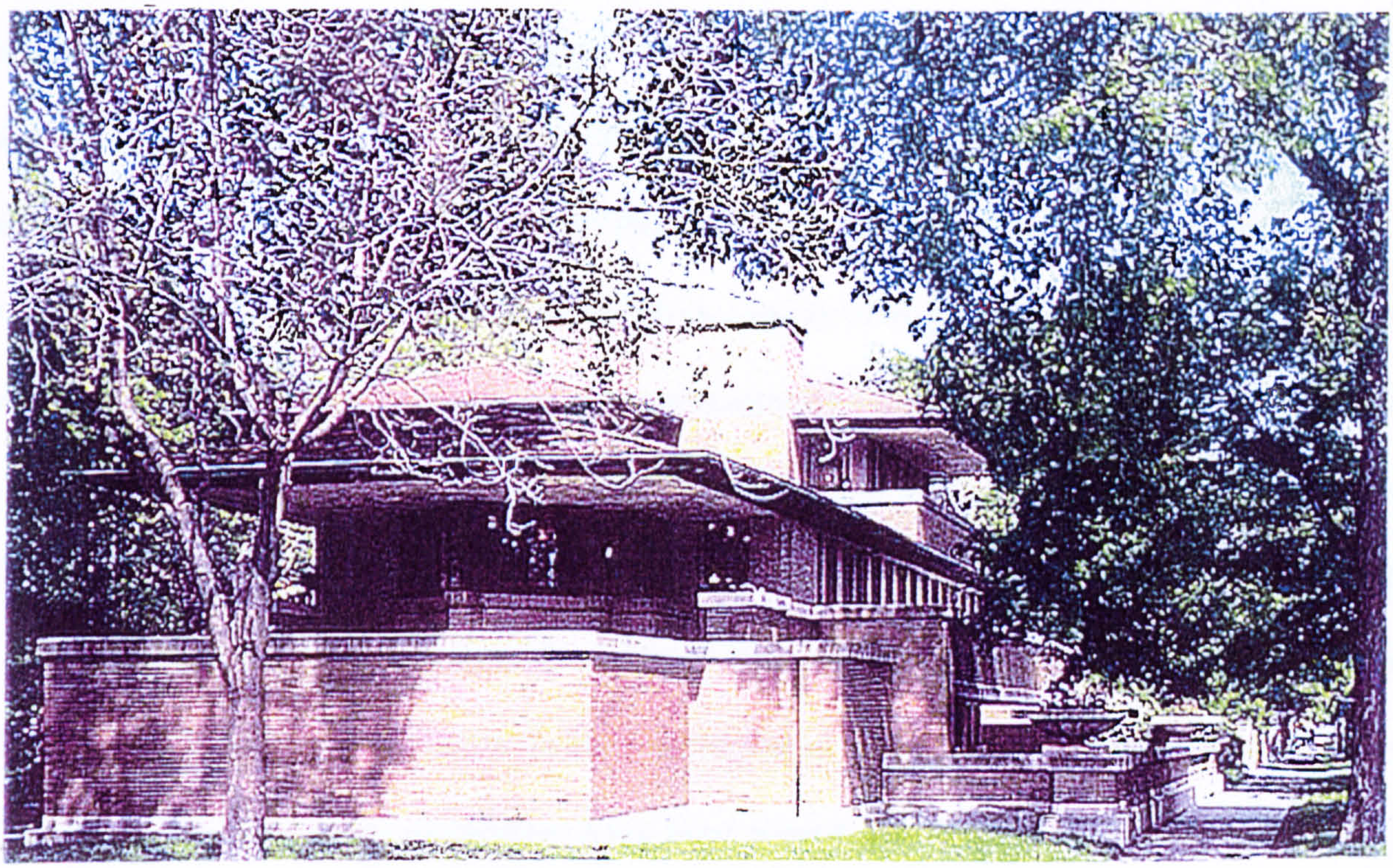

Figure 3.5 Robie House, Chicago, Illinois.[i]

[i] Frank Lloyd Wright Home and Studio Foundation, 1999.

not owned or operated by the federal government. The National Trust for Historic Preservation was established in 1946 and was set up as a non-governmental organisation so that it could be devoted to the preservation of properties both public and private. All of this legislation is based on the ideal of "conserving cultural resources for the benefit of future generations and focuses on the identification, designation, and protection of historic districts, sites, buildings, structures, and objects across the country."[41]

The 1966 National Historic Preservation Act expanded the federal commitment to the programme and established a National Advisory Council on historic preservation.[42] While encouraging a more vigorous approach in the field, the new legislation required that the Secretary of the Interior maintain an historic register. The legislation also provided states with matching funds for their registration efforts, to be distributed to owners of registered historic properties with up-grading to be done, therefore encouraging the renovation of buildings. This program started out as a success. However as abuse of the preservation property tax credit system became prevalent there were funding cuts for the program which in turn discouraged preservation for a number of years.

The National Historic Preservation Act of 1966 was the final piece of legislation to form the framework for historic preservation in the United States. Since 1966 quite a number of additional pieces of federal preservation legislation have been passed. However, those outlined above provide the framework for preservation laws in the United States.

In an interview in March, 2005, Dr. Morton Brown, one of the co-authors of *The Secretary of the Interior's Standards for Historic Preservation Projects* explained when these news laws were enacted energy efficiency was a primary requisite of the new fledgling preservation movement in the US. The US found itself in the middle of an energy crisis and it was a way to encourage preservation in the US, while fostering support for energy efficiency. While energy efficiency was seen to be an integral part of the new preservation mandate it became a secondary component. The efficiency requirements could be meet by solely recycling the building, not by reducing the energy required of the renovated building. Brown also served as the principal architect for the Historic American Buildings Survey and Chief, Technical Preservation Services Division of the National Park Service in the US. When asked about green building preservation, Professor Brown allowed that he was not familiar with any projects of this nature. He did elaborate that once the energy crisis of the 70s past the demand for preservation to meet the needs of an energy conservation agenda faded. It seems as thought the efficiency part of the initial phases of the preservation movement in the US was nothing more than a fad.

Currently the National Trust for Historic Preservation (the Trust) is the national force in the American preservation movement. It operates as a private non-profit organization and works to save America's treasures and revitalize America's neighbourhoods. Headquartered in Washington DC, the Trust fields six regional offices and maintains twenty-eight historic sites. In addition, the Trust draws from a membership base of approximately 270,000 members and has partnerships with local groups in all of the fifty states.

Through active community engagement the Trust has developed programming to involve lay people and preservation professionals. Many that come to the Trust would not consider themselves preservationists. Most approach the Trust looking for a way to save their community. In recent years the Trust has created a new program to handle all aspects of community revitalization, in addition to the educational and public policy programming. The Trust recognises that this is an important effort in order to make preservation relevant to people outside of the preservation profession. A successful approach to the preservation movement has been the burgeoning grassroots efforts to preserve communities. This can be seen in smaller cities like Pittsburgh, Pennsylvania and Saint Paul, Minnesota. In many cases these community activists may not fully understand why they are trying to save their community other than realizing that the inherent value of their community is at stake.

Through a variety of community projects the Trust is working hard to demonstrate, to the country at large, that preservation matters. It is seen time and again that preservation should be addressed as a key component in order to ensure the continued success of American communities, neighbourhoods and downtowns.

3.4 THE IMPORTANCE OF PRESERVATION

An international proclamation first came in 1964 in Venice with the establishment of the *International Charter for the Conservation and Restoration of Monuments and Sites. (ICOMOS)* Adaptations were made in 1978 in Moscow and the current version of the proclamation is know as the Burra Charter, which was adopted in Burra, South Australia in 1979. The last revisions were adopted in 1999. The Burra Charter advocates a cautious approach to preservation. Seeking where possible to provide necessary maintenance while refraining from any fundamental changes that would alter the cultural significance of the site. There is no indication that the Burra Charter has had significant impact of American preservation legislation. It is certainly possible that the initial *ICOMOS* (Venice 1964) proclamation helped to shape the *The Secretary of the Interior's Standards for Historic Preservation Projects. (SOIS)* However, the Burra Charter provides a far more detailed guideline for the preservation process. Not only is this helpful during the preservation process, it is particularly helpful when trying to determine what might be a valuable part of the historic fabric. Regionally there is much debate about the variety of properties that should or should be preserved. The Charter sets out that a determination of cultural significance should be adopted before proceeding with a preservation plan. Once this cultural significance has been established a comprehensive plan for the preservation process can be established. Within this framework the Charter sets out very clear avenues to successful preservation. It may be seen to be a cautious approach, but one can not be too cautious when dealing with this significant part of our collective memory.

The mandates made by the Burra Charter are significant in that they provide a comprehensive plan for the preservation process. The Charter takes a long-term view of the process, which can be lacking in many preservation projects, particularly when contemporary additions are being made. For those working in the preservation field in the US, application of the *SOIS* will only be mandatory under the historic tax credit plan. Any other preservation being pursued in the US that is not tied to the federal historic tax credits is not required to follow the *SOIS*. Communities looking to establish a clear set of preservation guidelines should look to the Burra Charter for clarity.

It appears as though re-utilisation, on both sides of the Atlantic, has been spurred on by more than just the desire to recycle old buildings. Amid the latest and one of the most destructive waves of urban renewal of the late sixties and early seventies, diversity was replaced with homogeneity and the sense of the familiar and vitality were lost. Historic landmarks and established communities were sacrificed. This only succeeded in accelerating decay in downtown areas and increased alienation and incidents of crime. However during the sixties there was a growing force which was vocal about the demolition of landmark monuments. Adaptive re-use grew in popularity and has proven to be an effective energy saver, recycling embodied energy and redirecting it, therefore using it for something else.

By preserving and reusing the best of the old buildings we enable communities to link with the foundations of their past. The point of the effort is nothing less than to preserve our past, to provide an anchor for our collective memory. Without the cultural link to the past not only is historical integrity of our communities lost, but so too is the community, as demonstrated by the unsuccessful programme of comprehensive development areas (CDAs) set-up in Glasgow in the late-fifties. This was perhaps the largest program of its kind in Britain and possibly in Europe. Considering the dominance of the Labour party in Glasgow, housing policy has always been a central part of politics in this city. During the post-war years debate was over where the new building should take place. By the mid-sixties large-scale housing construction was ending around the city's historic perimeter which had only been made possible by the boundary extensions right up until 1975.[43] The housing policy pursued by the city council during most of that post-war period was 'based on new building in the periphery together with comprehensive redevelopment in the old inner city areas.'[44]

The 1954 redevelopment plan initially dealt with the problem of urban slums by planning for three redevelopment areas in the city. This figure was later raised to twenty-nine and these were designated as CDAs. Within the CDAs everything would be demolished and rebuilt, including the roads. According to Michael Keating, author of *The City That Refused To Die: Glasgow: The Politics Of Urban Regeneration*, "100,000 houses, a third of the city's stock and half of all property not already owned by the corporation, would be demolished after compulsory purchase, to be replaced by municipal housing."[45]

The Gorbals-Hutchesonstown scheme was the first such scheme approved in 1957.[46] It was estimated to cost £13 million and was the largest development of its kind in the UK to date. Everything was to be demolished and rebuilt, reducing the population from 26,000 to 10,000.[47] In accordance with the reduction in population shops were to be reduced from 444 to 57, public houses from 46 to 9 and industry was moved out altogether.[48] The Saltire Society lauded the first phase of the project.

By the early-seventies little progress had been made on the twenty-nine proposed CDAs, although schemes had been completed in Pollokshaws, Anderston, Cowcaddens and Gorbals-Hutchesonstown. In other areas the lack of progress was attributed to planning delays and highway schemes, which were not resolved until the mid-seventies.[49] Perhaps the lack of progress stems from the huge capital expenditure required. The CDA programme was stopped in 1974. In the five years since its inception, fourteen of the original twenty-nine CDAs had received government approval yet of the 48,800 municipal houses built between 1960 and 1972 only 14,800 were built in CDAs.[50]

Comprehensive redevelopment turned out to be an unpopular political decision. The early results in these new communities were not up to the standard promised by local government. In addition the procedure was expensive and dissolved communities permanently, making people move to the peripheries and in the end produced concrete jungles. For example the Red Road flats were plagued with vandalism and malfunctioning lifts, which stranded many of the tenants. [51] Not ideal living conditions when there were elderly or very young tenants to be considered.

In an attempt at a quick fix in 1976 the Labour government prematurely announced the Glasgow Eastern Area Renewal, or 'GEAR', which became the new operative for the old CDAs. It was a desperate attempt to transform the socially unacceptable CDAs. Thus central government had recognised that comprehensive redevelopment was not successful. GEAR, which was executed in the east-end of Glasgow, was approached in a more holistic manner. The redevelopment was to be designed in a more imaginative and expeditious way while paying attention to social and economic needs as well as purely physical considerations.[52]

Furthermore the housing estates on the periphery of Glasgow, Easterhouse, Drumchapel, Castlemilk, and Pollok, posed some of the greatest social, environmental, and economic challenges.[53] According to a 1966 sample census, deprivation and environmental decay were already beginning to show, although these housing developments were approximately seven years old.[54] Officials were beginning to realise just how destructive the comprehensive development of highways and council housing could be, particularly when issues of losing good Victorian building stock, in areas such as Pollockshields and the damage being done to the environment became apparent. The role of the conservationists was on the increase during the early sixties and that also helped to establish the importance of maintaining and preserving Glasgow's built environment.

According to Keating, in other cities throughout Western Europe and North America the issue of highway development had been contentious, resulting in the mobilisation of communities that may have otherwise been politically inactive.[55] Initially there was some protest in Glasgow to the routing of highways through the CDAs. However, people were primarily concerned with being rehoused. For this reason community-based protest was inhibited, except in the Gorbals, which had undergone urban transformation in its early stages.

The real opposition came from the middle class professionals who were located primarily in the West End of Glasgow and faced redevelopment due to proposed new road links to the west of Scotland. It is no coincidence that this happened at the same time that Glasgow was becoming recognised for its Victorian heritage, nationally and internationally. Lord Esher pronounced in a 1971 report by the Royal Institute of British Architects (RIBA), following on a 1964 RIBA meeting held in Glasgow, "that Glasgow is the finest surviving Victorian city."[56] The New Glasgow Society was an early result of the reaction against the development proposed for the middle class areas of high environmental quality, notably the approach to the western outskirts of Glasgow.

Initially, opposition was mounted to divert traffic from Great Western Road to Maryhill Road to prevent the widening of Great Western Road. Then by the mid-seventies the conservationists in the city opposed urban highways altogether on the principle that they caused environmental damage wherever they were built and money would be better spent on public transportation. From such amateurish efforts came into being in the 1980s the professionally led Glasgow Conservation Trust West, which receives its core funding from the city council.

3.4.1 The Basis for A Solution

As the evidence in Glasgow has shown, we have come to a point in our enlightened way of life, where we need to identify with the human qualities of the past, something that has been pushed to the periphery with the so-called modern movement. This should enable our communities to have a sense of history, while regaining the lost sense of community. Many will argue that the 'genuine voice' is lost with the original artist and cannot be replicated by present day artisans. It is difficult to integrate a modern intervention with the original without having the intervention look inappropriate. The skill and manner in which this is handled defines the difference between the restorer / conservator and the original traditional craftsman. However, if the intervention is handled sensitively than it should not look too obtrusive.

Although the majority of buildings in Glasgow predate all of the new structures of the last forty years there are many approaches to designing new structures in old settings. (Figure 3.6) However, most of the structures of the past forty years fail in terms of their performance, as demonstrated by the CDA movement in Glasgow. Fundamentally these performance flaws were disenchanting to the population these structures were built to serve. Innovative thought and design are necessary components in the landscape of the built environment. However, the human component can not be disregarded if successful schemes are going to be achieved.

This does not suggest that modernist approaches were or are unacceptable. Until recently change as a form of progress has meant discarding the old – including the built world. The reverence for the new is a product of the reductionist philosophy of modern architecture and design. The concepts of modern architecture advocated the advancement of new forms, functions and materials at the expense of the old and familiar. The renewed vigour of the conservation movement is in part a reaction to these concepts. It is hoped that now as a whole conservation is a self-perpetuating process with immensely hopeful benefits for society.

If a building is to continue in its original use then modern modifications will need to be made gracefully and without major change to the building's character. In order to preserve any type of architectural heritage it is imperative that an attempt is made to keep traditional building methods

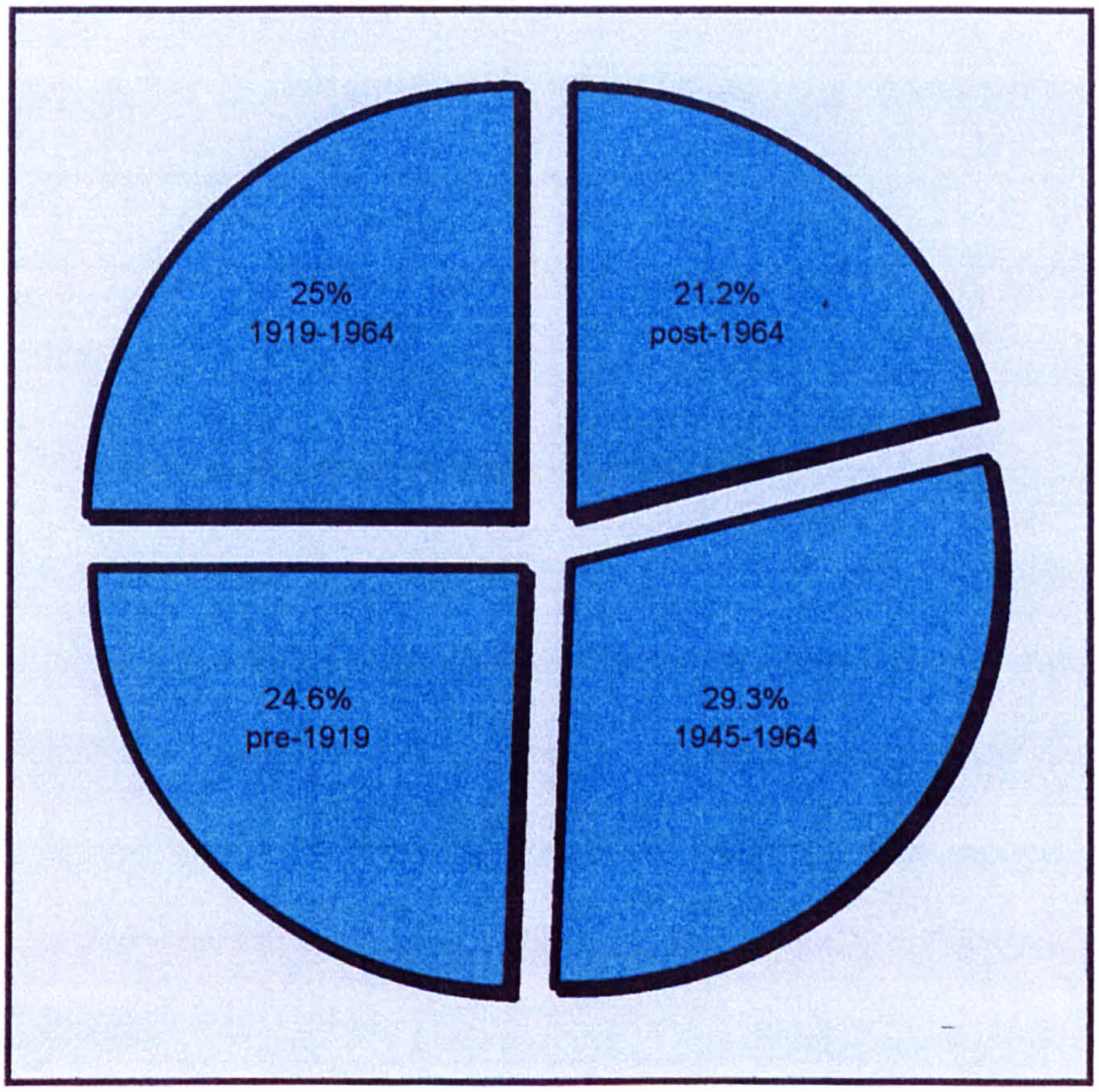

Figure 3.6 Glasgow Housing Stock by Age.[i]

i Glasgow City Council and Scottish Homes, Preliminary findings for Glasgow, 7 October, 1993, p. 12.

existent. While it may not be possible to replicate exactly the genuine voice of the traditional craftsman, it is possible to replicate his crafts. When pursuing a project, as such, it is imperative that nostalgia does not enter the spectrum of historical context, therefore avoiding the cheapening of the restoration process. The bridging of the past and the present with nostalgia should be averted. Instead the bridge should provide a basis for modern innovations based on the need for a new concept, "greenness" in architecture.

Adaptation, by way of preservation, seems to be the only way to prolong the useful life of well built structures in danger of becoming demolished, of course there are some structures which do not require adaptation in order to be preserved. Some structures have the tendency to out live their function; at worst the interior may have become obsolete while the exterior may be perfectly acceptable for adaptation. In future such adaptation projects should be based on the quality of the existing architecture and an adaptation sympathetic to the original design. The process of preservation should reclaim old buildings in an effort to retain a sense of community, which was an inherent part of society's yesteryear. With the social problems facing cities it appears as though a return to the scale and quality of the neighbourhood would in turn enhance the quality of life. Historically, romanticism does not address the economic realities of community redevelopment when adapting a building. For the long term success of any development project, individuals should be able to take pride in their communities through recognition of familiar spaces. The connection with the individual can be most successfully made through community conservation, which accommodates an intrinsic joy when individuals are able to recognise familiar structures.

According to Barbara Diamonstein, author of *Buildings Reborn, New Uses, Old Places*, "Creative adaptation provides pride in our heritage, a link with the past, respect for the aesthetics and craftsmanship of another time, insights into our development, ample creative opportunity for architectural innovation and problem-solving, enhancement of the urban fabric, greater security, stability and beauty, while conserving basic materials and meeting modern needs."[57] This approach to urban planning provides a method of channelling investment back into communities, thus accomplishing what modern development can not. This requires a completely new standard for architectural and environmental structuring.

3.5 CURRENT TRENDS IN PRESERVATION

Between 1981 and 1994 in Britain, 9.2 million people moved into Britain's seven largest cities; however 10.5 million moved out to escape bad schools, rising crime, and endless traffic.[58] A shift in population outside the city can be attributed to a perceived improvement in the quality of life which would be made convenient by the advances in modern technology, computer links, satellites, and mobile phones. Perhaps one of the most significant factors in the great migration is the rapid and affordable development of information technology, allowing an increasing number of people to work from home, at least part of the time. Along with the increased use of this new information technology, there will be a reduced pressure on inner city housing structures and increased pressure on the commuting facilities.

John Gummer, former Environment Secretary for the United Kingdom, announced to the House of Commons in December 1996, that 4.4 million homes will need to be built by 2016.[59] Gummer expected that 60% of the required space will be in existing towns and cities.[60] However Gummer predicted that in the next twenty years 160,000 homes will be needed in Hampshire and more than 120,000 each in Cambridgeshire, Essex, and Kent.[61]

Although this geographical spread will increase the need for refurbished space, it is feared that it will also increase the need for new building in the countryside. This could include the possibility of creating new towns and villages. Therefore, one of the most radical ways of preventing new building in the countryside is to invent ways of saving old architecture through new uses.

Currently there are an estimated 500,000 acres of derelict land in England and 800,000 homes sitting vacant.[62] The obvious and immediate task at hand for politicians, planners and designers alike is to entice people back to the urban areas, therefore encouraging a regeneration of the city centre, while maintaining a delicate balance within the suburban areas. A comprehensive redevelopment plan for existing redundant buildings should be able to prevent some of the anticipated new construction, of which 60% is anticipated to be needed in existing towns and cities.

According to David Martin, formerly Conservation Group Leader for the Glasgow City Council, energy efficiency in building renovation is taking place in Glasgow, but it is primarily within the commercial sector. [63] It can be seen in the Lion Chambers, the old Glasgow Herald building, now much extended as The Lighthouse in Mitchell Street, and the new Glasgow Building Preservation Trust headquarters in Miller Street. The extent of energy efficient building renovation within the residential sector is more difficult to judge, as it is more of a private matter unless structural work is being carried out, in which case planning permission is required.

3.5.1 Reuses Of Redundant Buildings

It has been reported in the architectural press and numerous do-it-yourself magazines that saving an old building through new uses is becoming an increasingly popular trend, particularly in the housing market.[A] Furthermore from television programmes it would seem that this is a trend in the housing market that has become increasingly popular in Britain in the last ten years and is already widespread in the United States. An increasing number of people have been investigating the possibilities of reinventing warehouses, chapels, lighthouses, windmills, and even a reservoir, to use as housing. The aim of many of these 'new-wave' homeowners is to retain a genuine sense of history from the original structure, rather than facilitating a phoney sense of history. This process has been

[A] Magazines such as Build It, Individual Homes, The Architect's Journal, and the design sections of several newspapers.

introduced as a way of preserving historical architecture that is in danger of becoming redundant or destroyed. Since there appears to be an avid interest from private homeowners, this process could be actively encouraged to provide further growth in a developing market.

A. The Merchant City

Within a city like Glasgow many buildings have been reused and converted to new uses, particularly in the Merchant City, an area of significant importance in terms of Glasgow's inner city redevelopment. In the eighteenth and nineteenth centuries this area was used by the tobacco lords for both commerce and housing.[64] As the tobacco lords moved out of the area it became an important commercial centre for warehouses, distributors and wholesale merchants. By the 1960s much of the area had fallen into disuse and was set for comprehensive redevelopment.[65] However, by the 1970s the exceptional character of the buildings had become apparent and this prompted the city to realise that this area would be prime for revitalisation.[66] The policy of revitalisation was encouraged through a program of refurbishment of the warehouses or mixed use; residential, commercial, and leisure. This was tried as an experiment in mixed-use development within the inner-city.

Unfortunately had the market been left to its own devices for this revitalisation experiment it would not have realised its full potential. Therefore, with the help of the Scottish Development Agency (SDA) subsidies were introduced for the renovation and conversion of properties. According to Keating, "Although housing is hardly part of the SDA's remit, it saw in the Merchant City opportunities for the application of its LEGUP grants, a central government scheme for urban economic projects administered in Scotland by the Agency."[67] Ultimately it was through grants from the district council improvement scheme and the SDA that the mixed-use development was initiated and set to rival the West End. This type of redevelopment has its parallels with similar projects in the USA and in other parts of Britain, London's Docklands for example. It also provides for the increasing demand for city centre living.

Critics of the Merchant City revitalisation point out that this type of project has catered for the 'yuppie' generation and those with upper bracket incomes. However, by the mid-eighties due to the gaining momentum of the project it was felt that the Merchant City would be able to attract enough private investment for further revitalisation. With the inception of this project came the founding of the City of Glasgow Development Trust. This provided a way to bring together the council, developers and financial institutions for formal planning. According to Keating, "This would raise a bond to finance the development programme for the city centre, leaving the district council free to spend its limited non-HRA moneys on the more deserving categories elsewhere in the city for whom grant aid was conceived in the first place."[68]

3.5.2 Salvage

The SPAB discourages homeowners from replacing lost items with originals from other properties. They advise that owners should carefully consider having modern replacements commissioned. As well as providing craftsmen with work, this process also cuts down on the growing problem of theft from listed buildings for their historic contents. However, it should be noted that salvage should be regarded as the lesser of two evils; either the building and materials are salvaged, in some cases for uses rather than the original intent, or these pieces of architectural heritage are lost forever.

The SPAB also feels strongly that homeowners should be fully aware of the treasures that the property holds before making radical decisions to dispose of seemingly outdated materials. For example, nothing can compare to old window glass. Old glass is being lost quite quickly in favour of new glass because people do not realise what historical value the old glass really has. Old glass is blown and rolled giving a rippled effect. In comparison new glass is flat. Choices such as these prompted the SPAB to start offering courses for homeowners in 1985. One weekend a year the Society offers courses covering everything from structural problems to interior finishes. Most owners come away from the weekend realising that they can not treat their property like a new build.

With the property boom of the early 1980s and a growing passion for heritage, junkyards made the transition to architectural salvage yards. What was then called scavenging, and now more politely salvaging, started with rummaging through skips when no one really knew what they had or what they were looking for. Currently it tends to be the reverse; -who is knocking what down and what do they have?

One of the first salvage yards was the London Architectural Salvage and Supply Company (LASSCO). The company was started twenty years ago and is located in a Grade I listed church, St. Michael's in Shoreditch, London.[69] It can supply practically any architectural detail; cupboards from a school science room, the authentic fittings of an American barbershop, even 16 foot doors from Marrakech.[70] LASSCO even rescued 10,000 square feet of marble flooring from Whiteley's, a London department store.[71] An increasingly lucrative business, various specialists have cropped up across Britain.

One who specialises in timber is Jeremy Nelson. He started a timber reclamation business in 1975, specialising in North American pitch pine.[72] Pitch is the pine resin and pitch pine is stronger structurally, has fewer knots, is larger and is generally more durable than European pine. The timber was shipped to Britain from the end of the eighteenth century. At the time the merchant trade was shipping metal to the States and the ships would bring the trees back as ballast. Originally whisky distilleries, the naval docks and mercantile properties were big consumers of pitch pine.

When Nelson first began his business he reclaimed as much as 600 tons of wood from a Liverpool warehouse.[73] Some of the timber was as much as seven meters in length and in some cases the reclaimed wood is originally from fifteenth century virgin forests.[74] As the reclamation business has grown it has saved hundreds of tons of salvageable timber from being burned. Nelson, himself, has salvaged timber from an old bridge in Newcastle, the docks at Sunderland and from the Albert Docks, where the timber was buried in mud for up to 100 years.[75]

Nelson estimates that most of his wood having been around for two hundred years, is likely to be around for another two hundred.[76] Unless the end of a beam has been set into the wall, where it is unable to breathe the wood should be quite durable and good for reuse. Upon further investigation it was found that most of the wood contained arsenic, making the wood very durable and resistant to infestation.[77] According to Nelson, patience is imperative, as it is impossible to know what will be found and in what condition it is likely to be in.[78] This is a business of unpredictable results.

Another salvage firm, Retrouvious, which started in Glasgow focused on incorporating the city's architectural and design heritage into modern living standards.[79] In some cases salvaged details are recycled and not used for their original purpose. For example salvaged pulpits have been used for shelving and ornate metal gates have been transformed into trelliswork or even radiator covers.

It can be said that during the last twenty years salvaging has not only increased but significantly diversified due to an increasing interest in the heritage movement. Because of this a greater knowledge of buildings, their history and materials, has also increased. This knowledge encourages the public to take on a greater role in the development of their personal architecture, as well as voicing concerns relating to the fate of public architecture. Quite possibly the salvage industry has also benefited from a so-called freedom of styles, resulting in a more individualistic style rather than conforming to strict social dictates and standards. In addition the emphasis has shifted from accurate and reverential restoration to a freer and more creative attitude to the changes that an old building may undergo; from the building as an art object to the building as the product of a whole socio-economic system.[80] Whatever the reasons salvage and preservation have become a growing phenomenon with likely repercussions in both the property and retail markets.

3.6 SUMMARY

> 'Every ugly or senseless building is an insult to the man passing in front of it. Every building should be embellished and adding to its culture. This is very difficult now that we have abandoned human scale and human reference. We need to reintroduce human scale, human reference and musicality into architecture.'
>
> - Dr. Hassan Fathy, Egyptian architect[81]

The aim of this chapter has been to provide the beginnings and foundations of the conservation movement in the United Kingdom, where the movement has its roots, and how this movement influenced the United States. During the process it has attempted to draw in some of the legislation and guidelines that have given the preservation movement merit. It uses Glasgow as an example of what went wrong during the 1960s in the UK and how the public tried to stop "modernisation", as well as providing links to the USA.

Much of Glasgow's housing stock is listed or included in conservation areas. Therefore, the relationship between building and the environment has great relevance for this city. A notable recent example is the Tobacco Merchant's House, Miller Street, where the heating, lighting and ventilation are energy efficient and sympathetic to the building and its new use as a conservation centre. The Tobacco Merchant's House is part of a growing international awareness and can be related, for example, to the Audubon House in New York.

All aspects of the survival of buildings, which are old and interesting, fall under the parameters of the criteria to be considered. As good buildings age, the bond with their site strengthens and they become readily identifiable parts of the community. A beautiful, interesting, or simply ancient building belongs where it stands, however corrupted the place may have become. Use and adaptation of buildings have their marks and these, in time, we also see as aspects of the building's integrity.

At this juncture it is significant to note that communities should not disregard existing buildings which may not be considered significant pieces of history. A building's worth is not solely dependent upon its historical significance. The overall texture of the community and city of which the building is a part needs to be carefully examined before any decisions are made as to the fate of the structure because once the building is gone it is irreplaceable.

Perhaps it could be perceived that there has been a backlash against the modern movement with its egotistical and elitist decision-makers solely shaping the course of our architectural heritage. The disappointment of the public with the products of modern architecture and planning, while appearing to be somewhat separate from the heritage movement, is actually a direct result of the failure of the modern movement to meet successfully and completely the needs of the public, particularly in housing. This backlash has steered the course of architectural heritage towards a new dynamic; finding ways of incorporating historical architecture with new uses. Somehow modern industrial society has become based on a series of radical disconnections: body / soul, and community / earth. Only by restoring these connections can we attempt to put back and restore the health of the community at large. Emergence of imaginative adaptation is compulsory for the continued grace and variety of cities, towns and countryside.

We should not, however, attempt to restore everything of the past. According to David Pearce, author of *Conservation Today*, 'There are those ancient monuments, churches in use, a minority of outstanding buildings, and, indeed, engineering structures, are so intrinsically fine and owe their interest, character and beauty so much to what they are, rather than any possible interpretation or new use, that they must be preserved intact, unaltered, and, if necessary unused. It is a mark of civilised society that this be so. A small proportion of barns, parish churches, viaducts, and... eighteenth century landscaped parks are... perfectly useless.'[82] Certainly there exists the components of the museum and the historic preservation associations, which serve the purpose of preserving the rarest and finest examples.

By combining the values of the conservation ethic, knowledge of our historic past, and man's sympathy for nostalgia we can establish that recycling is already part of the ethic of historic preservation. The consequences of preservation may be observed as an indirect, but significant, way of recycling, increasing the accessibility of preservation to every receptive community. According to Ruskin, "God has lent us the earth for our life; it is a great entail. It belongs as much to those who are to come after us, and whose names are already written in the book of creation, as to us; and we have no right, by anything we do or neglect, to involve them in unnecessary penalties, or deprive them of benefits which it was in our power to bequeath."[83] Ruskin appears to have had the foresight to regard the earth and its heritage as almost sacred. Although he never could have imagined the advances that his descendants would make, he did realise, however, that the footprints of modern man should not be so big as to leave indelible signs.

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Chapter Four
Integration: The Audubon House

4.1 INTRODUCTION

The premise of the Audubon building, in New York is simple. It places equal importance on the environmental criteria (sustainability of resources, energy efficiency and air quality) with traditional criteria (cost, practicality and aesthetics). It proves that a building can successfully meet all of these criteria, clearly demonstrating that environmental performance and economic sense are compatible. Most of the material in this chapter comes from a publication released by the National Audubon Society shortly after the project was completed. Other than that account there has not been another fully comprehensive investigation into the successful integration of both environmental and traditional criteria.

The Audubon House sets the precedent for other projects related to the renovation of an ordinary historic structure. Thus far there have not been many other projects, such as the Audubon House, that have met both of these criteria, environmental and traditional. The Audubon House was the first. The popular trend seems to be either one of two options: first to re-evaluate and adjust a modern structure in terms of its environmental output, or secondly to construct a new environmentally friendly building. Although the influences of the Audubon project were mainly ecological, the project provides preservation with a resourceful and conscientious rationale regarding the salvaging of ordinary historic architecture for reuse. Environmental and traditional criteria, while important individually, are equally important to the outcome of any undertaking of this nature. A successful project will maintain a balance between the environmental and traditional criteria, otherwise the project would be sacrificed for the sake of either criteria.

4.2 HISTORY

The National Audubon Society began a three year project, completed in November 1992, to renovate a one hundred year old building, purchased in 1989, that was to become the Society's new headquarters.[1] (Figure 4.1) Once known as the Schermerhorn Building, it is located at 700 Broadway on the corner of Broadway and East Fourth Street in Greenwich Village, New York. (Figure 4.2) The Schermerhorns were an old Dutch family who believed that they could compete with the Macy's family.

Built in 1891 this eight-story loft building is a typical example of late nineteenth century Romanesque Revival architecture.[2] The Schermerhorn Building was designed by George Browne Post and closely resembles the red brick Romanesque New York Produce Exchange, which he designed in the 1880s. (Figure 4.3) The Produce Exchange, which occupied a prominent corner of Bowling Green, fell victim to the demolition ball in the 1950s, before the enactment of the current US landmarks preservation laws.[3] Post also designed the Williamsburg Bank in Brooklyn and the New York Stock Exchange (Figure 4.4) on Wall Street, still celebrated landmarks of Manhattan's glory days.

Over the years, like many buildings in the Broadway district, the Schermerhorn Building suffered what some call a New York phenomenon, which seems to occur in most urban areas over time. It had become one of the landmarks that no one noticed any longer. The subsequent fortune of the Schermerhorn building was that it was to suffer from bottoming rentals and abandoned maintenance. The upper floors became home to illegal sweat shops, while the ground floors housed retail space with shops that were perpetually deteriorating.

The original eight-story structure is faced in brownstone, brick and terracotta, a penthouse was added later. The cast-iron support structure of the Schermerhorn Building is supported by basement level masonry piers. Post was granted the latitude to situate

Figure 4.1 National Audubon Society Headquarters.[i]

[i] National Audubon Society, 1994.

Figure 4.2 Map showing the NAS headquarters in Manhattan.[i]

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[i] City Maps, Access Maps, 2002.

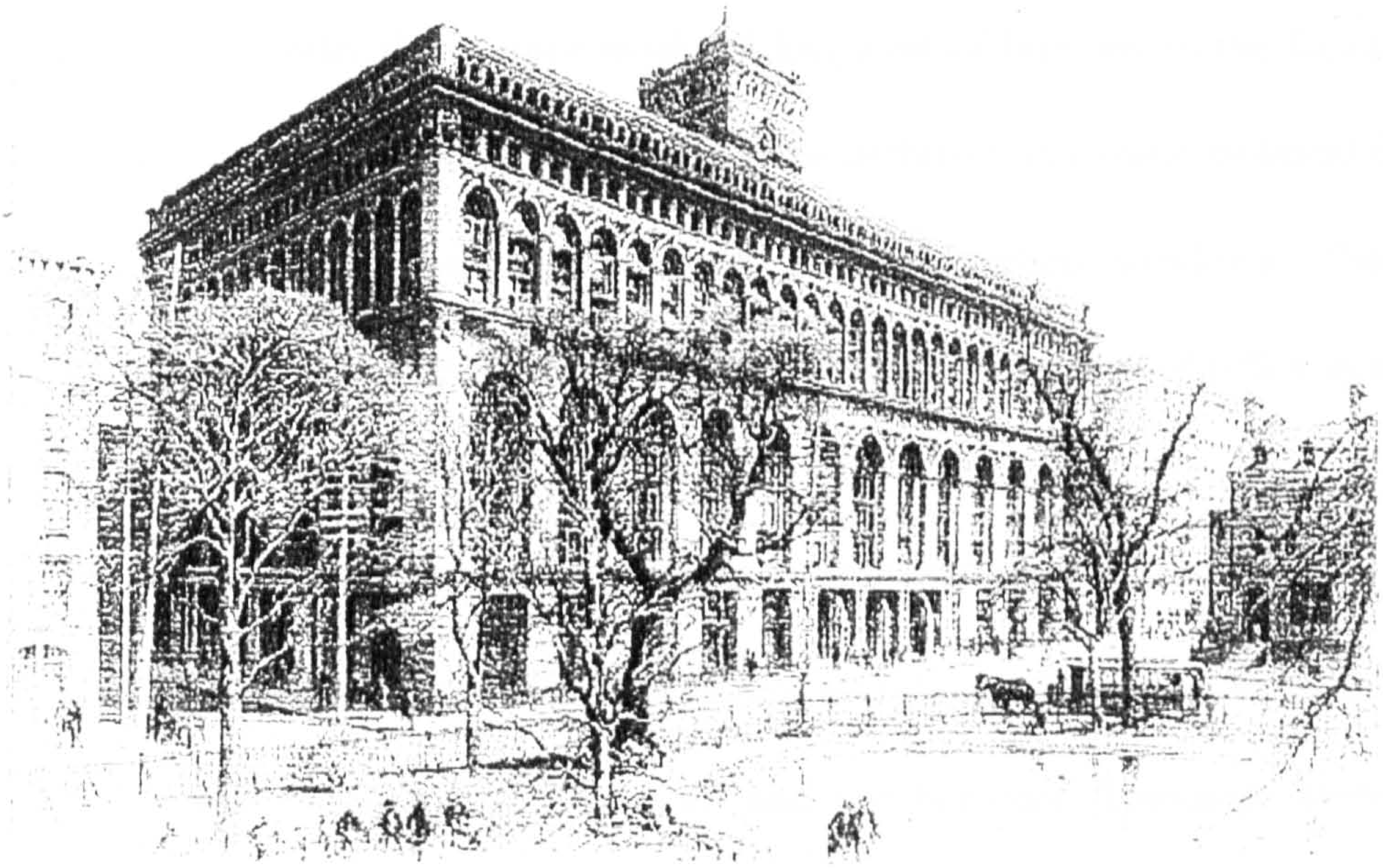

Figure 4.3 The New York Produce Exchange.[i]

Figure 4.4 New York Stock Exchange with 1922 addition.[ii]

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[i] Wood engraving, *Harper's*, ca 1890.
[ii] GAMBEE, Robert, Wall Street Christmas. New York: W.W. Norton & Co., 1990, p. 43.

mischievous gargoyles just under the cornice work, adding a bit of humour to the facade and indeed it is rumoured that there is a gargoyle in the image of the architect and some political figures of the time.[4] The detailing other than the gargoyles also includes arched windows. Throughout the completed nine floors, including the penthouse there are 98,000 square feet of office space.[5]

4.3 PREVIOUS WORK OF THE CROXTON COLLABORATIVE

The Croxton Collaborative was the architecture and design firm used to carry out projects for the National Audubon Society (the Audubon) and the National Resources Defence Council (NRDC). The advantage they had working for both organisations was that both of these organisations were environmentally enlightened from the start. The real test seems to be with the rest of corporate America and whether or not the environmental precedents are considered valuable enough to adopt as an architectural standard. According to Ralph Croxton, the project architect, such practises are not being adopted in a manner that would quickly transform the urban environment into a truly sustainable environment.[6]

Croxton Collaborative worked on a plan with Home Box Office (HBO), a dominant corporation in cable television in the United States. In 1989, the chairman and chief executive officer of HBO, Michael Fuchs realised that the potential savings by taking an environmental stand would be financially beneficial to his bottom line.[7] Initially, he began a recycling programme at the company's headquarters at 1100 Sixth Avenue, New York.[8] The programme was initially designed to find a way to lower the cost of office supplies. First, HBO found a recycling paper mill to supply them with their corporate stationary. Then HBO struck a deal to get the mill to supply stationery at a reduced rate, while in return HBO supplied the mill with paper waste as raw material.

The next step in the greening of this company was to enlist the help of Croxton Collaborative. HBO's goal was to upgrade the building's energy performance. While there were no plans for a complete building restoration, the Collaborative put together guidelines in the event that HBO changed its mind. The Collaborative has provided HBO with a handbook itemising the issues to be dealt with in case of a total building renovation. It has provided HBO with the environmental characteristics of the project at hand, leaving the details to be decided by HBO when the time comes.

A tracer gas test was done on the building's shell.[9] This type of test determines the building shell's permeability to the outdoors by releasing an inert gas throughout the building and measuring the rate of dissipation. The test proved to be quite useful as the gas on the first floor through to the third floors and the fifteenth dissipated quickly enough to suggest that the building was losing a lot of energy.[10] This was followed up by a smoke test done solely on those specific floors. As the smoke dissipated most of it could be observed escaping through what would have been microscopic cracks in the exterior walls.[11]

Once again the question arose - How much will the renovations cost? The answer translates to $.50 per square foot yet by solely caulking and sealing these leaks, Croxton estimated that HBO would save $10,000 a year in utility costs.[12] Therefore, by saving energy, using recycled supplies, and creating an environment that encourages happier and healthier employees, HBO will easily realise these initial costs in the next three to five years.[13]

When the Audubon Society commissioned Croxton Collaborative for their project the Collaborative had recently completed the remodelling of three floors for the headquarters of the Natural Resources Defence Council in a building on West Twentieth Street in New York. The result was that:

> According to the NRDC, if the heating systems and air-conditioning systems in every American office were as efficient as NRDC's we could save sixty billion dollars in avoided power-plant construction costs. We could also reduce the amount of ozone depleting CFCs (chlorofluorocarbons) used for air-conditioning by twenty five percent.... If NRDC's lighting improvements were duplicated nation-wide,

> we would avoid the generating capacity equivalent to all the nuclear power plants in the country.... If NRDC's 'thermal envelope' of ceiling and wall insulation, window coatings, and other strategies for reducing oil consumption were duplicated nation-wide, we could reverse the environmentally destructive 'greenhouse effect' by directly reducing the level of carbon dioxide and other gases that contribute to global warming.[14]

4.4 THE MISSION

Relocation presents a host of opportunity and complications. Typically when an organisation considers relocation the convention is usually to begin with finding a green site in suburbia and building what would appear, to the uneducated eye, to be an environmentally sound building. The finished building would be situated in a manner that would provide the employees with a nice view and would hide the parking lot. That would be the scenario until the needed infrastructure was allowed to intrude and the necessary conveniences would appear overnight as if by magic; the mandatory gas station, strip mall and so forth would all emerge. Therefore, in 1988 when the Audubon Society decided that it needed to relocate it went as far out on a limb as it could go. This project could provide the organisation with an opportunity to fulfil their mission. Audubon's President, Peter AA. Berle, opted for a plan that would radically change and affect the Society as well as the future of the working environment. Beginning with a building shell and a new way of thinking was a fine way to marry idealism and realism, creating a synthesis among the past, present and future of architecture. It seemed a natural advancement for the Society to progress from protecting solely the natural environment to becoming the protector for the urban environment, although the Society does not draw the same parallels between endangered species of the wild with the 'endangered' dweller of cities.

While hardly an obvious candidate for the new headquarters, the Schermerhorn building made sense for many reasons. In 1989 the purchase price reflected that the building had been sitting vacant for ten years.[15] At ten million dollars for the entire property the purchase price represented just a fraction over the cost of the lot on its own.[16] This allowed the Society to spend a further fourteen million dollars on the building's renovation and upgrade.[17] From the exterior no one would ever guess today that this is the most energy efficient building in Manhattan.

Once the interior was renovated and redesigned it was an ideal example of an. energy-efficient, environmentally responsible workplace. (Figures 4.5 – 4.9) The exterior of the Audubon House was completely restored to celebrate the turn of the century grandeur of the Schermerhorn Building. The Schermerhorn represented New York of a dying age. The loss of this prominent Manhattan building would have severely damaged the cohesive community of buildings in this neighbourhood therefore jeopardising the community's identity. Vacant lots scar a community. It can take decades to replace the physical structure and there is no guarantee that the character or nature of the community will be repaired. When the Audubon bought the Schermerhorn building only the ground floor was occupied. Adaptive reuse of the building helped to revitalize an otherwise declining area. Not only were Croxton and his team able to maintain the integrity of the exterior, they were also able to maintain the integrity of the interior floor spacing. (Figure 4.10, 4.11)

In the end, the Society successfully recycled a valuable and treasured, but probably dispensable, piece of New York City's architectural heritage and history. This building represents a significant part of he texture of this Manhattan community. In a day and age of massive pubic commercial buildings, the renovation and adaptive reuse of the Schermerhorn represents a quality building that relates to human scale and memory. The materials, scale and design of the Schermerhorn create a texture in this neighbourhood that is impossible to replicate. By the time the project was completed the Society had saved a considerable sum of money, by comparison with the cost of an equivalent structure built from scratch.

> The grandeur and rich history of the urban environment are written in its architecture. Unfortunately these qualities are fast disappearing in favour of cookie-cutter skyscrapers. By choosing to renovate this building we are able to preserve a piece of New York history, as well as to achieve our environmental goals. -Peter AA Berle[18]

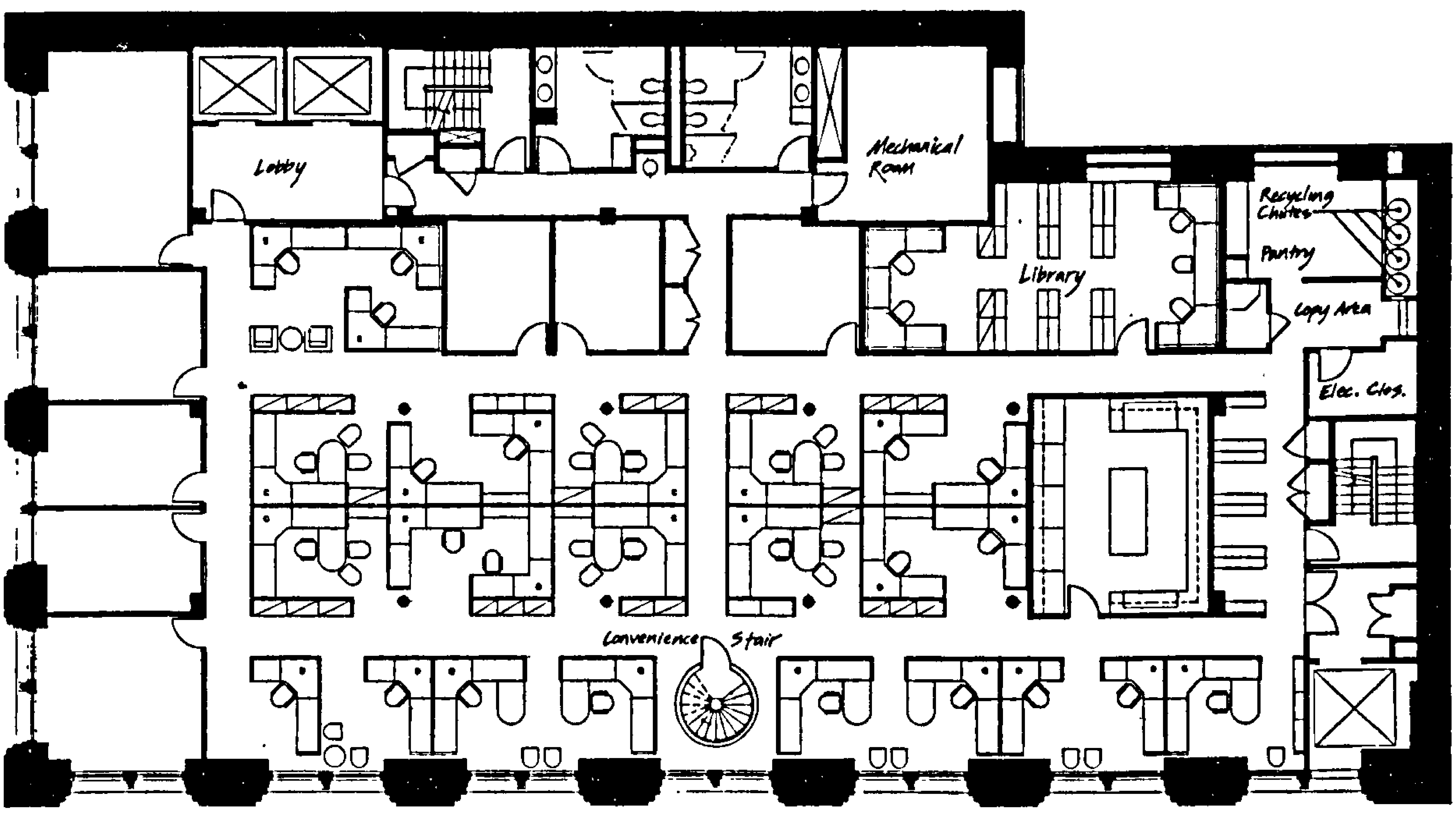

Figure 4.5 Typical floor plan at Audubon House.[i]

[i] Croxton Collaborative.

Figure 4.6 Interior, typical workspace, Audubon House.[i]

[i] Bernstein Associates.

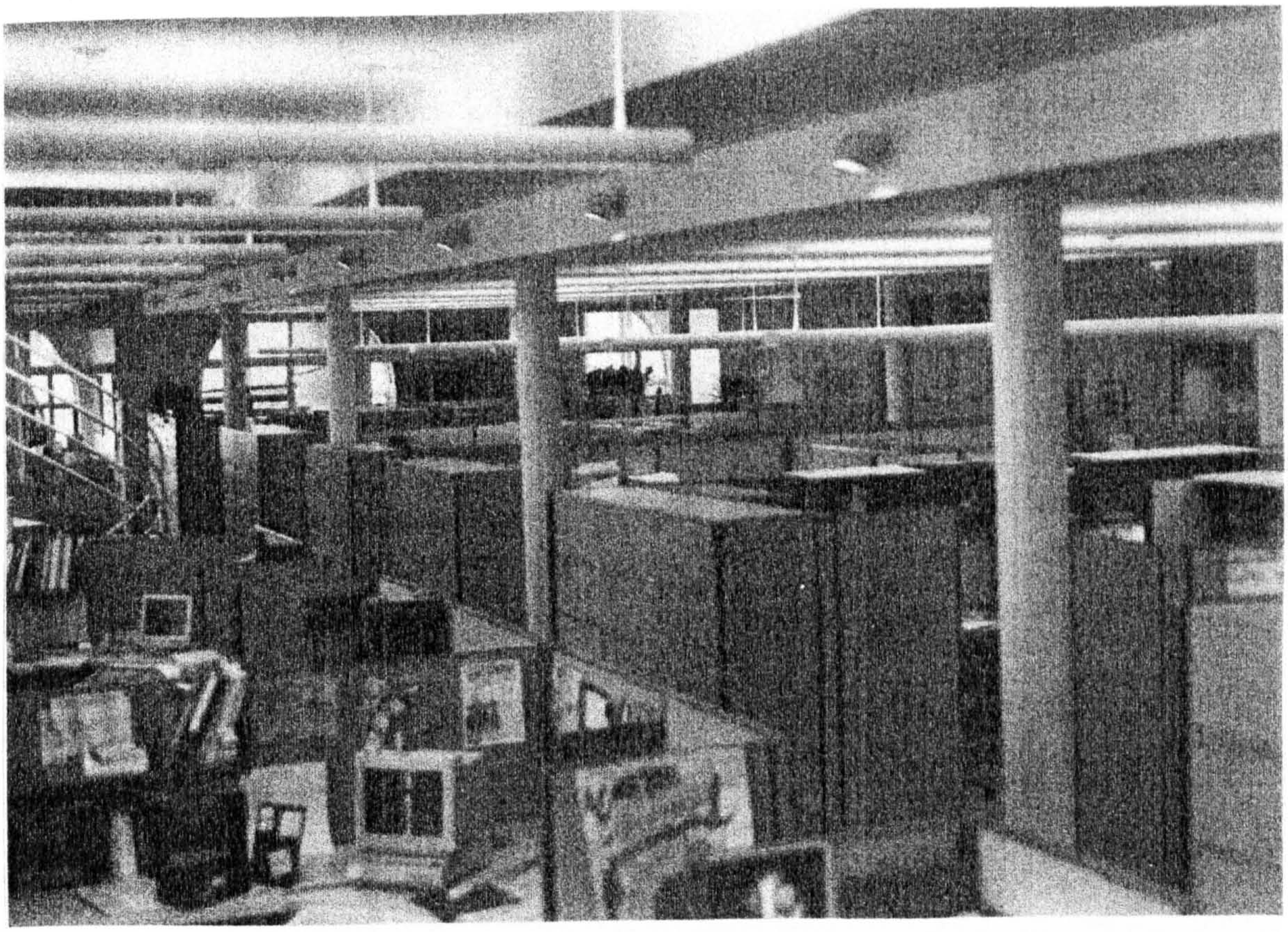

Figure 4.7 Central workspace, Audubon House.[i]

[i] Tom Mead.

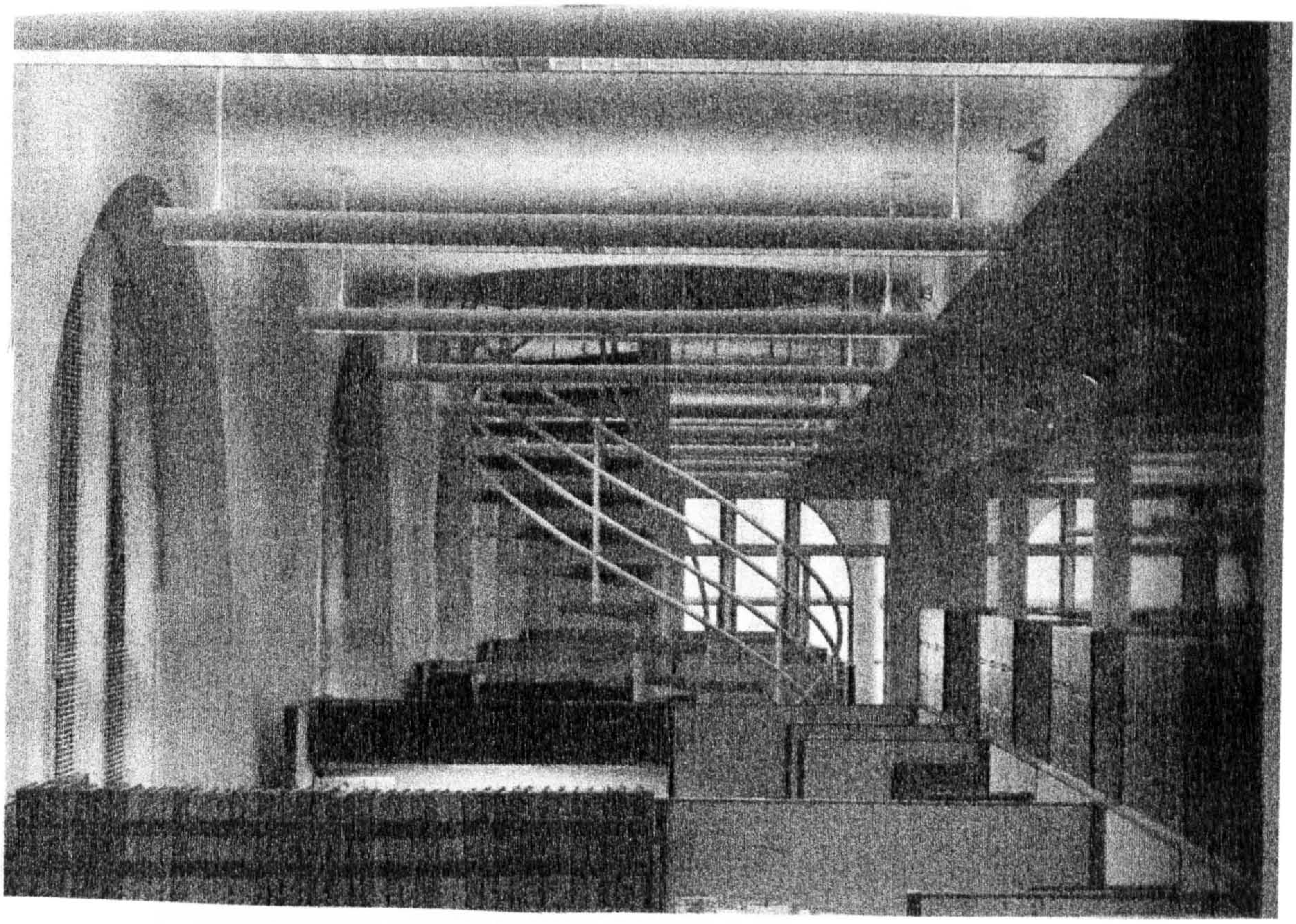

Figure 4.8 Interior workstation, Audubon House.[i]

[i] Otto Baitz.

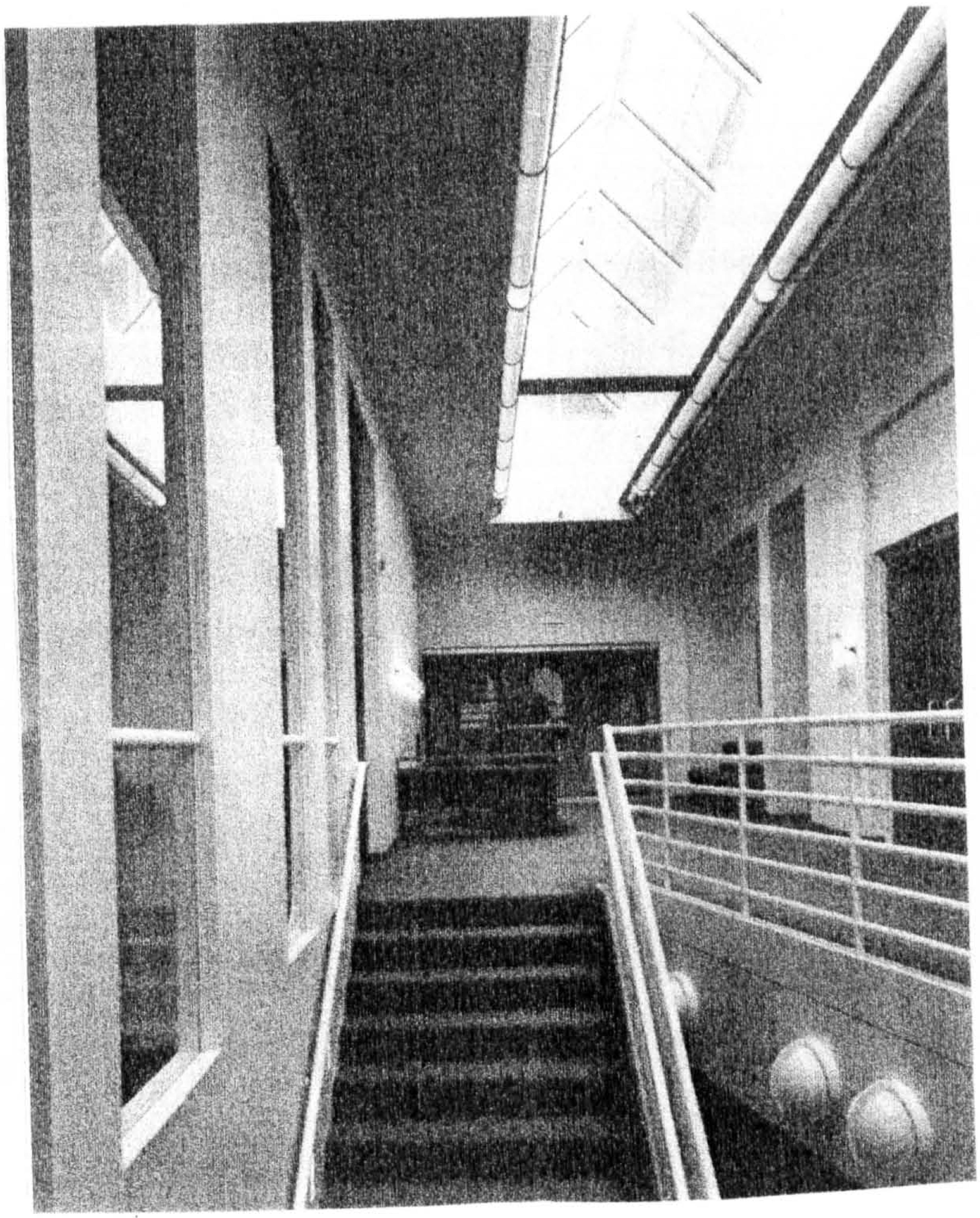

Figure 4.9 Interior, Audubon House.[i]

[i] Jeff Goldberg/Esto.

Figure 4.10 Audubon House elevation – details recycling system.[i]

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[i] Croxton Collaborative.

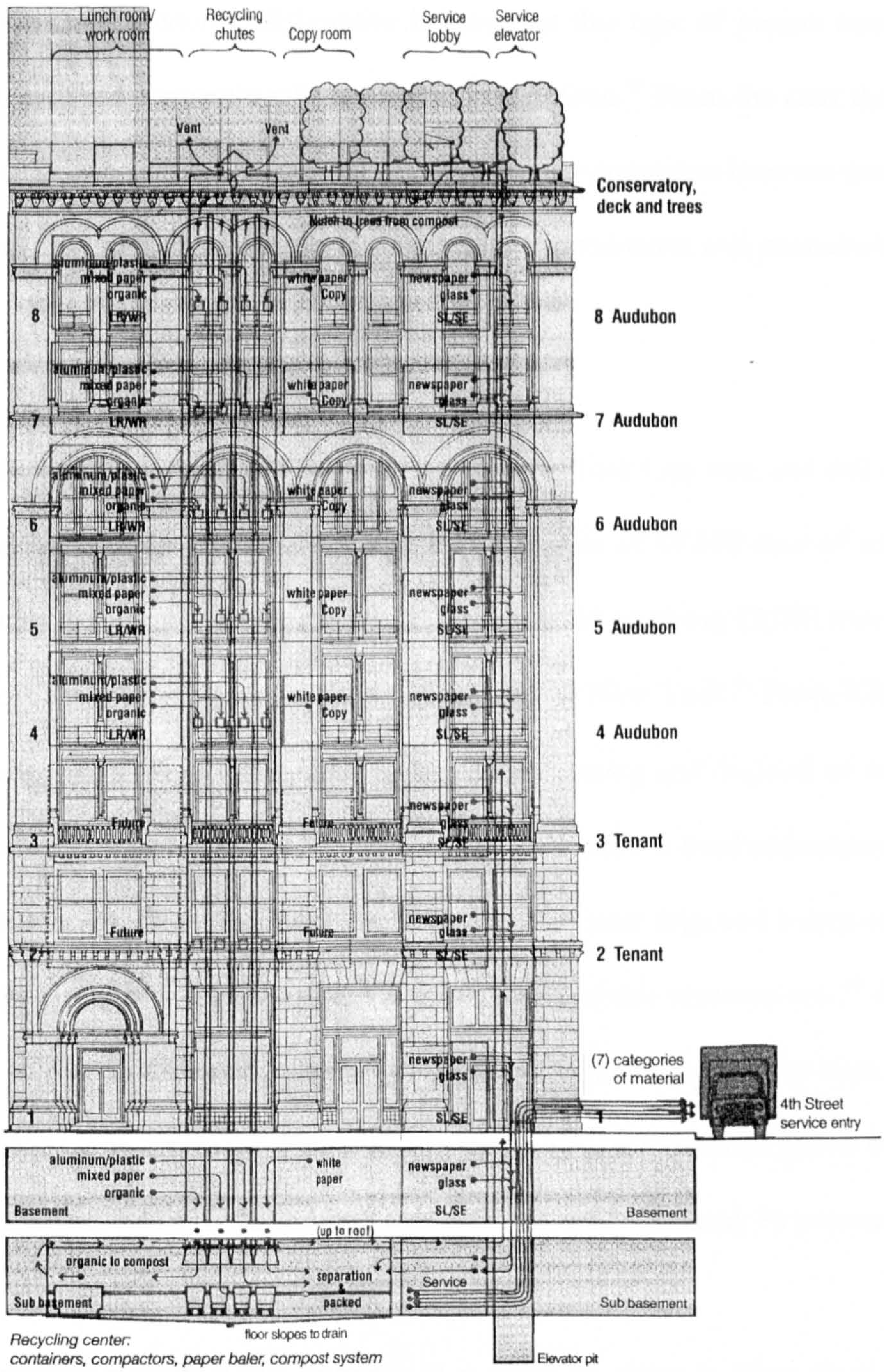

Figure 4.11 Audubon House schematic – south and west exterior elevations.[i]

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[i] Croxton Collaborative.

Both the Audubon and Croxton Collaborative believe that this type of project needs to be directly cost competitive with the conventionally inefficient comparison.[19] From the start the project needed to satisfy the bottom line scrutiny. It needed to prove to cost-conscious business-people that the model would be productive and reasonable, rather than counterproductive and unattainable.

4.5 RECYCLING

While the Audubon was purchasing its new premises, New York City was, and still is, in the midst of a solid waste crisis. During 1989 the city needed to dispose of 19,000 tons of trash each day.[20] Fresh Kills on Staten Island, was the largest landfill in the world receiving 12,000 tons of trash every day, which is almost three fourths of the output of the city of New York.[21] Fresh Kills closed in July, 2001, but was reopened in September, 2002 to handle the sorting and disposal of the World Trade Centre debris. Approximately another 2,395 tons per day is burned in local incinerators adding to the air pollution problems already realised by New York City.[22] A state imposed 5-cent returnable deposit on retail beverage containers resulted in more than a third of this recovery rate.[23] Currently not much has changed, so that an increasing number of incinerators are being built to cope with the swelling amount of garbage being produced. Nationally, in the U.S.A., the problem grows every year and continues to go unresolved. In 1991, 280 million tons of waste was produced; 75 percent went to landfills, 10 percent was incinerated and 14 percent was recycled.[24]

Although the recycling picture is not as pretty as it could be, there is some good news. In 1991 6.6 million tons of newsprint were recycled, an increase of 90 percent from 1983, bumping the total amount of recycled paper up to 31.1 million tons.[25] However, efforts to increase recycling have been slowed by a moderate market for recycled and recyclable materials readily available on the market, as well as compounded by people's reluctance to change their habits.

With this in mind the Audubon set out to put recycling at the heart of its mission. By setting an example it was hoped that other organisations would follow suit with similar programmes. As general guidelines these can be applied to projects both in the commercial and residential sectors. They were directly concerned with the Audubon's direct contribution to the flow of solid waste in New York. Audubon's solid waste programme includes both recycling and a limitation of consumption. It is broken into five comprehensive areas:

> 1. "Recycling the building: renovating an existing structure
> 2. Recycling materials from demolition
> 3. Finding materials made with recycled content
> 4. Programming and designing a physical in-house recycling system to capture office waste
> 5. Establishing guidelines for the purchase of recycled and/or recyclable supplies (as well as waste reduction and use)"[26]

By making a commitment to an existing structure the Audubon House automatically committed itself to saving resources and energy. The Audubon recycled approximately 300 tons of steel, 9,000 tons of masonry, and 560 tons of concrete, all of which would have otherwise ended up in precious landfill space.[27] Not only would this wreckage have ended up in a landfill, but also the manufacturing of these goods would have placed another strain on already drained natural resources and environment. In addition to saving a piece of architectural history as well as the resources listed earlier, the Audubon was also concerned with new construction material and the responsibility of life cycle costing.

The Audubon benefited the community in that it preserved part of a rich architectural heritage found in that district of New York City. Rather than imposing a structure of glass and steel, the Society tailored itself to the architectural fabric of the community. Greenwich Village, the community where the Society relocated, houses some of the finest examples of early cast-iron buildings by such early American masters in the development of the skyscraper as Sullivan and Post. All things considered the Society also saved money. The Society estimates that a new conventional structure on the same site would have cost $17 to $18 million.[28] Add to that the purchase of the site and demolition, and the total cost of $32 million would have been approximately $8 million more than the $24 million spent to purchase the land and reuse the building.[29] By fulfilling their needs in an environmentally responsible way the Audubon has personified the environmental directive to reduce, reuse, and recycle.

Ideally, the Audubon would have reused every part of the old building, but renovation required a certain amount of demolition and replacement with new construction. Part of contract negotiations with builders and subcontractors included subcontractors taking responsibility for the sorting of identified materials and locating appropriate salvage dealers.[30]

Only two materials were identified as either too cost prohibitive or too dangerous to recycle. The first, window glass, was assessed to be cost prohibitive. Without a dealer in the area it was too expensive to ship the material elsewhere to be processed.[31] The second, heating oil, was deemed too dangerous. It had spilled from the original boiler system in the basement and was contaminated with mercury: it was treated as hazardous waste.[32]

All told the rest of the demolition material was successfully farmed out for recycling. The scrap iron, tin and steel were sold to a scrap dealer.[33] Wood from the window frames was taken by a dealer in Brooklyn who was going to reuse it for future landscaping projects.[34] The concrete and masonry was to be recycled for roadbed fill.[35] The cost effectiveness of recycling these materials was either offset entirely, as in the case of the scrap metals, or the cost of recycling was significantly less than paying to dump the materials.[36] As the market for recyclables increases it is thought that recycling demolition materials will some day be profitable.

The Audubon maintained its dedication to recycling by utilising recycled building materials in this project. Not only does this practice reduce the number of and demand for new materials, decreasing the demand for energy and natural resources, but it also decreases the influx of solid waste into our shrinking landfills and boosts the market for recycled goods. Therefore the effort is a superlative example of what recycling and using recycled goods can do for the environment and the economy.

Post-consumer goods, which are of particular significance to environmentalists, make up the majority of what is being dumped into the landfills. Unfortunately these materials are the last to be recycled because of the difficulty in doing so, as they require more equipment and time than pre-consumer materials. Often these goods need to be rid of impurities before they are made suitable for reuse. Developing the market for these post-consumer goods has the greatest potential and would be the most beneficial to the community.

There is beginning to emerge a market of environmentally responsible product lines available through manufacturers. The Audubon used recycled building materials whenever they were available and cost-effective. Some of the recycled building products used were: bathroom countertops made of recycled detergent bottles. Because of the cost the Audubon chose to use this product for countertop space only, although the product can be used in various circumstances.[37] The tiles in the elevator foyers were made up of 60 percent waste from incandescent light bulb manufacturing.[38] The gypsum wallboard used for dividing offices was made with a core of partially recycled gypsum (8 to 15 percent) and the outer layers of 100 percent recycled newspaper.[39] Partially recycled steel studs were used in construction, as well as partially recycled aluminium used in the furniture frames.[40] The original wood floors were covered with *Homasote*™ fibreboard which worked as the sub-flooring. This product is made up of 50 percent recycled newspaper and is pressed and bound with agents of low toxicity and fireproofing and is both sound absorbent and comfortable.[41] An effort was made to incorporate natural products such as padding, wool and fabric as much as possible. Some of the products used may add a bit to the bottom line, but increased use in commercial and residential projects should create a reasonable market for these environmentally friendly products in the future. According to Peter Berle, president of the Audubon Society, it does cost approximately 10% more to build green than to build conventionally, but, and certainly in this project, every environmentally friendly measure taken will payback within the first five years.[42] The public needs to realise that the policy-makers need to start creating legislation to enforce higher standards regarding the use of post-consumer content in building codes and product requirements.

Audubon also installed a recycling system dedicated to recycling up to 80 percent of their solid waste, mostly paper.[43] The system consists of a series of four chutes, for white paper, mixed paper, aluminium containers and food waste, channelling the waste to containers in the basement recycling room.[44] Initiating an in-house compost system using the compost for the rooftop garden is another way of incorporating the seemingly radical recycling programme into the Society's strategy.

The total cost of the recycling system added approximately another $185,000 to the renovation cost, but this is included in the market price of $122 per square foot, which is competitive with the margins of the market rate ($120-$128 per square foot) for comparable size, location and time.[45] To some extent the cost is insignificant to what the Society has implemented years ahead of government regulation and in anticipation of the growing recyclable market; looking down the road to one day turning a profit from the sale of recyclable goods.

4.6 ENERGY EFFICIENCY

The Audubon addressed the two main areas concerning energy consumption. First it dealt with upgrading its thermal shell and secondly, it dealt with ways of decreasing the need for artificial light. In order to have an energy efficient building there were three areas where the Audubon did not want to compromise; cost-effectiveness, to be realised within the next three to five years; employee comfort would only be allowed to increase; and lastly, aesthetics would not be compromised.[46] These were the only restrictions.

4.6.1 Thermal Shell

Like many other old buildings, Audubon's thermal shell was sound with only the masonry for insulation. Immediately the endeavour was to augment the energy efficiency of the thermal shell; the exterior walls, roof and windows. The main task at hand was to re-fit the building with a high grade performance insulation. Advancement in building codes as well as window and insulation technology permitted the building shell to be upgraded to its most efficient. Replacing insulation in a building that already exists is difficult, but restoring the windows can be just as beneficial.

There were only two types of insulation readily available on the market; foam insulation and rigid fibre glass. Foam insulation is a plastic that is manufactured with and may contain either chlorofluorocarbons (CFCs) or hydrofluorocarbons (HCFCs). As discussed in Chapter One, 'The Environmental Predicament', when either one of these compounds is released into the air they become the leading cause of stratospheric ozone depletion, causing upwards of 25 percent of the greenhouse effect. There are some other foam insulations on the market that may not contain CFCs or HCFCs, but do emit formaldehyde and contain other harmful chemicals. Fibreglass, seemingly the only other option, contains tiny particles that may cause respiratory irritation.

After considerable investigation and debate, the Audubon found a product called *Air-Krete*™.[47] This product is made from magnesium compounds, extracted from seawater and is mixed with dolomite and other minerals.[48] It comes in a foam and is air-blown wet into the wall cavity where it hardens, like concrete.[49] The walls were insulated to a value of R=12 with the *Air-Krete*™, which is three times the required city code.[50] Because the foam has to be blown in wet it is not suitable for horizontal applications, so that rigid fibreglass insulation was used for the roof space. As the roof can be a major factor in heat loss, the Audubon has insulated its roof to a value of R>33, again three times the required city code.[51]

Because window technology has advanced quite a bit in the last ten years finding replacement windows was much simpler and cost effective as the prices of the most competitive high-quality windows has come down. The windows installed used *Heat-Mirror*™ technology.[52] Suspended between two panes of glass is a polymer sheet, a low-emissivity and wavelength selective coated film (shade co-efficient = 0.41, with daylight transmittance of 53 percent) that deflects the majority of the sun's radiant heat outward, keeping the interior cool in summer, and deflects convector radiant heat inward, conserving heat in winter.[53] The skylights also use the *Heat-Mirror*™ technology but the daylight transmittance is 45 percent analogous with the window's ability to reduce higher levels of heat gain.[54]

The windows have an insulation value of 3.7, which is the equivalent of a brick wall (R=4).[55] Currently, it is possible to obtain newer models of windows that have values of R=8 or higher.[56] The windows used at the Audubon are constructed with a rubberised thermal break thus minimising the transfer of temperate air though the window seal.[57]

Overall, the walls at Audubon House achieve an R-value>12, four times that allowed by New York state code (R=3) at the time of construction.[58] The roof is also much more highly insulated than required by code (R>33), as compared to code (R=12). [59] It is apparent that the Audubon House is thermally sound, far exceeding the code set out by the state of New York.

4.6.2 Lighting

On average 30 to 40 cents of every dollar spent by American companies is spent on energy for lighting.[60] Clearly, lighting is then one of the top expenses for companies nation-wide. Traditional office structures are the most wasteful as they account for one third of the nation's peak electricity consumption. Because lighting places these huge demands on the electrical supply, both for the commercial and residential domains, it is a major environmental strain. The bad news is that most energy is wasted because of over-lit spaces, inefficient and poorly designed fixtures, and lights that are left on needlessly. As a result of over-lighting, for every watt of light another increment of heat is adding an extra strain to the usually already overworked air-conditioners. The good news is that these excess costs can easily be resolved, by incorporating what is already available, natural light, and targeting areas in need of high-perfomance supplementary lighting. By implementing these relatively simple initiatives the Audubon has cut its total need for lighting electricity by 75 percent.[61] As a result of the initiative taken by the Audubon, employees benefit from the ability to sense the change of seasons and the time of day. It is remarkable how these environmental changes can impact on an employee's accomplishment and capability.

By incorporating the existing large windows on the southern and western exposures as well as installing a skylight over the central reception area, lots of natural daylight was let into the office work spaces. The window blinds are perforated with pin-sized holes, diffusing what can be harsh, bright natural daylight into soft interior lighting.[62] Not only were the windows conducive to maximising natural light, they were also fabricated in the old tradition, so that they still opened and closed; allowing employees to have further control over their environment. Daylight dimming sensors are used on the southern exposure to regulate the use of ancillary artificial light in proportion to the intensity of the incoming natural light.[63]

The Audubon's utility services, such as ducts, pipes, and wires, were placed at the core of the building making it possible to raise the ceiling, therefore maximising light penetration. The layout of the interior walls and corridors was advantageous in allowing the maximum natural light penetration into the interior workspace; add to this the clerestory lighting in perimeter offices and the need for harsh secondary lighting is eliminated. Instead soft background light is supplied to the entire office, while desklamps provide focused directable light. This background light is supplied by pendant ceiling fixtures, casting light in a 360 degree radius as well as reflecting 88 percent of the light.[64] T-8

Triphosphorflourescent lamps were also used to supplement background lighting.[65] These T-8 lamps provide a natural sort of light without providing heat.

The colours and furnishings of the building are not only cosmetic, but they also play a role in the efficiency of the building. The pale colours of the furnishings and interior surfaces further contribute significantly by reflecting the already plentiful daylight.

4.6.3 Heating and Cooling System

By increasing the efficiency of the thermal shell and employing compact forms, the heating and cooling system could be drastically downsized. Requirements before the renovation would have dictated that the building needed a unit of 350-ton capacity.[66] With the renovation and upgrade complete this requirement dropped significantly to a unit of 180-ton capacity with a certain amount of 'extra' capability.[67] By applying good practices of lighting design and a proficient upgrade of the thermal wall and windows the heating and cooling needs of the building were cut by 40 percent, in effect half of what would have originally been required.[68]

Most commercial buildings in New York are heated by direct steam furnished by Con Edison, the local utility. Characteristically heating systems are run on fuel oil, natural gas or electricity. Cooling systems are generally run off electricity, but gas and other fossil fuels may be used. The majority of commercial and residential buildings in the United States require separate heating and cooling systems. While both of these procedures may seem necessary using two separate units is not.

Because Audubon bought and fully renovated its premises it could fully evaluate their needs. The Audubon House utilises a gas-fired chiller-heater for its heating and cooling purposes: this single unit is situated on the top floor of the building.[69] Three other power options were considered; steam, a gas-screw compressor and solar energy.[70] While steam, provided by the utility company may be a good option in other regions, it was prohibitively expensive for use in the New York City area.[71] Another form of gas appliance, the gas-screw compressor, rated lower on the coefficient performance and therefore was ruled out.[72] Finally, solar energy was fully considered. However, while this is a completely auspicious energy source, it was also cost prohibitive, taking longer than five years to realise the cost. Nonetheless, the Audubon does employ passive solar energy tactics in the form of the night cooling and economiser systems. A survey was completed and in the event that this energy source becomes cost-effective, the Audubon will have the necessary tools in place to utilise it. The choice of machinery and natural gas have set the Audubon House apart from conventional buildings in New York.

There are quite a few advantages of having an on site, gas-fired chiller-heater system as opposed to other systems. One of the most evident and direct effects is the elimination of emissions of sulphur oxides and a drastic reduction of nitrogen oxides.[73] Because the system uses lithium bromide and water, rather than traditional cooling refrigerants, there are no emissions of chlorofluorocarbons.[74] Depending upon regional variations, generally this type of system, the on-site burning of natural gas, is more efficient than other energy sources. This energy source helps to eliminate the environmental problems associated with oil, coal, and nuclear energy and will save the Audubon $18,000 a year over an electrical system tied solely into the grid.[75]

Although gas may not appear to be the perfect solution to the problem at hand, the Audubon felt that this was the best and most realistic solution. It would have been senseless and unsatisfactory to delay the project while searching for the 'perfect' energy source. Instead the Audubon has demonstrated how through resourceful choices the community would be able to reduce greatly the impact of the built environment on the global environment.

The Audubon decided, after much investigation, to use an absorption chiller-heater system, rather than employing two pieces of equipment. The Audubon found that its needs could be met with one piece of equipment suited to their specific heating and cooling needs. The absorption chiller-heater can be powered with either oil or gas and the Audubon opted for gas.[76] The chiller-heater has a cooling capacity of 180 tons and a heating capacity of 1.7 million Btu per hour.[77] The cooling cycle utilises six steps. Cool water is circulated through air handler cooling coils, consequently cooling each floor. Air is cooled and dehumidified by fans circulating the air over the chilled water cooling coils before it is blown into the office and workspace. The heating system utilises only three steps. Water is heated and circulated through pipes located at the perimeter of the building.[78]

This HVAC system offers quite a few benefits enabling the Audubon to realise maximum results from the system. Separate controls regulate the flow of hot water to different areas allowing the employees greater climate control over their workspace. Cooling and ventilation are reliant on individual fan rooms, rather than a central air distribution unit. These individual fan rooms are on each floor, therefore, each floor has its own air handling unit, allowing customised control. Filtered air enters the building from the roof. It is important to note that this air is highly filtered and is taken in from the roof rather than the street level, thus avoiding traffic fumes and pollution. It is distributed directly to the air handling units where it mixes with re-circulated air and returned to the floor. During the winter months the filtered in-take air is heated. In addition, the filtered fresh air is newly circulated at a rate of 6.3 times per hour, more than three times the code-compliant minimum.[79]

The temperature is regulated by devices located in the air terminal vents. These variable air volume controls (VAV) regulate the volume of air passing through each vent in relation to space temperature. 'The amount of air can also be regulated by a fan using a static pressure sensor mounted in the ductwork and a variable frequency drive that electronically slows the fan motor, which reduces energy significantly, yet maintains comfort.'[80] Every VAV outlet controls its own office or workspace, therefore permitting better comfort and climate control. Overall comfort is monitored by temperature sensors. These readings are monitored by a central computer, further enabling more control of the absorption chiller-heater and possibly reducing energy demand.[81]

Two supplemental systems were built into the Audubon system. Firstly the night-cooling system enables the use of night-time air from outdoors to cool directly the building, consequently decreasing the need for the cooling system in the morning. Obviously this system would only be used during the nights when the weather was temperate. Secondly, the system can operate on an economiser cycle. This system applies a direct temperature exchange from the water in the cooling tower to water used for the cooling system. During these seasonal changes when temperatures are approximately 40°-50°F the economiser cycle completely eliminates the need for the absorption chiller to be used.[82]

By incorporating a central energy system the Audubon considerably improves the performance options available. The most energy efficient system for any particular given situation can be selected. Although there are more technologically advanced systems on the market, the Audubon has certainly chosen an efficient and cost-effective one. There is the added benefit of the individual climate/comfort control, but more importantly with the incorporation of the passive solar options the system is 'naturally-driven' rather than 'energy-driven'. Therefore the HVAC system automatically adjusts to internal and external temperature changes, which provides for prime working conditions while conserving energy.[83]

4.6.4 Combined Savings

Older buildings consume four watts of light per square foot while the Audubon consumes less than three-quarters of a watt per square foot.[84] The Audubon has installed occupancy sensors and daylight dimmers, which in fact drives the energy use figure down to between 0.6 and 0.7 watts per square foot, approximately 80 percent less than the energy used in code compliant buildings.[85] Mostly because of this decrease the Audubon's overall energy demand, during peak periods, is 68 percent less than code compliant buildings.[86]

The initial outlay cost for the new lighting system was approximately $92,000.[87] The direct benefits from the system are projected to be savings in the region of $60,000 a year.[88] Audubon also benefited from rebates totalling $31,000 offered by Con Edison, the local utility.[89]

While obviously the rebates benefit the Audubon House these rebates also benefit the utility. Installation of this demand management equipment serves to alleviate the cost of supplying more and more electricity. These energy saving devices help the utility companies to prevent further environmental destruction by preventing construction of more electricity sources. In the future it is anticipated that energy rebates will be directly linked to the energy efficiency of the equipment, i.e. how much energy the equipment actually uses, rather than an organisation simply installing 'energy saving' equipment.[90]

In order to understand fully what type of impact these measures can have on the environment Audubon House has correlated its statistics with statistics released by the US Environmental Protection Agency (EPA). Replacing a single conventional light switch with an occupancy sensor saves 950 kilowatt hours - preventing pollution equivalent to 1,500 pounds of carbon dioxide, 11 pounds of sulphur oxides, and 6 pounds of nitrogen oxides a year.[91] Estimates by the NRDC suggest that if energy saving techniques of similar designs were implemented by American companies, the United States would save 40,000 megawatts of baseload capacity thereby preventing 175 million tons of carbon dioxide from being released, eliminating 85 percent of the operating nuclear power plants and saving the economy $60 to $80 billion over the next twenty years.[92]

Another major factor in the success of this building is the amount of natural light that has been incorporated into the everyday workspace. By relying heavily on natural light and using artificial light sparingly, employees are anticipated to complain less about eyestrain, headaches and fatigue, all symptoms of sick building syndrome. This seemingly insignificant change is thought to have a significant impact on employee productivity. The considerable decrease in artificial light will also significantly decrease the load demand placed on the cooling system during the summer months.

Finally, the absorption chiller-heater cost the new headquarters $102,000 more than the most technologically advanced electric cooling system available, even after rebates of $72,000 given by Con Edison for energy conservation.[93] As well as the $18,000 a year saved owing to energy conservation, the Audubon saved $15,000 owing to conservation of space.[94] The overall capacity and features of the HVAC system saved the Audubon another $10,000.[95] Keeping these savings in mind the payback for the absorption chiller-heater was three to five years.

4.7 SUMMARY

As discussed earlier there has been some headway made in the last few years regarding the integration of the built environment with green architecture. However, there is nothing documenting the integration of building conservation and green architecture in housing. Presently, there are documented examples of building conservation and green architecture working in conjunction in commercial buildings. To date the best documented, comprehensive example is the National Audubon Society Headquarters, the Audubon House in New York City, New York.

By achieving completion at a competitive market rate and by incorporating the energy saving features, the Audubon House has been successful in cutting operating costs by as much as $100,000 a year, a reduction of 64% in energy costs, compared to similar code-compliant buildings.[96] The lifetime of the Audubon building has been extended by probably another one hundred years. By pursuing energy and resource conservation in conjunction with recycling strategies, the Audubon has ensured that during the course of the next century it will have less of an impact on the environment.

In a recent followup conversation with Ken Hamilton, director of facilities and services for the National Audubon Society, he commented that since the building's completion, there has been interest from all over the world. Primarily these have been architects or students of architecture interested in the green aspect of the building. However, as far as he knew no one had yet improved upon the initial goals of the Audubon building. Currently in New York City there is a project located at 4 Times Square, which seems to be following the same premise as the Audubon Building. Mr. Hamilton felt that interest in the project had waned during the last three years probably because this was no longer the new phenomenon.

Overall the NAS is pleased with their headquarters now that they have had time to settle into the property. Approximately 85% of the staff wish that there were more enclosed offices. This is attributed to a traditional attitude that pervades East Coast corporate culture.

As for the preservation aspect there had not been any interest shown by local groups although they had been invited to tour the premises. However, the community corridor of which the Audubon is a part has just been designated as a local preservation district. Interestingly enough the preservationists pushing for the designation used the Audubon House as an example of fine local architecture. Had the National Audubon Society been required to seek preservation approval they never would have been able to apply even a fraction of the technology used.

Since the completion of this project eleven years ago the neighbourhood has enjoyed an increase in foot traffic which is comparable to that of Bloomingdale's, 6,200 people per hour at the corner of Broadway and East Fourth Street. (Figure 4.2) Consequently the success of the rental spaces has far exceeded the Audubon's expectations.

In the last eleven years the value of the building has appreciated from $24 million to approximately $35 million. While this project can be considered a victory for the NAS it is not the focus of their mission. In the last five years the NAS has undergone executive changes. The new directors have felt that it is important to redirect the Society's energies to grassroots operation for the survival of endangered species. So while they were able to live their mission with the creation of their new headquarters they have not made their brand of sustainable development a continuing part of their mission. Perhaps this too is a reason for the waning interest.

The vast majority of building owners proceed with one premise in mind; to cut costs and save money without cutting too many corners. This project challenges future architects designers, and developers to find creative, ecologically sound and economically feasible solutions to their problems. By rehabilitating the Schermerhorn building the National Audubon Society's new headquarters serves as a model for the energy-efficient, environmentally responsible workplace. Achieved with off-the-shelf technology the Audubon project proves that this type of environmentally conscious design is attainable, sensible and can be affordable.

Sustainability can be achieved through a profound understanding of the built environment in correlation with the natural environment. Focus should be directed to diverting money from new ostentatious, inefficient commercial and residential buildings to retrofitting and reviving the ageing building stock that make up the dynamic fabric of the built environment. Although the Audubon project is part of the commercial sector, in terms of energy use and resource conservation, many of the same principles and practices can be implemented in the residential sector, therefore reducing the huge ecological impact the industrialised world has certainly made on the environment.

NOTES

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Chapter Five
Belmont House, St. John, Barbados, West Indies

5.1 INTRODUCTION

Belmont House demonstrates that traditional buildings utilise efficient and earth friendly techniques as a part of its traditional design. With the introduction of modern efficiency technologies these projects can become even more efficient. Here we have a building, which may be considered limited, in terms of design and materials. However, it does perform rather successfully in terms of its basic layout in a passive relationship to the environment. We can expect that this building with its limitations – small island environment with limits on accessibility, materials, products, climate and wealth - can succeed. It is perfectly reasonable to expect that building projects in industrial countries, which do not have these limitations, should have every opportunity to be successful when certain strategies are applied to their restoration.

Belmont House was chosen as an example because not only is it a superb example of Dutch Colonial architecture, but it is also credited with providing most of the inspiration for other structures being built in Barbados at the time, c.1806. Belmont House is credited with the introduction of a particular architectural device known locally as the Barbadian parapet. This home is also a fine example of coral stone construction a method of construction found in only a few countries. Overall the construction and condition of Belmont House are conducive to the integration of green architecture methods.

5.1.1 Geography and Geology

Barbados sits at the most easterly point in the Windward chain of islands connecting Florida with South America. (Figure 5.1) Barbados is roughly pear-shaped, 21 miles (34km) long by 14 miles (23 km) wide, with a total area of 166 square miles.[1] (Figure 5.2) The island is relatively flat with the

Figure 5.1 Map of the Caribbean.

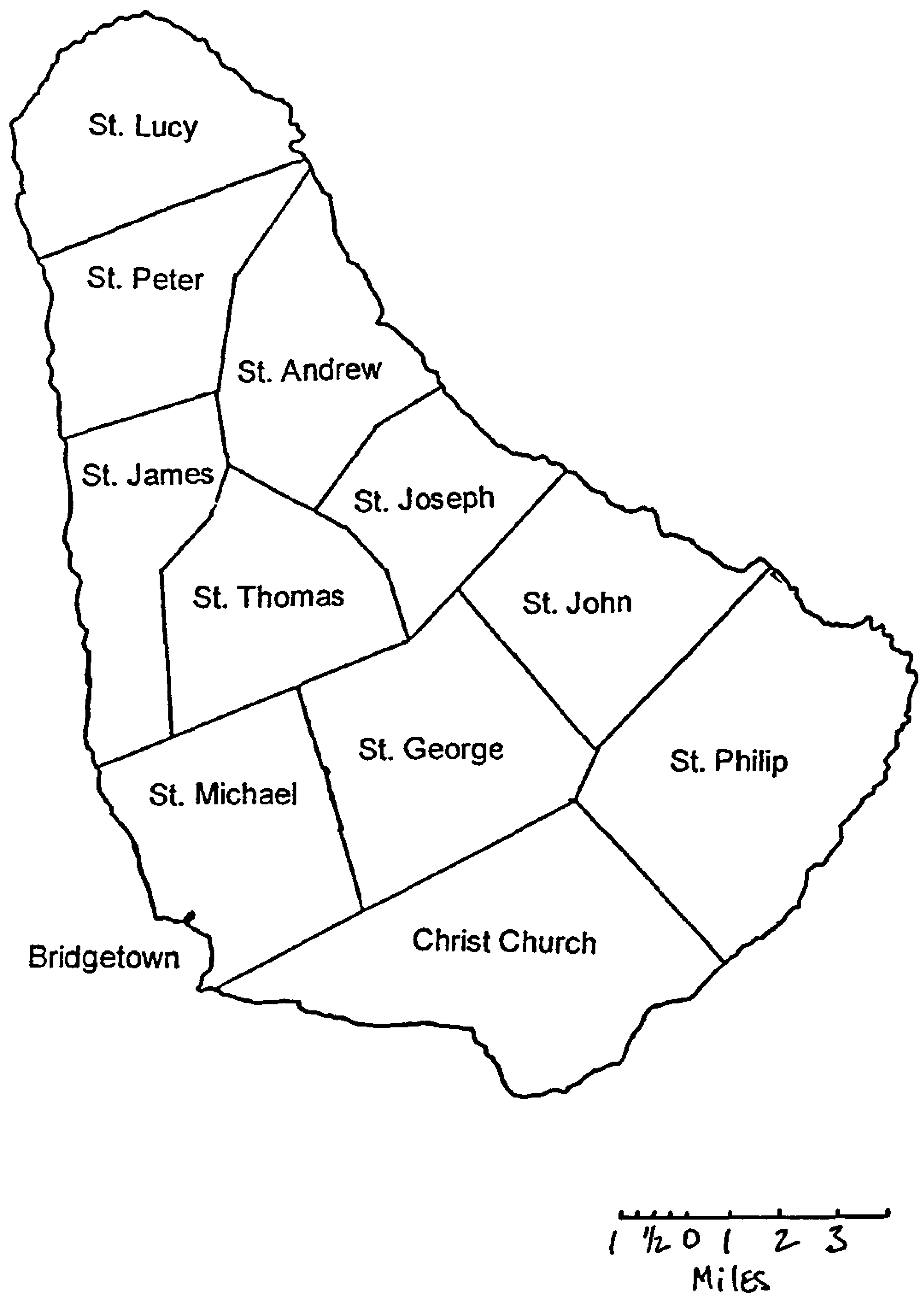

Figure 5.2 Map of Barbados.

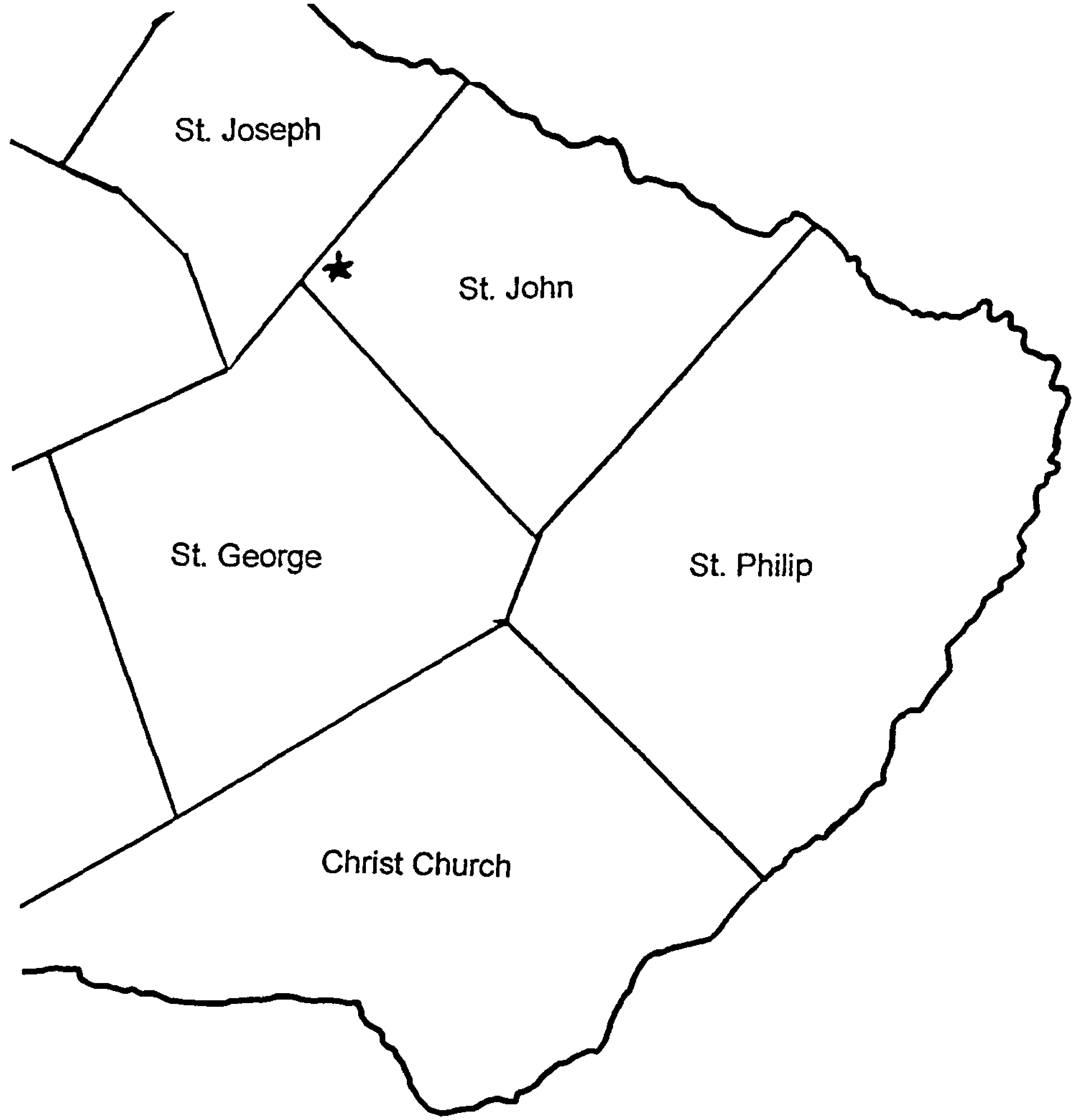

Figure 5.3 Map showing location of Belmont House in St. John.

highest point being approximately 1,100 feet (335,280m) above sea level.[2] Barbados is a coral limestone island. However the coral is a cap underneath which is thought to be geology similar to that of Trinidad and Tobago. The Scotland District, an eastern region of the island, is the only part of the island not covered by the coral cap. It is in this part of the island that oil prospecting began almost 100 years ago.[3]

5.2 A BRIEF ARCHITECTURAL HISTORY OF BARBADOS

The fact that the island is mainly made of coral and the accessibility of the sea cliffs made quarrying relatively easy and cheap, so that in most instances coral stone was used for building. This is in contrast to the neighbouring volcanic and forested Windward Islands, which rely heavily on wood for building.

The earliest houses were simple structures made of wood. The wealth of the first sugar plantations enabled planters to build in the style of medieval English homes. However, lessons were quickly learned about the affects of living in a tropical climate; wide verandas, jalousied windows, Demerara windows (borrowed from Guyana), high ventilated gables, and tray ceilings were introduced.[4] Because Barbados is located in the hurricane belt of the Caribbean, designs had to bow to Mother Nature. In this case it meant squat, horizontal buildings with coral stone parapet roofs to protect gabled roofs from high winds.

5.2.1 Seventeenth Century Houses

The earliest indication of the styles of Barbadian houses is depicted in a copper plate, "A Prospect of Bridgeton in Barbados", created by Samuel Copen in 1695.[5] The plate, a panoramic view of Bridgetown, depicts tall, narrow, gabled houses, many with Dutch stepped gables. Most of these houses have long since disappeared as a result of the natural disasters befalling the island. However, the Nicholls building, in Bridgetown, still stands as a testament to the early architectural designs of the island.

St. Nicholas Abbey and Drax Hall, both of which still stand today, are monuments to the style enjoyed by the planter aristocrats of the seventeenth century. The style of both mansions is described as Jacobean, which is not surprising since the planter class of Barbados was closely related to the landed gentry of England. These buildings belong to the period of Barbadian history when sugar was established as the staple crop of the island. While Barbados could not compete with the tobacco crops of Virginia, the island was to gain great affluence from the sugar it produced.

Father Père Labat, a French priest, was the first to publish a commentary on the finery he observed when visiting the island in 1700. According to Labat, "the plantations... are far smaller than those in the French islands.... the houses on the plantations are even better built than those in the towns. They are large in size, have numerous glass windows, and have fine rooms that are conveniently arranged. Nearly all the houses have avenues of tamarind, or shaddocks, or other trees which make the temperature cool and the houses *toutes riantes*. One observes the wealth and good taste of the inhabitants in their furniture, which is very fine, and their silver, of which they have so large a quantity that were this island to be sacked for the silver alone it would be worth the value of several galleons."[6]

The English and French set out to establish colonies in the Eastern Caribbean, while the Dutch "continued to aim at the virtual monopoly of the maritime trade of the world."[7] When the new colonies became prosperous it became increasingly evident that it was in large part because of the trading and financial conditions shared with the Dutch.

It is important to establish the link between a young Barbados and the generosity and influence of the Dutch colonies. Initially, the Dutch provided Barbados with agricultural expertise along with military and commercial support; later it was the British who greatly influenced island life.

By establishing the close relationship the colonies enjoyed, it should become obvious that through this direct assistance there was an indirect influence on other aspects of Barbadian life, such as architecture. Even though it may be possible to identify certain elements of Dutch influence, it should be noted that Barbados has always remained faithful to more than 300 years of British heritage.

5.2.2 Caribbean Georgian

According to Pamela Gosner, author of *Caribbean Georgian: The Great and Small Houses of the West Indies*, "Georgian architecture is central to Caribbean architecture and Barbados is no exception."[8] After the hurricane of 1780 hardly any significant early houses were left standing and the island would have almost entirely adopted the Georgian style. It was at this time that the British Garrison was built and in the next fifty years a major building programme was carried out. These buildings included Queen's Park House, the barracks and residences of the Garrison, the Eye Hospital, the Light and Power Building, the Hospital at Hastings (now Pavilion Court), the Pavilion, and many others.[9] According to Fraser and Hughes, "The Georgian / Palladian lines of these buildings with their magnificent arcades and pediments and grand Palladian staircases must have had a profound influence on domestic architecture in Barbados."[10]

5.2.3 Barbadian Vernacular

Rather than being fully adapted in its own right the Victorian style was incorporated into existing domestic architecture. Most notably Victorian details were incorporated into the design of Chattel houses, possibly the most distinctive of Barbadian styles. (Figure 5.4) Originally slaves would have lived in huts made of wattle and daub. These houses progressed into permanent stone structures and were more practical and became more of the norm after Emancipation. After

Figure 5.4 Barbados Chattel Houses.[i]

[i] Mendes, Stephen, 1998.

Emancipation they were the houses of the cane workers, who lived on the plantations, but owned or rented their homes. Later the houses were made up of on to four wooden unites supported by coral stone blocks. This design made them easy to move from place to place.

5.3 BELMONT HOUSE, ST. JOHN, BARBADOS, WEST INDIES

Belmont House is not necessarily the oldest building in Barbados, but it does represent a fine example of existing architecture and the possibilities which a retrofit might represent. It is believed that Belmont house has had a particular influence in other parts of the island, most notably in the Cheapside community. The design of Belmont house represents the traditions of local colonial architecture, which are indicative of buildings of this period. It is also credited with the inspiration of the Barbadian parapet, as seen in the gable end of the house. Furthermore, the house is a fine example of coral stone construction, which is a particular feature of historic Barbadian architecture.

Clearly there is evidence of a rich colonial legacy left in Barbados. It is most unfortunate that there are dwindling examples of the remaining architectural heritage. Simply put these buildings disappear due to lack of money, or as in a recent case too much money. In most cases extensive repairs are required and adequate funds are not available.

There is a system in place in the island for the preservation of monumental architecture. However, it is not as likely that private residences are subject to the similar rigorous preservation process. The Barbados National Trust oversees many of these nationally significant projects. It is thought that implementing guidelines for projects of lesser significance, Belmont house would fall into this category, would provide this island nation with a way to preserve more of its architectural heritage. It would be prudent for Barbados to adopt the precepts of the Burra Charter (*Appendix D*) as a comprehensive plan for preservation. The Burra Charter lays out a concise and clear vision for effective and proper preservation. It encourages care and maintenance of the existing building fabric but does not discourage alterations to the original structure. (Article 15) For any additions or alterations that would be made the Burra Charter determines that this can be appropriate as long as the cultural significance of the property is carefully maintained. (Article 8) It would help guide the community to preserve their built environment in a way that is universally recognized. Currently this island nation has faced an explosion in growth. By adopting the framework of the Burra Charter they elevate the status and notion of their architectural heritage.

5.3.1 Historical Survey

Belmont House provides somewhat of a dilemma in determining its particular style. First it is not exactly clear when it was built. It would seem appropriate to attribute Belmont House to Francis Bell, Belmont House's first known owner. However, it should be noted that this is solely through name association: Bellemount / Bellmont / or Belmont House, as it is know today. If this is so Belmont House could have been built anytime before 1808, the year Bell died. Belmont House originally stood on ten acres of land, which were used to farm sugar cane and aloe.

At his death in 1808 Francis Bell left Belmont House to his children.[11] His daughter, Sarah Bell, was married to Edmund Haynes who by 1816 was the owner of record.[12] Haynes was the founder of the Moravian Church at Mt. Tabor and the builder of Villa Nova, which sits to the East of Belmont House and has undergone a transformation into a luxury hotel. In 1827 Haynes sold Belmont House to Francis Cheeseman for £1,000.[13] Cheeseman died in 1833, leaving Belmont House to his wife and children and in 1839 they sold Belmont House to Dr. John Eastmond Todd for £2,400.[14]

Dr. Todd owned Belmont House until his death in 1867.[15] He too left the property to his family. By the end of the nineteenth century Dr. Henry Greaves owned Belmont House. Greaves' widow left Belmont House to her husband's family, who subsequently sold it to the Dowding family. In turn it was sold to a Mrs. Julian of Trinidad. Philip Goddard purchased Belmont House in 1971 from Mrs. Julian and is the current owner.[16]

Belmont House has a number of outstanding features. The most striking feature of the house is the gable end of the house with the red elliptical window. (Figure 5.5) There are also strong Palladian influences demonstrated by the symmetrical central staircase and verandas along the gable end of the house. (Figure 5.6)

The south approach is by way of a steep drive, which reaches a hairpin turn on an intermediary landing. (Figure 5.7) A massive coral stone double staircase, which appears as though it is cut directly into the cliff-side, ascends to the next level, connecting the drive to the front garden of the house. Under the stairway is a storm shelter with a barrel vaulted chamber and ventilation shafts.

The north approach is through a grove of palms and manicured lawns, very different to the rugged southern approach. (Figure 5.9) Most of the farming land has since been sold, but the grounds still contain sizeable gardens and an orchard. Part of this complex includes the pits, used to boil aloe, which are currently used as a fernery and for compost. Once past the orchards to the east of the house the grounds open up to a swimming pool and carport. The kitchen may be entered at this point. (Figure 5.10) Once past the carport, the fernery and compost pit are to the east and then the descent begins down the steep southern drive. (Figures 5.11, 5.12)

The interior of the house is distinctly separated into living and service spaces, although the spaces are not necessarily used in these ways. The distinction has been made because the southern part of the house has three exceptional reception rooms with wood parquet floors and panelling, separated by matching arches giving an impression of grandeur. (Figure 5.13) A later twentieth century addition, an circular flying staircase, complements the elegance of the three reception rooms and serves as a focal point in the first floor layout of the house. (Figure 5.14) Just off the main

Figure 5.5 Southern view of Belmont house, showing the red elliptical window.

Figure 5.6 Southeastern view of Belmont House.

Figure 5.7 Panoramic southern view of Belmont House, showing walls and shape of driveway.

Figure 5.8 Cane fields to the south of Belmont House.

Figure 5.9 Driveway access from the northern end of the house.

Figure 5.10 Northeastern orientation showing the pool and kitchen entry.

Figure 5.11 Driveway facing south with the house on the left.

Figure 5.12 Fernery and compost pit.

Figure 5.13 View of the 'great room', shows the anteroom through the matching arches.

Figure 5.14 View of the 'great room', shows the elliptical flying staircase, wood parquet floors and door to the service area.

reception room, is a formal dining room to the east and anteroom to the west. (Figures 5.15, 5.16) Linking the formal dining room and the kitchen is what could be described as a butler's pantry. It is used as an informal dining room. (Figure 5.17)

To the south of the reception rooms is a sunroom, which catches the breeze, as do the verandas stretching along the southern façade. (Figures 5.18, 5.19) The floor in this area is tiled which also helps to keep the room cool. The sun room can be entered from a number of directions, north, south, east or, west. This is the most delightful part of the house, providing an enjoyable well-ventilated space.

At the rear of the house are the kitchen, informal eating area, office, bathroom, and a pantry which houses the refrigerator and freezer. (Figures 5.20 – 5.22) This portion of the houses serves as the most used entry point to the house, being the most convenient to the carport.

The elliptical staircase provides the only access to the second floor, which houses the master bedroom, two guest bedrooms, and three bathrooms. The rooms are entered off of a large central corridor. (Figures 5.23 – 5.26)

5.3.2 Material Survey

Fabrication of Belmont House varies from rubble construction and masonry assembled in coral stone blocks in the oldest parts of the house, to more modern construction which has been completed in concrete breezeblocks. (Figures 5.27, 5.28) The structure appears to be sound. The only cause for concern would be the algae and moss growth. (Figures 5.29 - 5.31) This is discussed in section 5.4.4, *Moisture*. If there were to be any significant structural problems requiring extensive reconstruction it is recommended that renewable indigenous building materials be used to the greatest extent possible. In this instance it would be coral stone. However, the quarry is closed and obtaining substantial amounts of coral stone may be cost prohibitive. There are two alternatives with

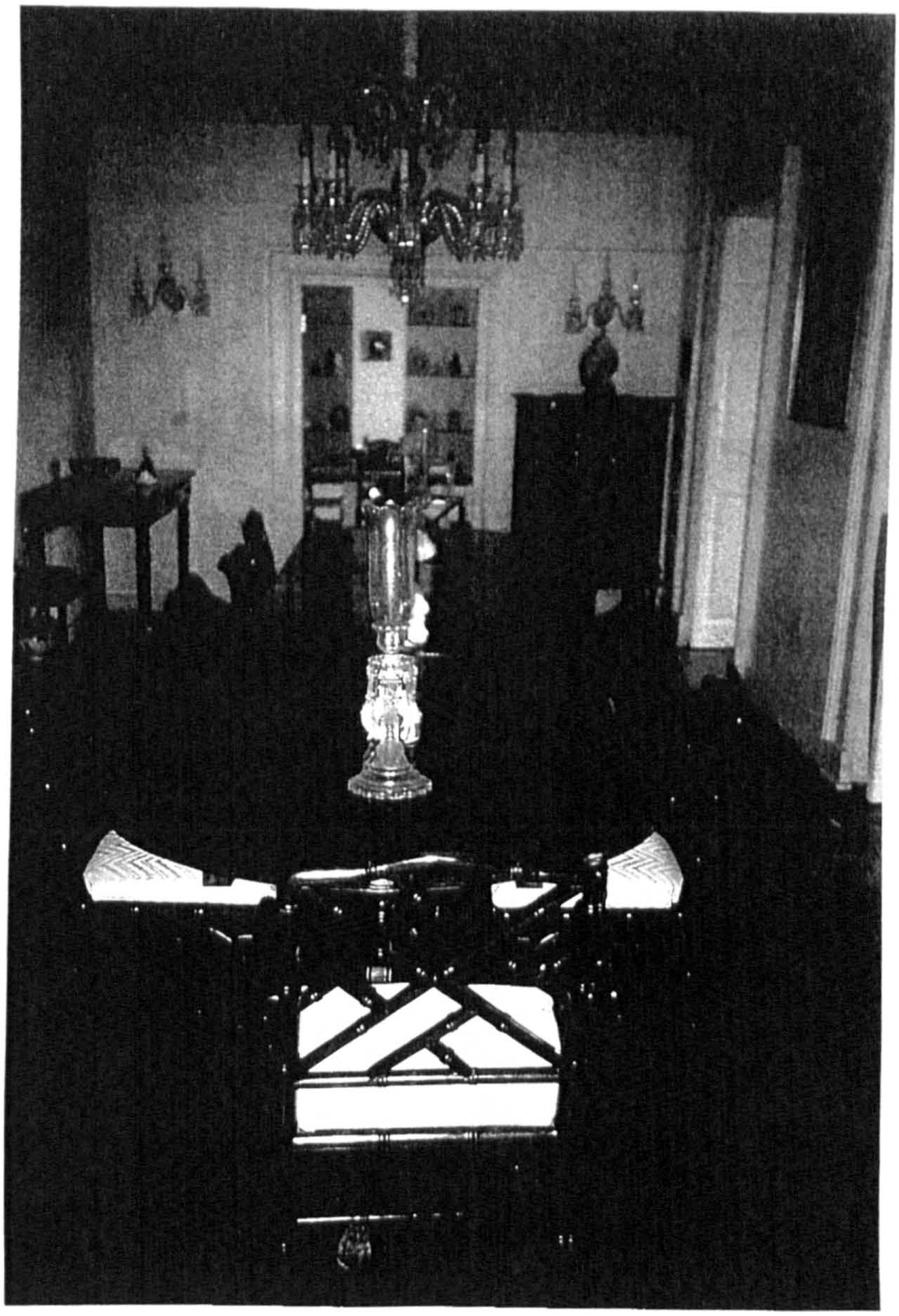

Figure 5.15 View of the formal dining room with a view of the butler's pantry through the door.

Figure 5.16 View of the anteroom with view of 'great room' through the arch.

Figure 5.17 Butler's pantry with steps to the kitchen to the left.

Figure 5.18 Southwestern view of the sunroom showing louvered windows and a tiled floor.

Figure 5.19 View of the southern façade detailing the veranda.

Figure 5.20 View of the kitchen facing the pool.

Figure 5.21 Through access to the office. Informal eating area is further ahead to the right and the pantry is to the left.

Figure 5.22 View of the office which is at the north end of the building.

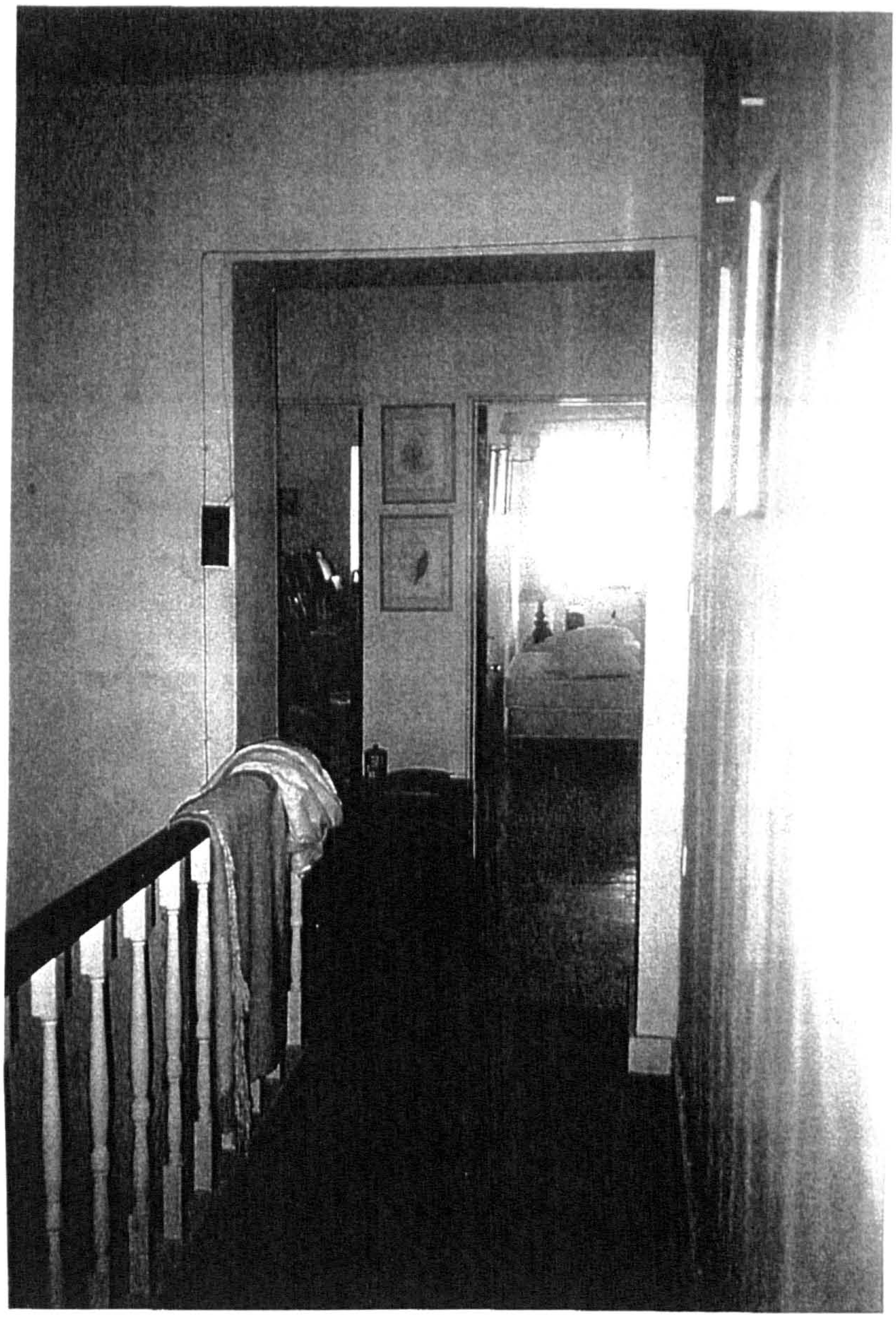

Figure 5.23 Second floor. Main corridor showing access to the two guest bedrooms.

Figure 5.24 Master bedroom.

Figure 5.25 Master bedroom.

Figure 5.26 View of the master bathroom from the master bedroom.

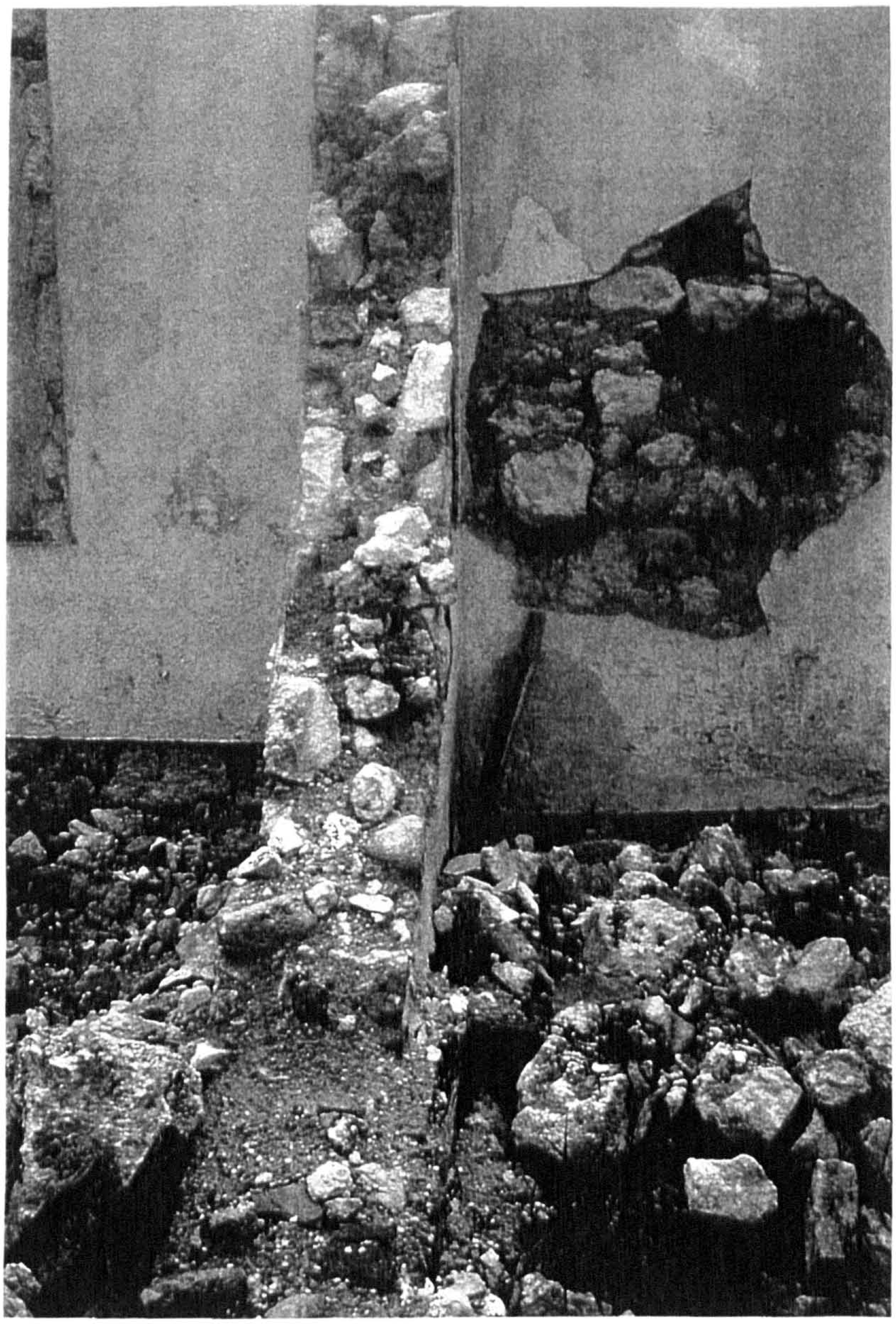

Figure 5.27 Wall constructed using the rubble construction method.

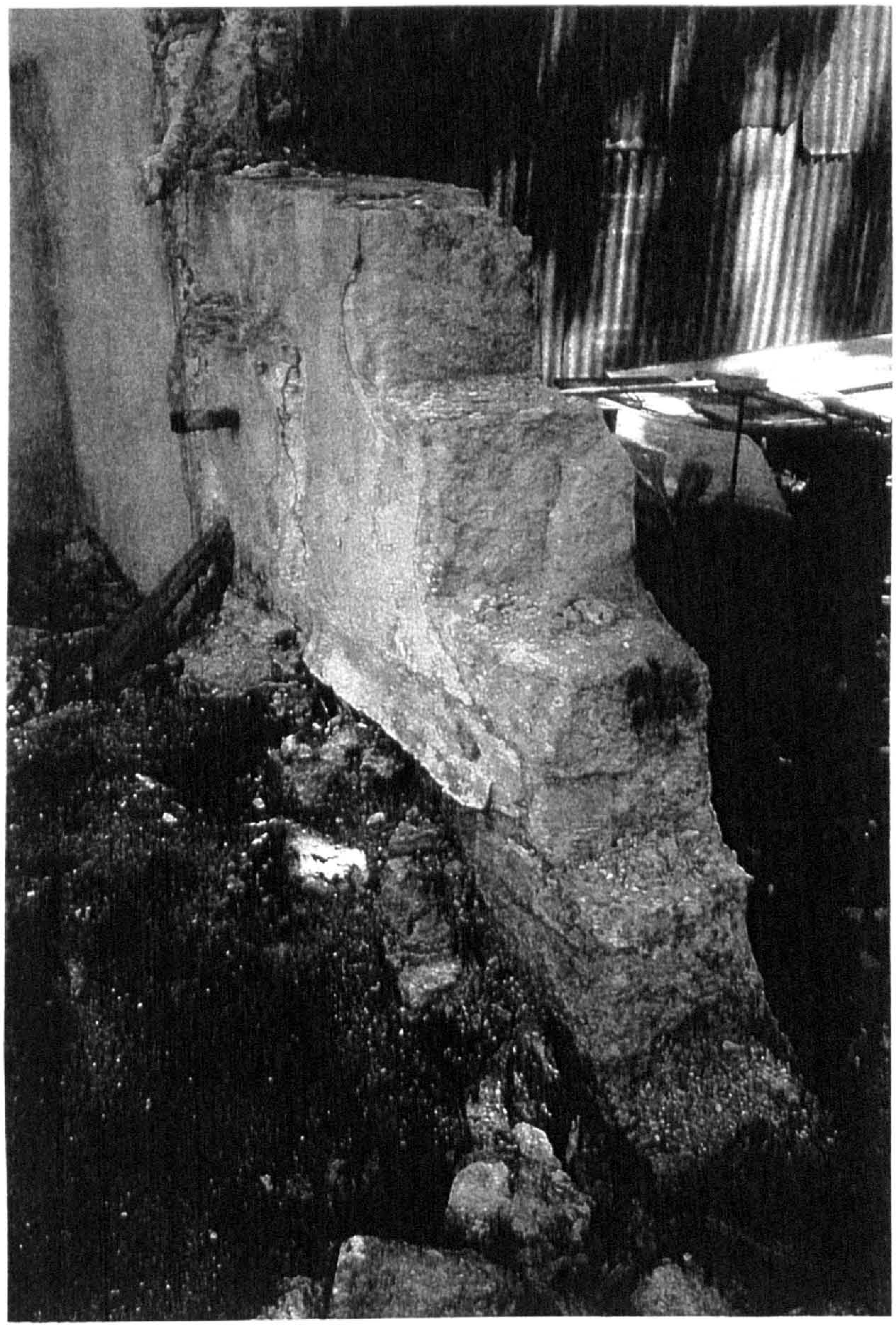

Figure 5.28 Wall constructed using coral stone for the masonry.

Figure 5.29 Shows damaged exterior masonry.

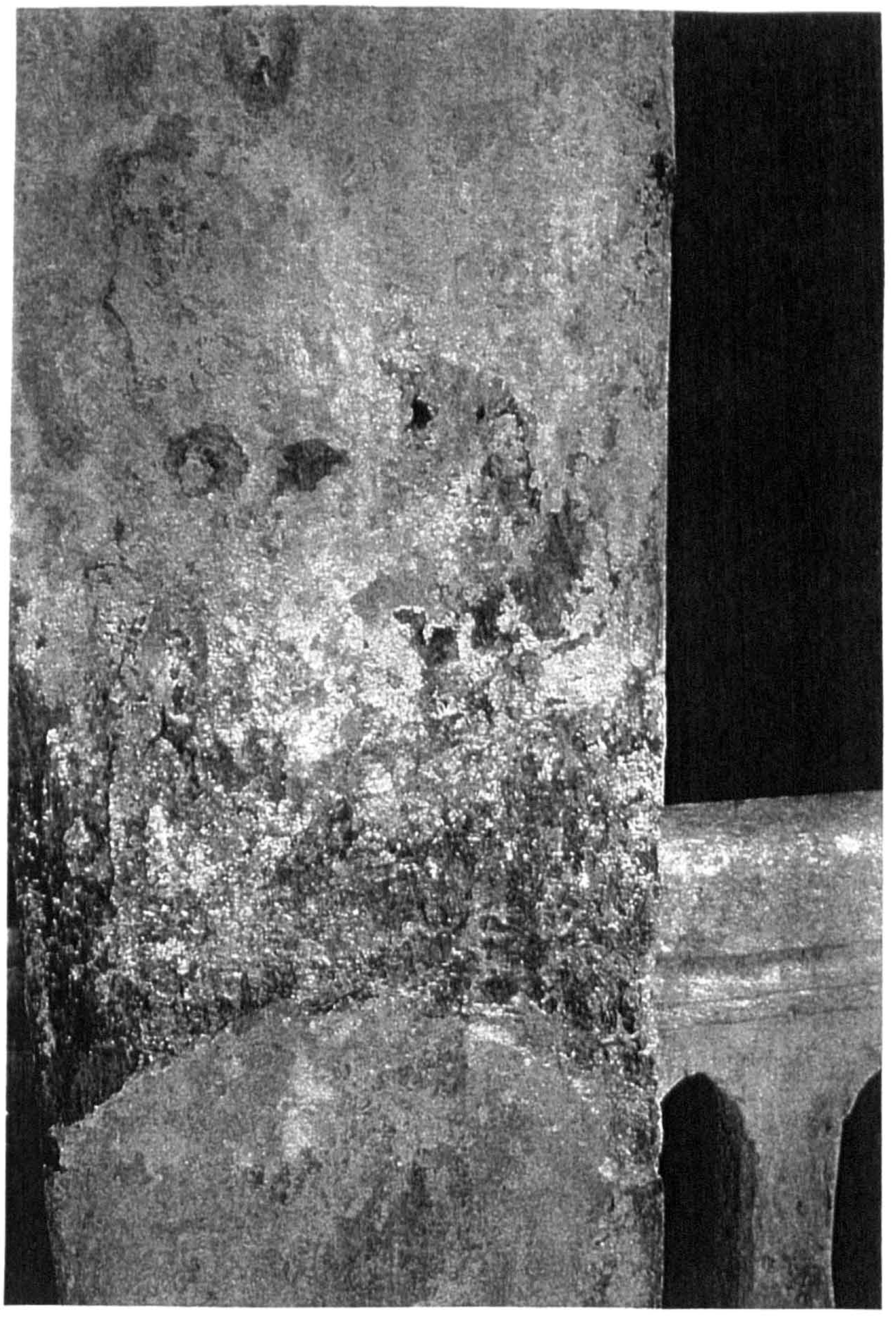

Figure 5.30 Close-up of the damage.

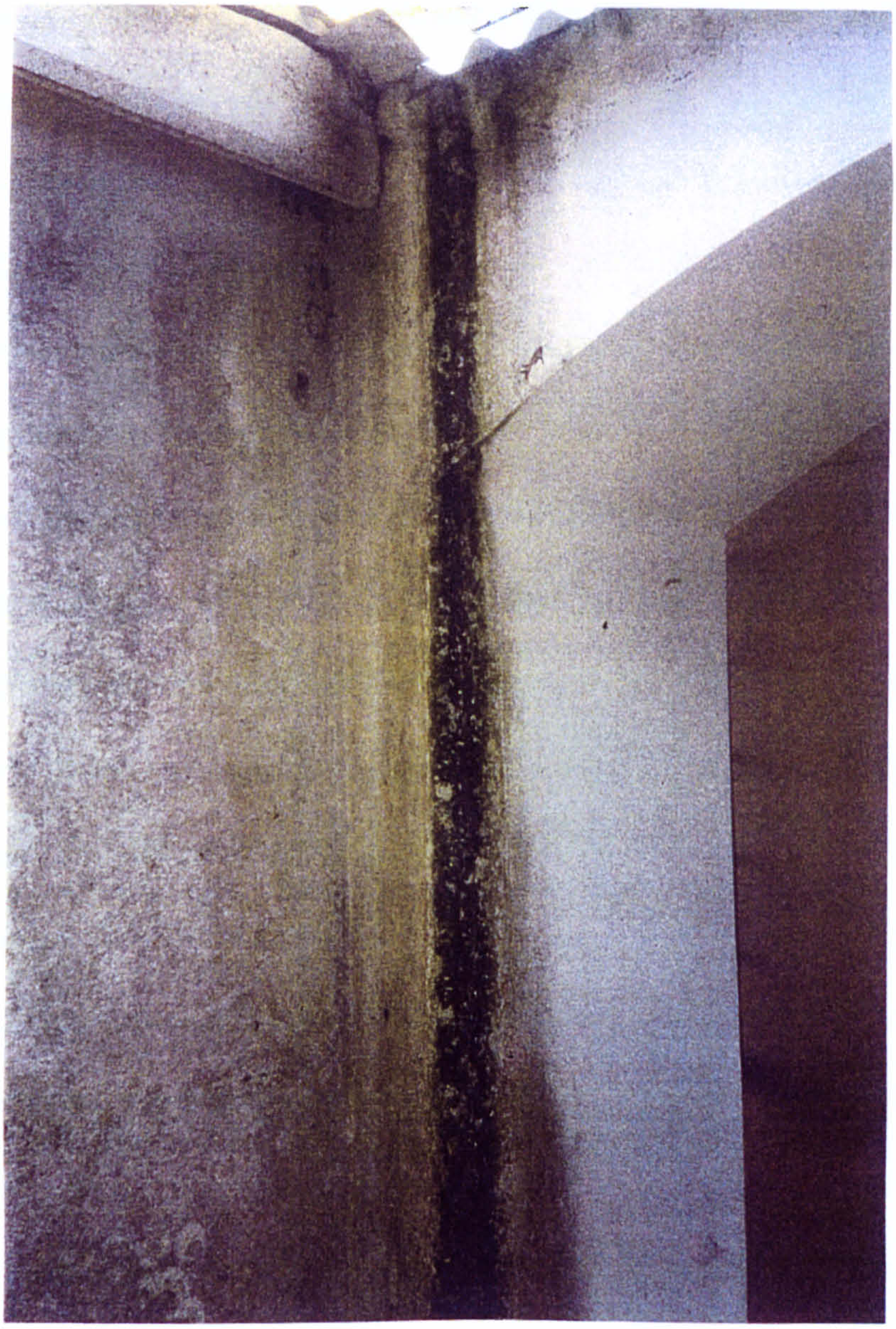

Figure 5.31 Drainage problems highlighted by the moss growth.

the most environmentally significant being to salvage coral stone from a demolition site. If this is not a viable option concrete blocks could be used and a skim coat of plaster could be applied to disguise the replacement material.

5.4 BUILT ENVIRONMENT: DESIGN AND THE ENVIRONMENT

It is necessary not to separate human needs from the environment. The key is not to facilitate an over-dependence on mechanical controls, thereby manipulating the natural environment artificially. This over-dependence can be avoided by incorporating environmentally appropriate design, which prevents dislocation from the local environment. Generally this is not a problem in traditionally designed homes, but if a building is converted advantageous design may be a problem. As has been mentioned the first sugar planters learned some valuable lessons concerning their native style of architecture and the effects of living in the tropics. While certain architectural styles and elements could be maintained, the traditional British layout needed to be altered to suit the tropical climate. This transition helped the early settlers to enhance their relationship with the environment thereby allowing them to reap the benefits of living in accord with the local environment.

By manipulating any one of the primary climatic controls, temperature, sun, wind, or moisture, it becomes possible to maximise comfort levels when the climate proves to be uncomfortable. This study will focus on climate controls which are significant to hot, humid tropical climates. It will not address cold climates, for example air-conditioning versus heating. Elements will be examined for their significant impacts in terms of structure and comfort levels.

5.4.1 Temperature

A) Comfort

Temperature control can significantly impact comfort levels in hot climates. Temperature is the most significant liability in climates that become too hot. When this happens there are a number of strategies, which can be implemented.

Overall the floor plan of Belmont House is relatively open. In these terms the space on the first floor of the living quarters flows one room into the other. The great room is successful in reducing solid enclosure and internal thermal mass thereby preventing the build-up of internal temperatures. In the service area of the house this is not so much the case. While the kitchen itself is open plan, the rest of this area has more solid enclosure, preventing circulation and ventilation. This could be perceived as an advantage as the solid enclosure prevents heat and moisture from cooking to be released into the rest of the house. Both the kitchen and the laundry facilities have been separated from the living and sleeping quarters of the house, preventing heat and moisture gain in these areas. The laundry facilities are in a completely separate building.

The overall layout of the structure is elongated, north to south, and somewhat segmented thereby minimising internal heat gains and maximising ventilation. An increase in both temperature and moisture could lead to increased discomfort levels unnaturally influenced by mechanical uses, cooking and washing. There are breezeways and porches along the southern and western perimeter which maximise wall shading and ventilation and as a result reduce the build-up of thermal gain. These areas provide shaded outdoor living areas, further capitalising on air flow and maximising living space.

5.4.2 Sun

A) Comfort

The sun can also be a liability in hot climates. Building design must relate to seasonal variations in the intensity of the sun and storms. Ideally these issues should be addressed in all buildings. In order to alleviate solar gain, which can effect comfort levels, Belmont House incorporates some traditional techniques for alleviating the intensity of the sun.

The porches and porticoes along the southern and western exposure prevent a considerable amount of sunlight from penetrating into the enclosed living areas on the ground floor. Shading devices such as louvers and covered porches prevent exposure to the direct sun, while allowing breezes and natural light to penetrate. The site features vegetation along the eastern, southern, and western façades again diminishing the intensity of the sun and providing much needed shade to the walls and porches along these exposures. A covered porch and vegetation protect the south-western orientation of the house. The carport provides some overlap relief with the covered porch. Overall the western facade does take a brutal beating from the afternoon sun. Therefore while the orientation of the building is elongated along a north / south axis maximising airflow, the western façade has little relief from the mid-afternoon sun. This is most noticeably felt in the kitchen area.

The roofing material is corrugated tin, which has been painted verdigris green. The walls have been painted white, similar to the natural colour of coral stone. There have been problems with moisture, which has effected the colour of the building. While the house itself is a striking feature sitting on top of Wilson Hill, it is not conspicuous because the roof and wall colours blend well into the surrounding vegetation. Along the southern façade there is quite a bit of mature vegetation softening the lines of the house which can be seen from other locations in the valley. From the north the house is protected by walls and manicured gardens which disguise the house altogether.

It is possible that if the roof was to be painted a light colour approximately 55% of the energy beating down on it could be reflected.[17] This technique was used on the Missionary Guest House in Dar-es-Salaam, which has a corrugated tin roof and is also located in a tropical zone.[18] This approach may be too drastic and it may be that the change may not be aesthetically appropriate.

5.4.3 Wind

A) Comfort

In hot, humid tropical climates wind can be an asset. The traditional layout of Belmont House uses natural ventilation to its advantage wherever possible. There is good ventilation in the living areas of the house, but ventilation seems to be limited in the service quarters. In most instances, the layout maximises and minimises exposure to wind through plan orientation and configuration, number and position of wall openings, types of doors and windows, and the relationship to the grade and vegetation. Belmont House does not employ techniques such as wind scoops, thermal chimneys, or wind turbines. There is sufficient solid enclosure with limited and controlled ventilation. For example, there are louvered windows in the kitchen, otherwise cooking with gas would be almost impossible.

5.4.4 Moisture

A) Comfort

In tropical climates moisture can be both a liability and an asset. In terms of comfort, humidity in the Caribbean is always an issue. Excessive moisture can cause stickiness which will prevent perspiration. In order to reduce the effects of humidity it is suggested that ventilation be maximised thereby encouraging airflow. Ways in which Belmont House addresses ventilation have already been discussed.

In terms of comfort the best way to cope with humidity is to encourage natural ventilation, which we have seen Belmont House does quite efficiently. When natural ventilation is not suitable or does not meet comfort levels the suggested solution is to provide auxiliary circulation with ceiling and window fans. It should be noted that air-conditioning should be saved for special areas requiring special humidity or temperature control, otherwise there may be an increased demand and reliance on extreme mechanical controls. If excess moisture is a problem in an enclosed space perhaps a dehumidifier used in conjunction with ceiling or window fans would provide a good first alternative to air-conditioning.

B) Structure

Belmont House requires specific attention addressing the destructive effects excessive moisture has caused. Coral stone is very porous, which can in some cases such as thermal capacity, be an asset, although in terms of moisture it is a liability. The coral stone wicks moisture up through the foundation from the ground and through the walls during rainfall. This liability presents the problem of algae, moss, and fungus growing in and on the surfaces of both exterior and interior walls. This problem can be alleviated and possibly solved by painting the walls, both interior and exterior with a liquid silicate paint, as well as by installing gutters and down spouts.

5.5 SOLUTIONS

Perhaps the most significant factor concerning the preservation of Belmont House is the preservation of the structure itself. Once it is determined that the structure has been made sound then it would be wise to further carry out the preservation process and include efficient techniques in the process.

Nothing can be done to make the structure thermally efficient. Heating is obviously unnecessary and air-conditioning is currently not used. Ventilation is sufficient and is augmented with the use of window fans. Ceiling fans may be able to provide additional airflow, although installation would not be easy and could be unsightly.

The structure needs to be cleaned and made sound. Once this is done then the focus can be placed on making energy consumption efficient. The study will also address water consumption and conservation, as this is a serious issue in the Caribbean.

5.5.1 Exterior Masonry

There is a growing and renewed interest in non-toxic, low VOC paints and finishes. Through careful consideration it is thought that a product manufactured by *KEIM*™ paint is the most appropriate. It is estimated that perhaps the greatest initial expense incurred would be in the process of cleaning and painting the masonry. However if this expense is calculated against the durability time frame it is hoped that the owner would recognise the initial expense as valuable to the longevity of the building structure.

A) Keim Silicate Paint

The oldest manufacturer of liquid silicate paints is *KEIM* Mineral Systems. This product was commissioned in 1878 by King Ludwig I of Bavaria and used to paint fresco-like murals. The product has proven to be so successful that not only is it still manufactured, but also structures painted with this product in the nineteenth century are still a testament to the product's quality and durability.

According to the manufacturer, *KEIM* Mineral Systems, "Natural ingredients are the fundamentals of the unique quality of *KEIM*™ mineral paints: the binder, liquid potassium silicate whose structural form and hardness is akin to naturally occurring crystals, mineral fillers and inorganic colour pigments."[19]

Because the colour is a mineral base neither the weather or UV radiation can cause the paint colour to fade. The paint is resistant to acids and is therefore unaffected by pollution, for example sulphuric acid which is a primary component of acid rain. This protects the substrate from atmospheric pollution, a primary cause of exterior deterioration, particularly with limestone.

Since mineral paints have a microcrystalline structure they reflect light and thermal rays, which in hot climates reduces the thermal stress on the structure and prevents cracking. The paints are made of natural mineral compounds; for instance quartz, different feldspars, and inorganic mineral colour pigments. Therefore these paints are compatible, chemically and physically, with all mineral building materials, such as gypsum board, concrete, limestone, plaster, and so on. In addition because of their natural make-up the paints are harmless to the environment. The paint is odourless and non-allergenic.

Silicate paints penetrate the substrate and petrify creating a solid insoluble mineral structure. The crystalline structure of the silicate paints allows moisture present in the masonry to pass through the wall freely without causing cracking and peeling. In doing so it enables the stone to breathe outward while preventing further intrusion of moisture from the wall surface areas. While the silicate paint can not prevent the coral stone from wicking the moisture through the foundation it would enable the stone to breathe and therefore become less saturated. Cracking and peeling occurs with other paint products because they form a layer which adheres to the surface of the masonry but does not bond with it. The ability of the building to 'breathe' is maintained. Because of the inorganic make-up of silicate paints any fungi and algae growth is deterred, maintaining a clean paint layer. By preventing growth the structure is not weakened by unseen growth. Belmont House was last painted in 1986 and as the photographs show the masonry is in desperate need of repair.[20]

Deleterious threats to the environment by mining for the minerals used in the production of the paint must be considered. Can a cause and effect balance be struck by the use of such a product with harmful effects to the environment? Is it more important to use this product than chemical paints, which are toxic and difficult to dispose of? Obviously this system can not be used in every instance, while it can be used on a number of material surfaces. For most applications this product would be cost prohibitive. The only perceived drawback could be the mining process which could negatively impact the environment.

5.5.2 Appliances

There are two residents living in Belmont House so electricity use would be considered minimal. This may obstruct the possibilities for implementing solar applications unless a solution can be found to help offset the cost of the photovoltaic system.

Both availability and cost are factors when considering replacement technology for any of the electrical appliance purposes. Short term solutions for reducing the appliances energy demands are needed until replacements become necessary.

In general small appliances use less energy to operate. In the case of battery powered small electronics it is suggested that rechargeable batteries be used.

A) Cooking

All cooking is done with liquid natural gas. This method is the best option when compared with electric stoves and ovens, unless these appliances are serviced by a solar electric application. In an attempt to reduce the use of gas the pilot light is not kept burning. Instead the burners and oven are lit when needed. This conserves considerably on gas consumption.

B) Hot water

A solar hot water heater supplies hot water. This services all of the hot water needs of the household.

C) Lights

Belmont House would benefit from the installation of compact fluorescent bulbs. It is suggested that these bulbs be installed in the most frequently used fixtures. This would help to alleviate the overwhelming cost of replacing all of the bulbs at the same time. Overall the island would benefit from a utility company program of distributing compact fluorescent bulbs at or near cost to consumers. Such a scheme would provide the utility company with a way to reduce the energy demand and need for a new power station.

D) Refrigerators and freezers

It would be ideal if these appliances could be replaced with units which used hydrocarbon or Greenfreeze technology. In this case the old units would have to be disposed of properly. However, cost is again a problem. CFC replacement technology could be implemented without replacing the entire appliance, however the CFC cartridges would need to be properly disposed of. The charges could possibly be exported for processing through the recycling companies which already have an export network in place for the recyclable waste to be sent to Miami.

The layout of the kitchen and pantry may also play a part in increasing the efficiency of the fridge and freezer. The cooker and oven both back onto the fridges and freezer on the other side of the wall. Perhaps this is not the most efficient option and efficiency may be increased if the refrigerator and freezer were placed along the opposite wall of the pantry. In this position they may be in direct afternoon sunlight and a blackout shade may further reduce the thermal stress on these appliances.

E) Washing Machine

It has been shown that the front loading washing machine is the most efficient, Chapter Two, 'The Built Environment'. It requires less water as well as less energy to wash a load. In order to decrease further the machine's energy demand, the machine could be connected to a solar hot water heater, therefore eliminating the need for the unit to heat water. This coupled with solar drying would greatly reduce the amount of energy used for washing and drying clothes.

F) Dishwasher

Perhaps the most efficient option is not to use a dishwasher. However if its use is inevitable then the machine should be filled to capacity and operated during off-peak hours, which in most cases is overnight. If the dishwasher is operated using solar energy perhaps it is still wise to operate the machine overnight from the stored supply of energy so that the machine is not pulling from other energy requirements during the day.

5.6 BARBADOS GOVERNMENT INCENTIVES AND POLICY

Wind, water and Biomass have been and are used for power generation in the island. However it is believed that solar applications are the least intrusive, simplest to operate and the least polluting (at the source) regardless of the size of the application. According to the Barbados Department of Energy, "So far only wind, solar and Biomass have proven to be suitable to our physical and socio-economic conditions."[21] Bagasse and wind energy have been used in Barbados for centuries by the sugar industry for grinding cane and pumping water. In 1992 bagasse supplied

22.5% of the total energy consumption on the island.[22] This in light of the fact that this source of energy is sold to the local energy company by the sugar industry and various small farms throughout the island. So there is an established business and system for selling excess fuel to the utility company. Keeping this in mind it is hoped that the utility company would continue to be open to the idea of purchasing energy.

There should also be a concerted effort by Government to encourage the use of renewables by the utility company. The fair price for the energy sold should reflect the utility company's savings over the cost of increasing energy production via 'conventional' methods, i.e. construction of a new power station or drilling for oil. The price passed onto consumers should allow for the 'fair price' paid to the generator and if necessary include a tariff, just like the tariff imposed on the fossil fuels industry.

The Barbados Government offers tax rebates for homeowners who install energy saving devices. These savings can total up to $3500BDS ($1750USD) and have been extensively used for solar hot water systems. Solar energy has been successful as demonstrated by the rather extensive use of solar hot water heaters throughout the island. The success has been partly driven by the tax rebates offered by the government for the installation of these units.

5.7 LIGHT PENETRATION

Lighting levels at Belmont House need to be at levels that are conducive to performing household tasks and some office tasks. The need is for good quality lighting which is free from glare.

Direct skylight, light reflected from the ground and light reflected from vertical facades will determine the amount of interior daylighting. Only the northern facade of Belmont House is affected by all three of these factors. The other facades are not affected by light reflected by vertical facades. The exterior measurements taken at Belmont House are influenced by these three variables.

This is effective in helping to determine whether or not lighting levels meet the required criteria. (Figures 5.32-5.44)

On the first floor the floors are either dark mahogany or coloured tile. The reflectance property of these floors is probably between 1% and 10%. Hopkinson, et al categorise the reflectance property of dark grey at 10% and dark black at 1%.[23] On the contrary the walls are painted white giving them a value of 85%.[24] However, it is necessary to include a variance for dirt, 0.8, which specifically in this case is algae growth. Therefore the reflectance value of the walls is reduced to 68%.

In addition deep porches and porticoes protect the first floor and as a result of the low reflectance value the first floor registered low luminance levels. Although the second floor is decorated in the same manner than the first, it is anticipated that the second floor would have recorded higher luminance levels, primarily because the second floor does not have the same exterior protection. In addition the glare is greater in the rooms which are not shaded. The fixed awnings on the windows do not offer much relief from the glare when the sun is not at its zenith.

There are two purposes to good daylighting design. First, to provide sufficient light for efficient visual performance. Second, to ensure a comfortable and pleasing environment appropriate to its purpose.[25] Belmont House best uses natural light in the service area of the first floor, and the second floor. Artificial light is used to extend the day. However, the amount of available natural light will determine at what point artificial light becomes necessary. Much of the available research focuses primarily on daylighting in the workplace. It would seem that this is the case because preferences for lighting in the home are subjective and lighting for specific work tasks is not as necessary as in the workplace.

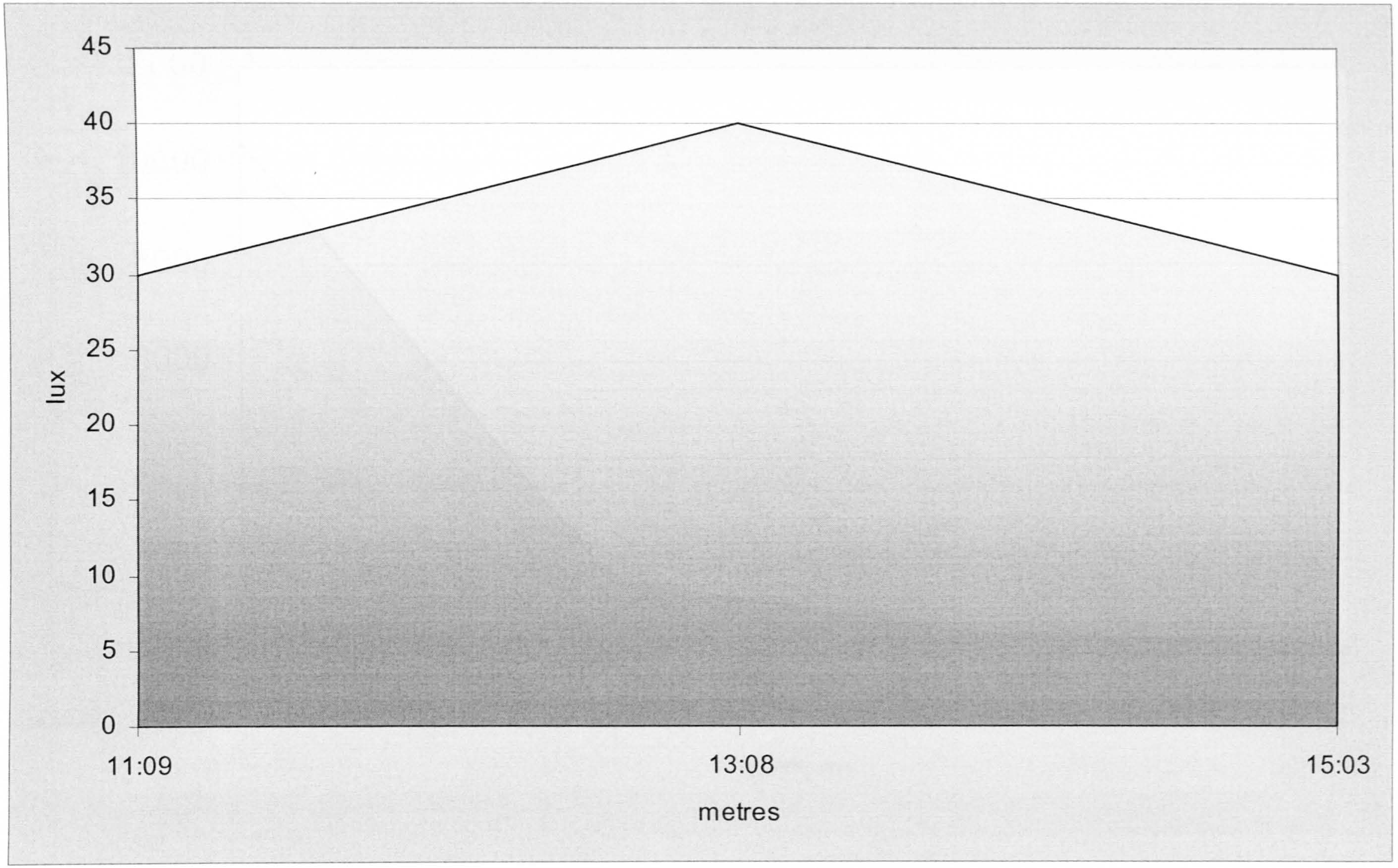

Figure 5.32 Lux readings for the Great Room

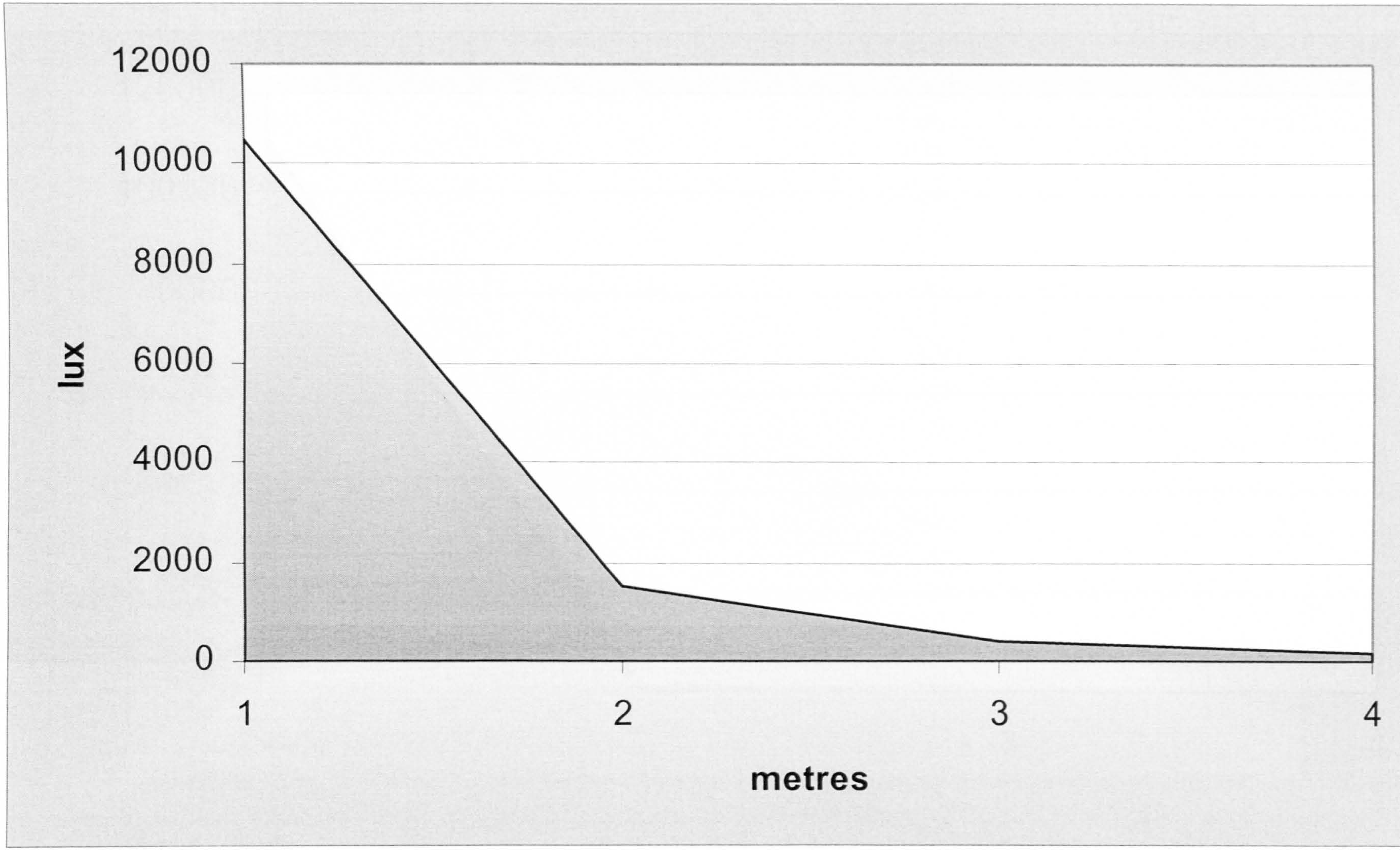

Figure 5.33 Lux reading for the northern façade at 11am, Belmont House.

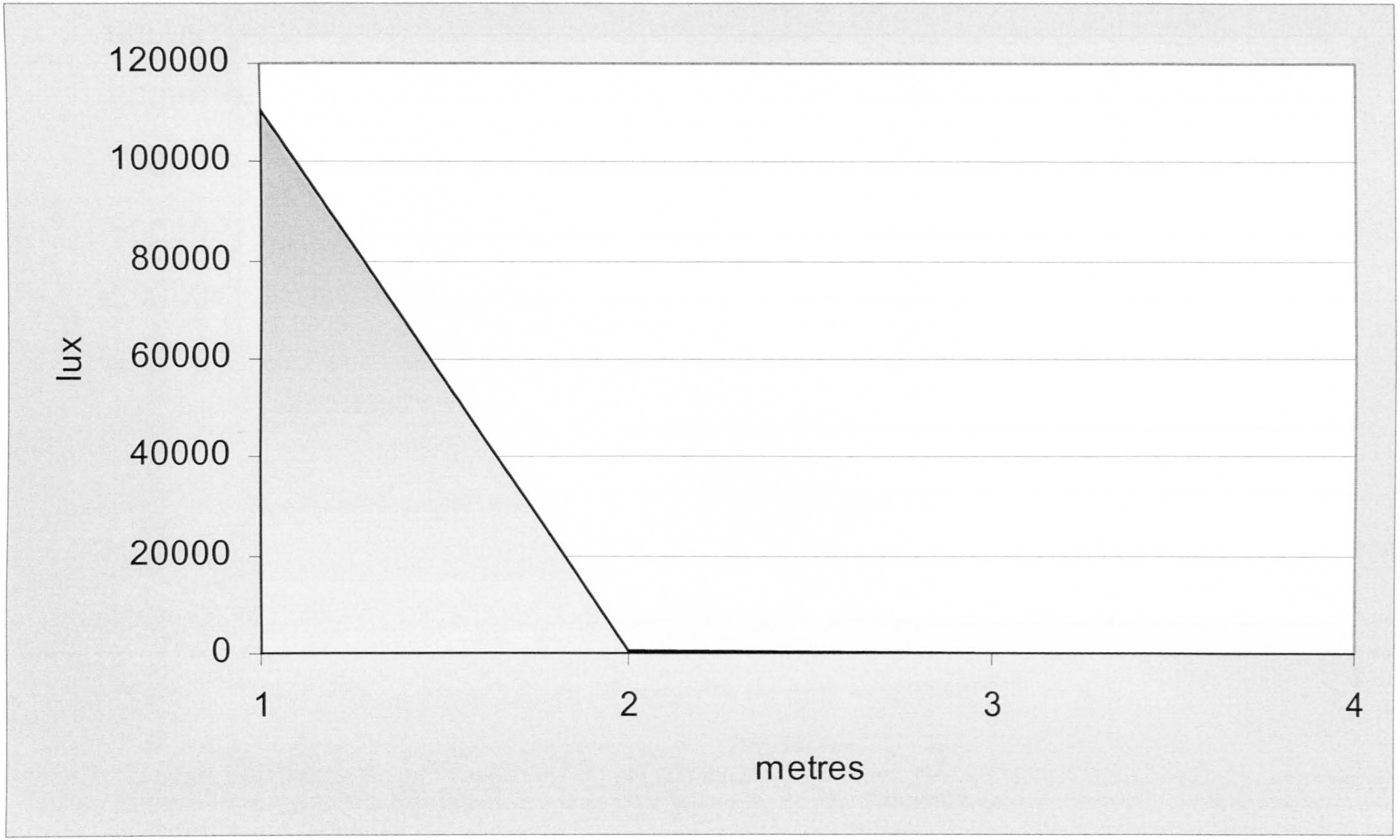

Figure 5.34 Lux reading for the northern façade at 1pm, Belmont House.

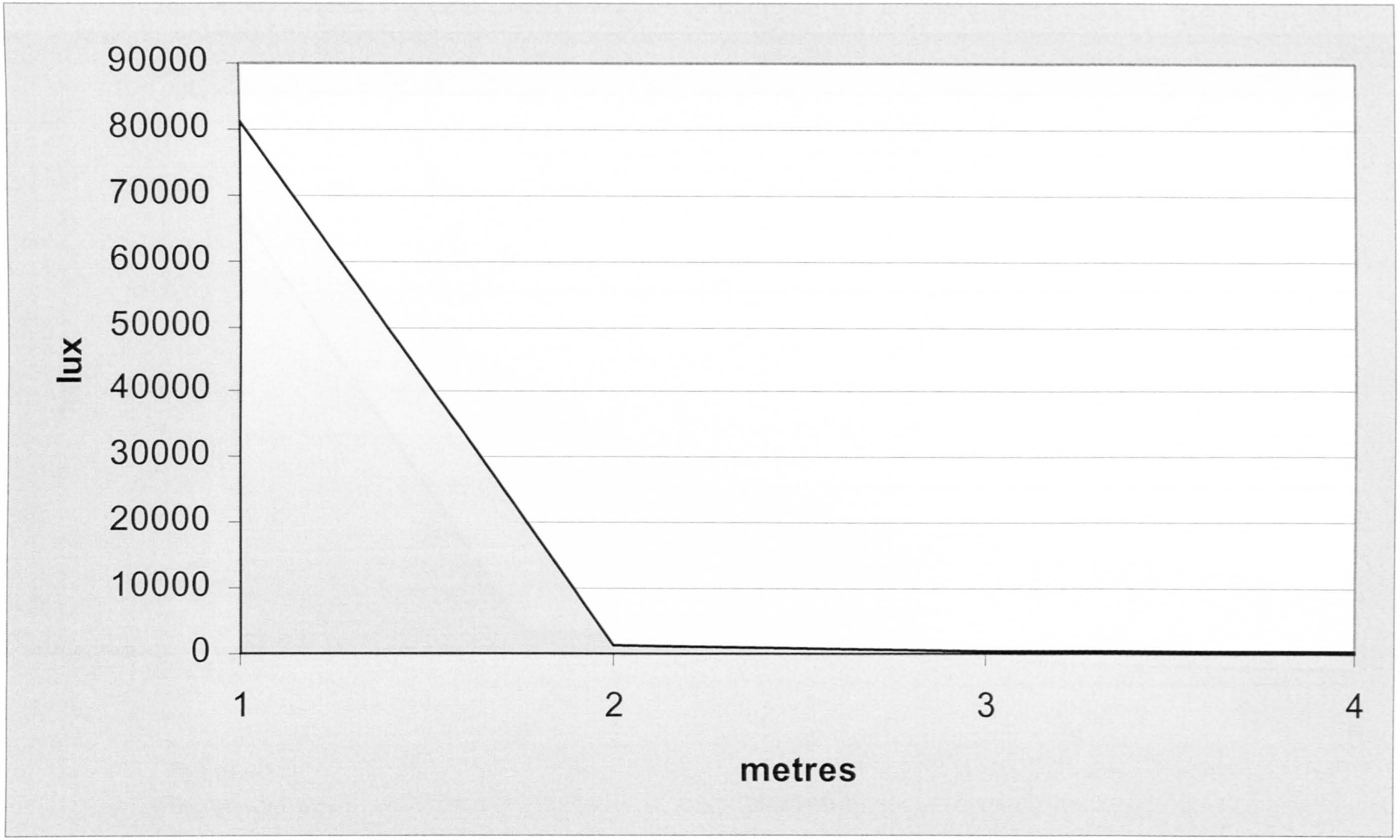

Figure 5.35 Lux reading for the northern façade at 3pm, Belmont House.

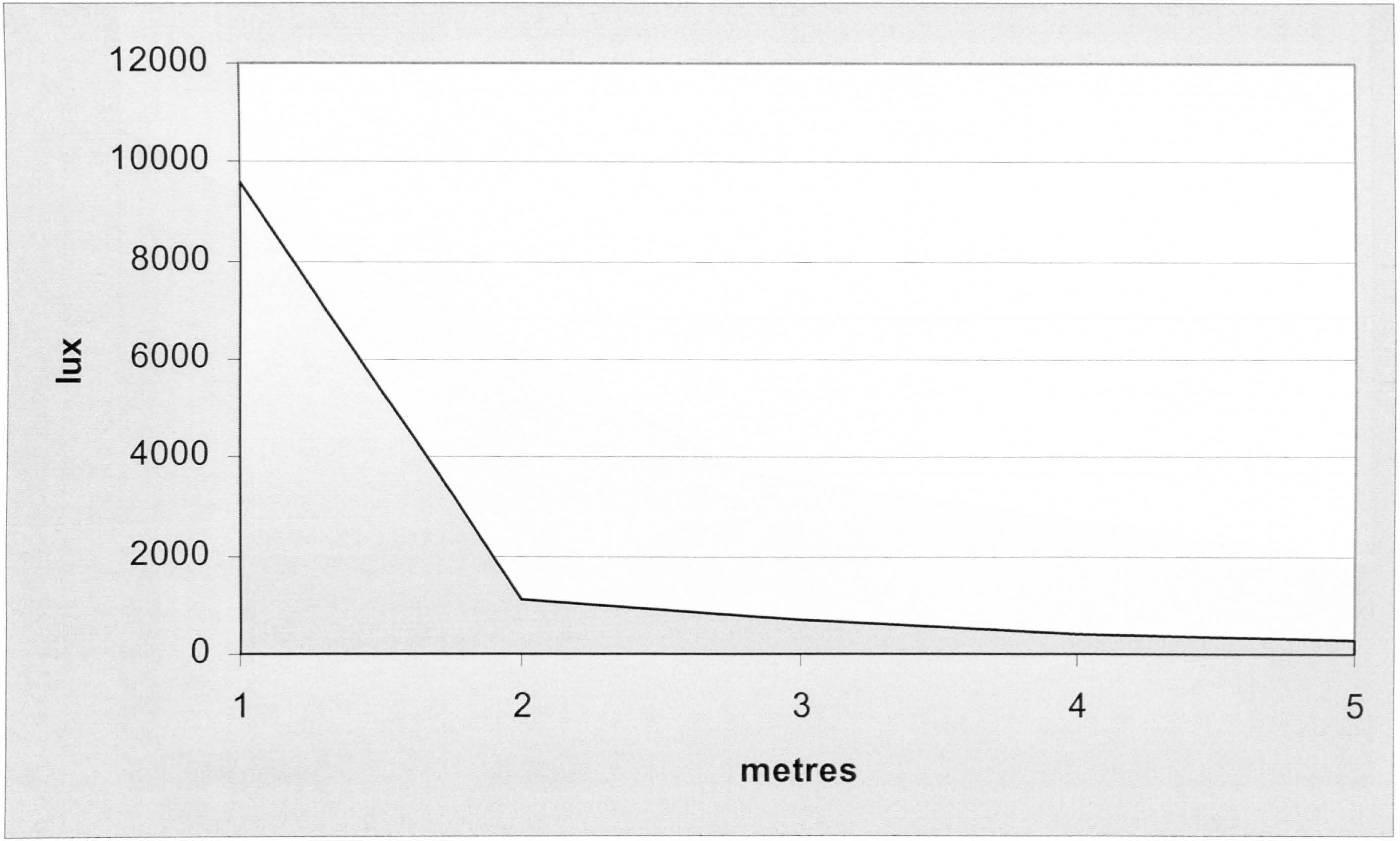

Figure 5.36 Lux reading for the southern façade at 11am, Belmont House.

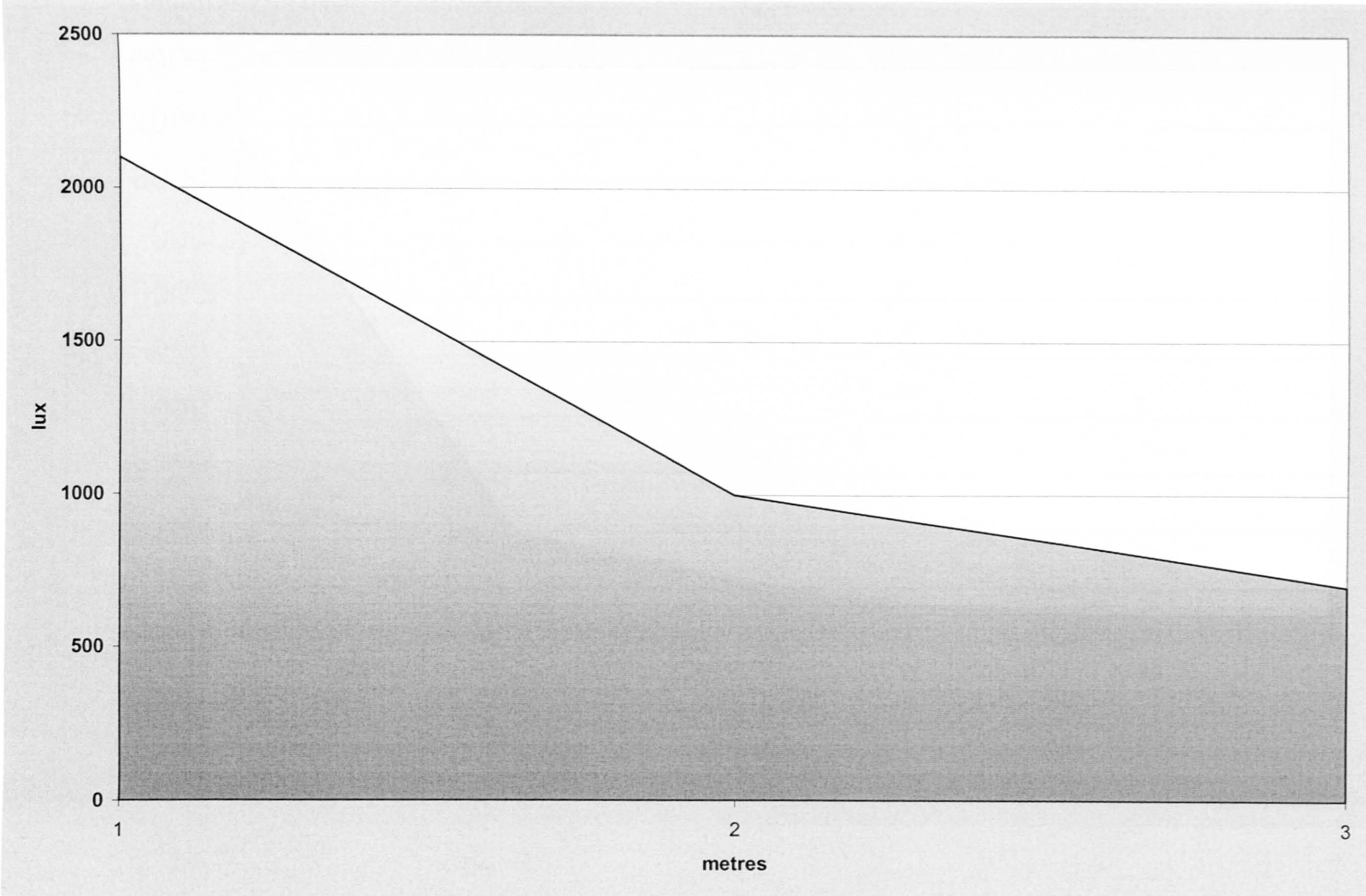

Figure 5.37 Lux reading for the southern façade at 1pm, Belmont House.

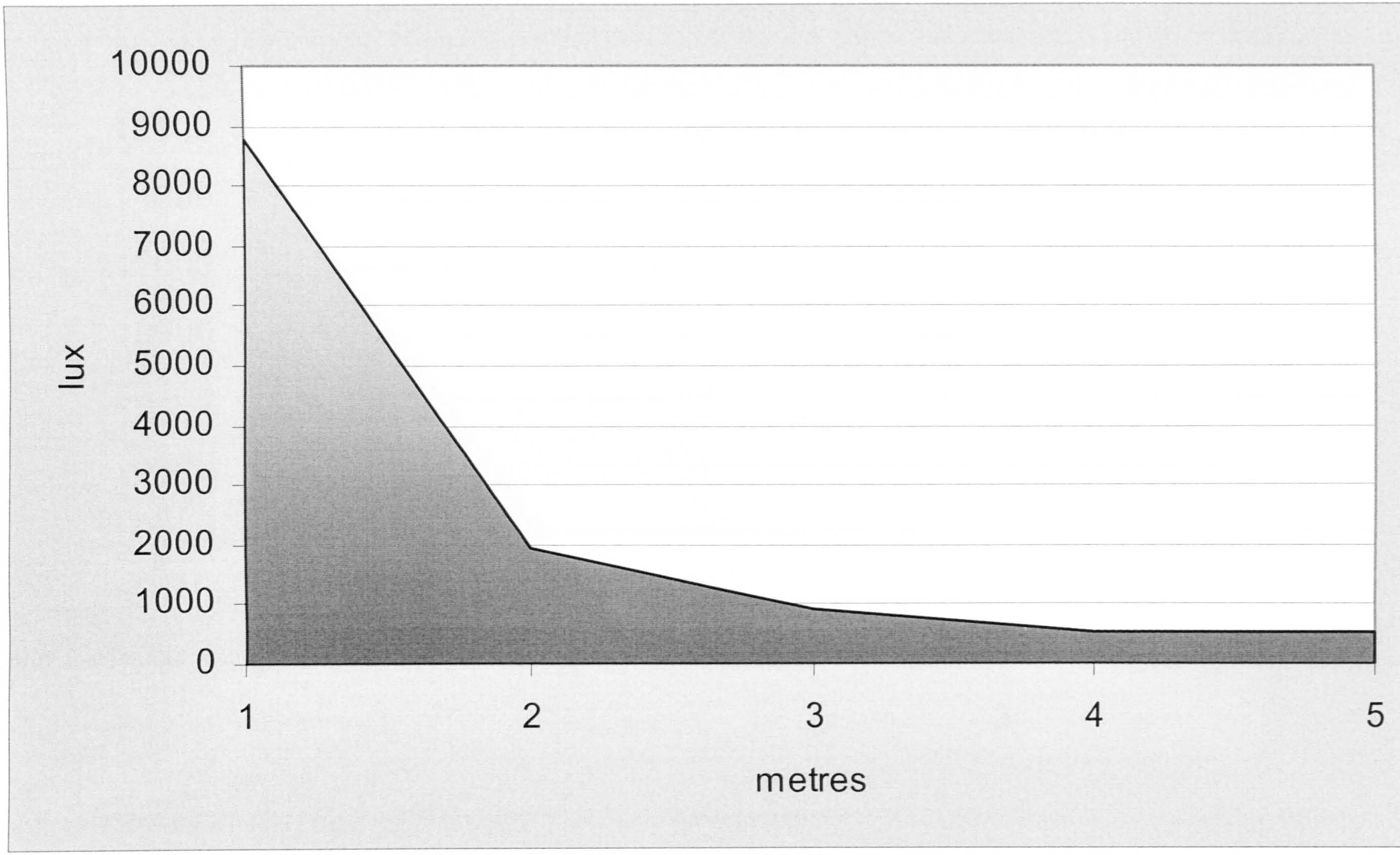

Figure 5.38 Lux reading for the southern façade at 3pm, Belmont House.

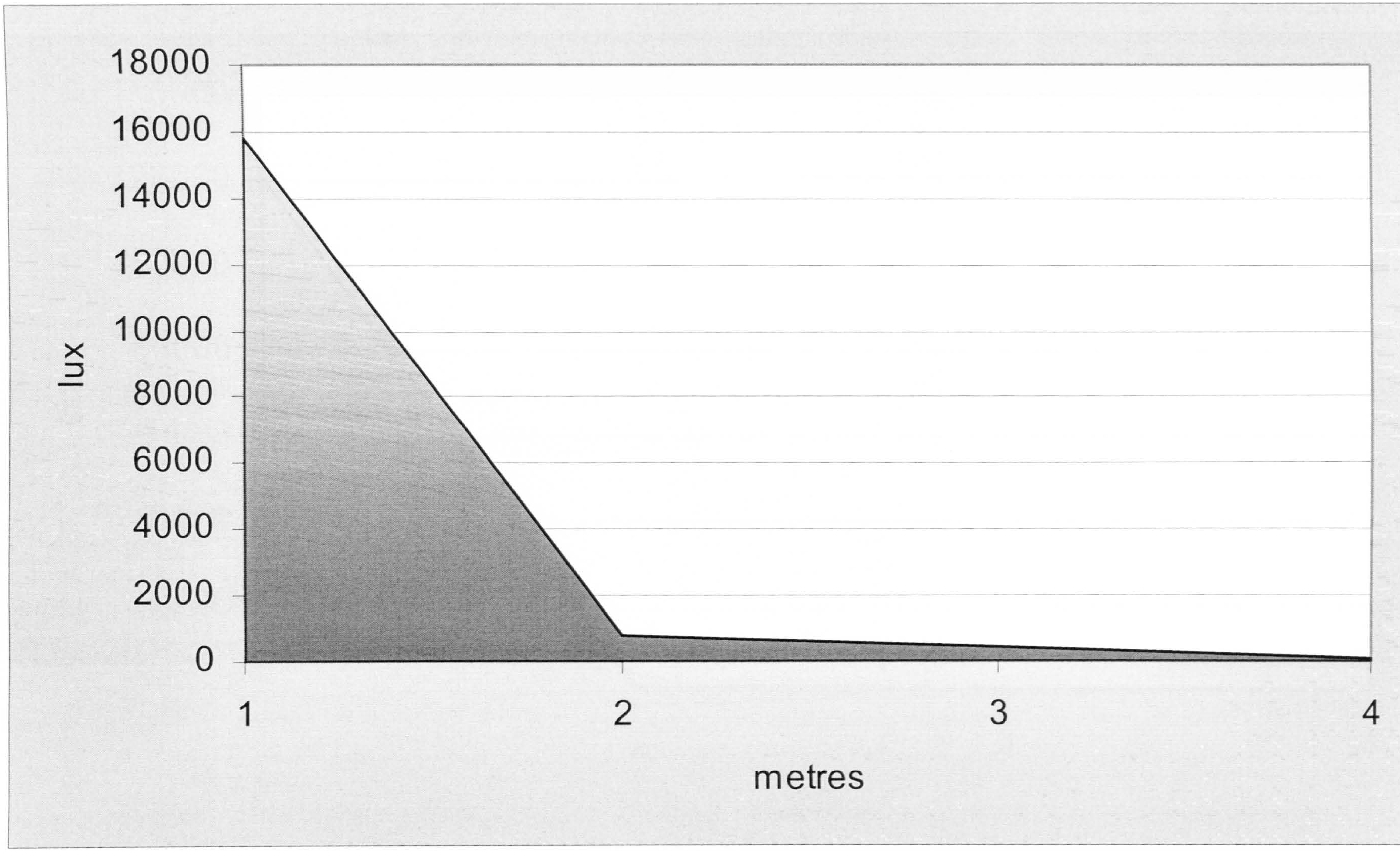

Figure 5.39 Lux reading for the eastern façade at 11am, Belmont House.

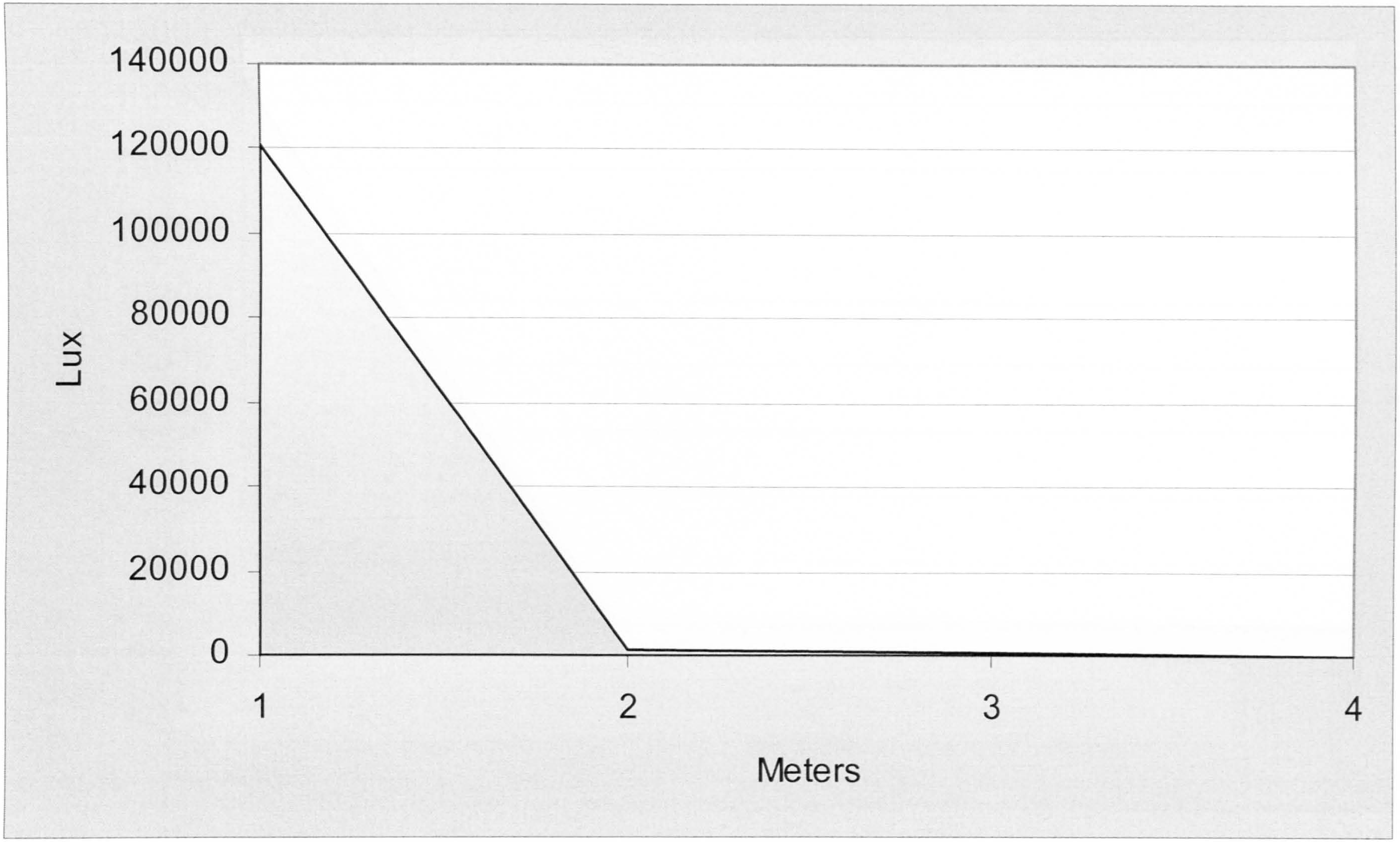

Figure 5.40 Lux reading for the eastern façade at 1pm, Belmont House.

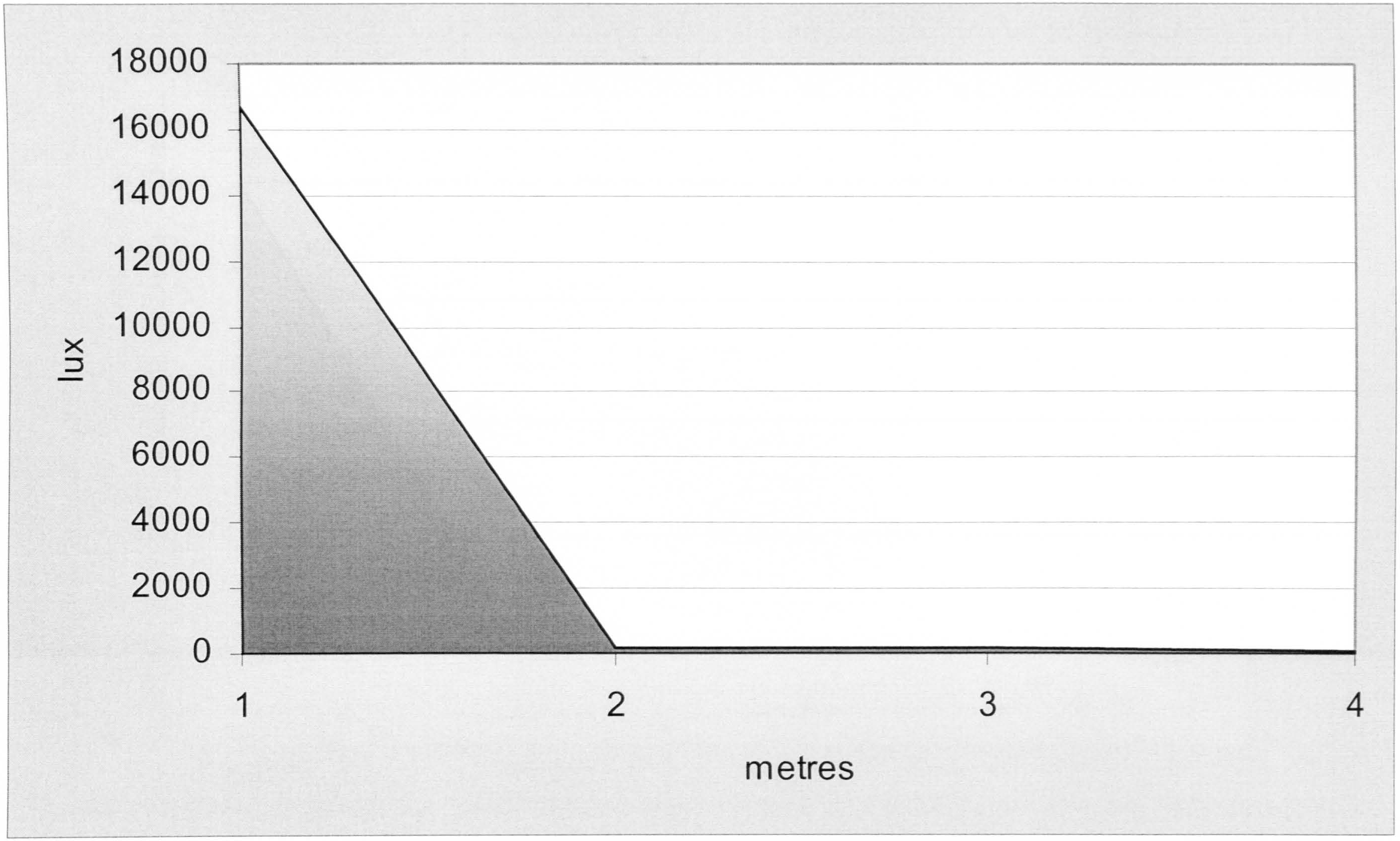

Figure 5.41 Lux reading for the eastern façade at 3pm, Belmont House.

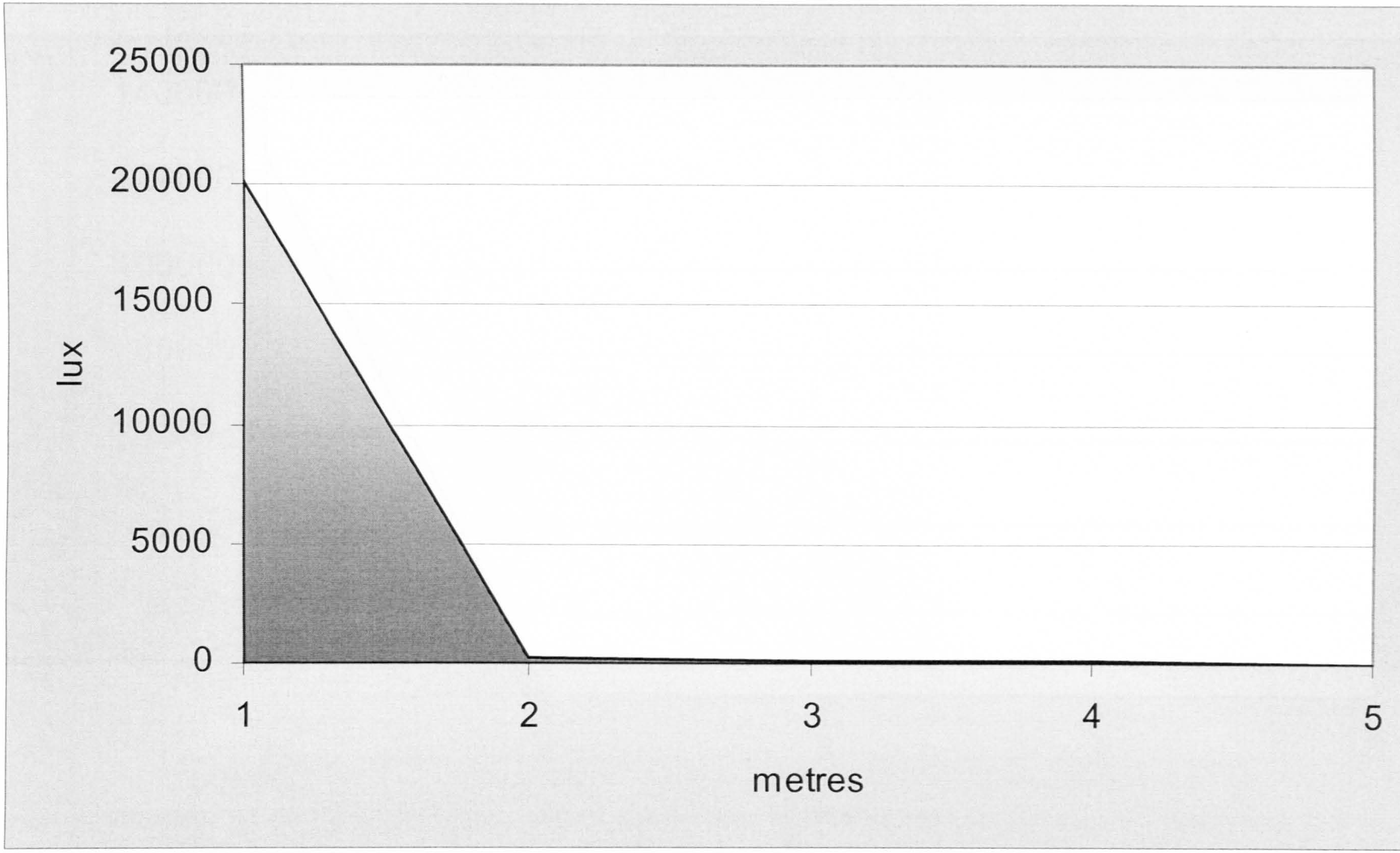

Figure 5.42 Lux reading for the western façade at 11am, Belmont House.

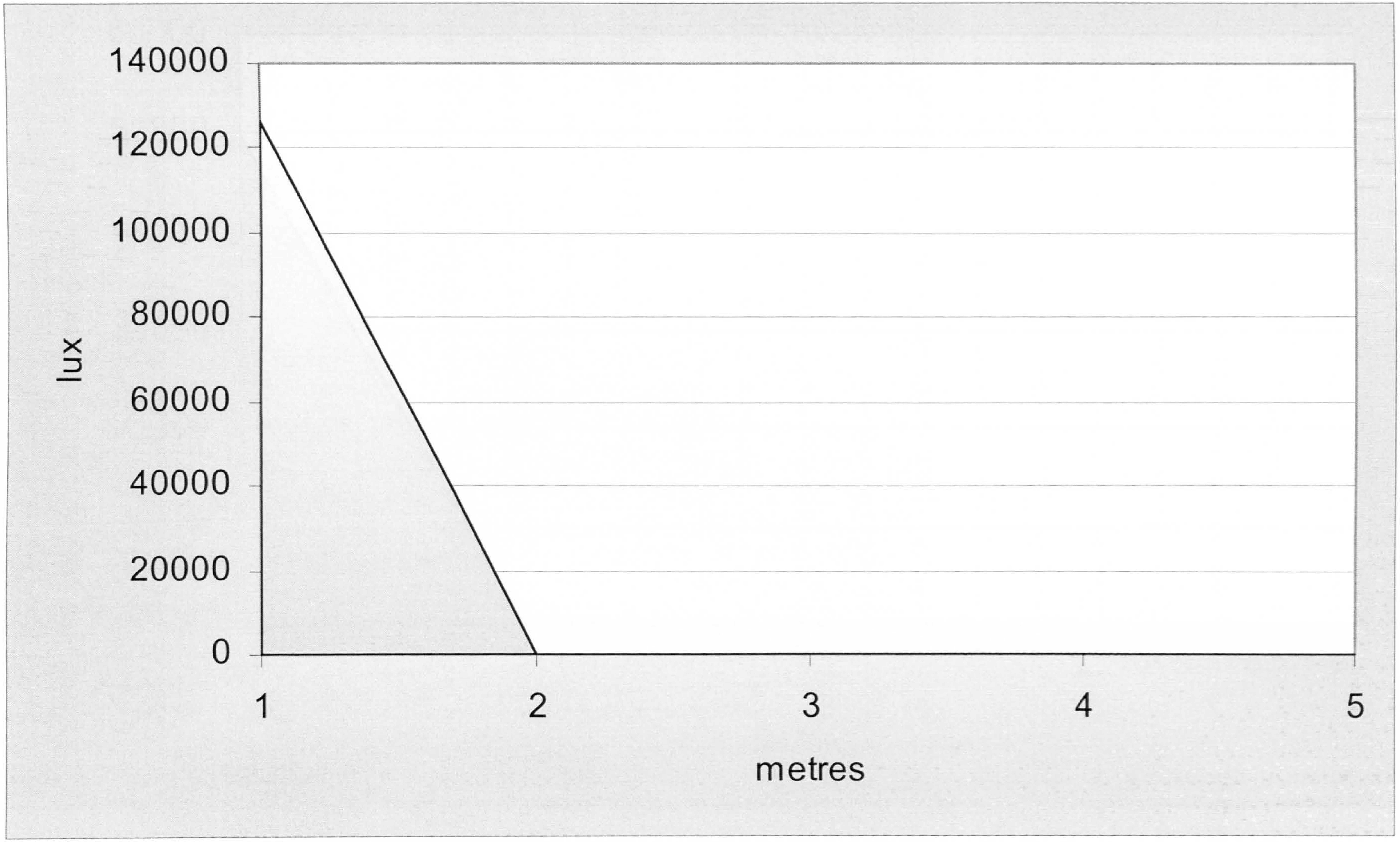

Figure 5.43 Lux reading for the western façade at 1pm, Belmont House.

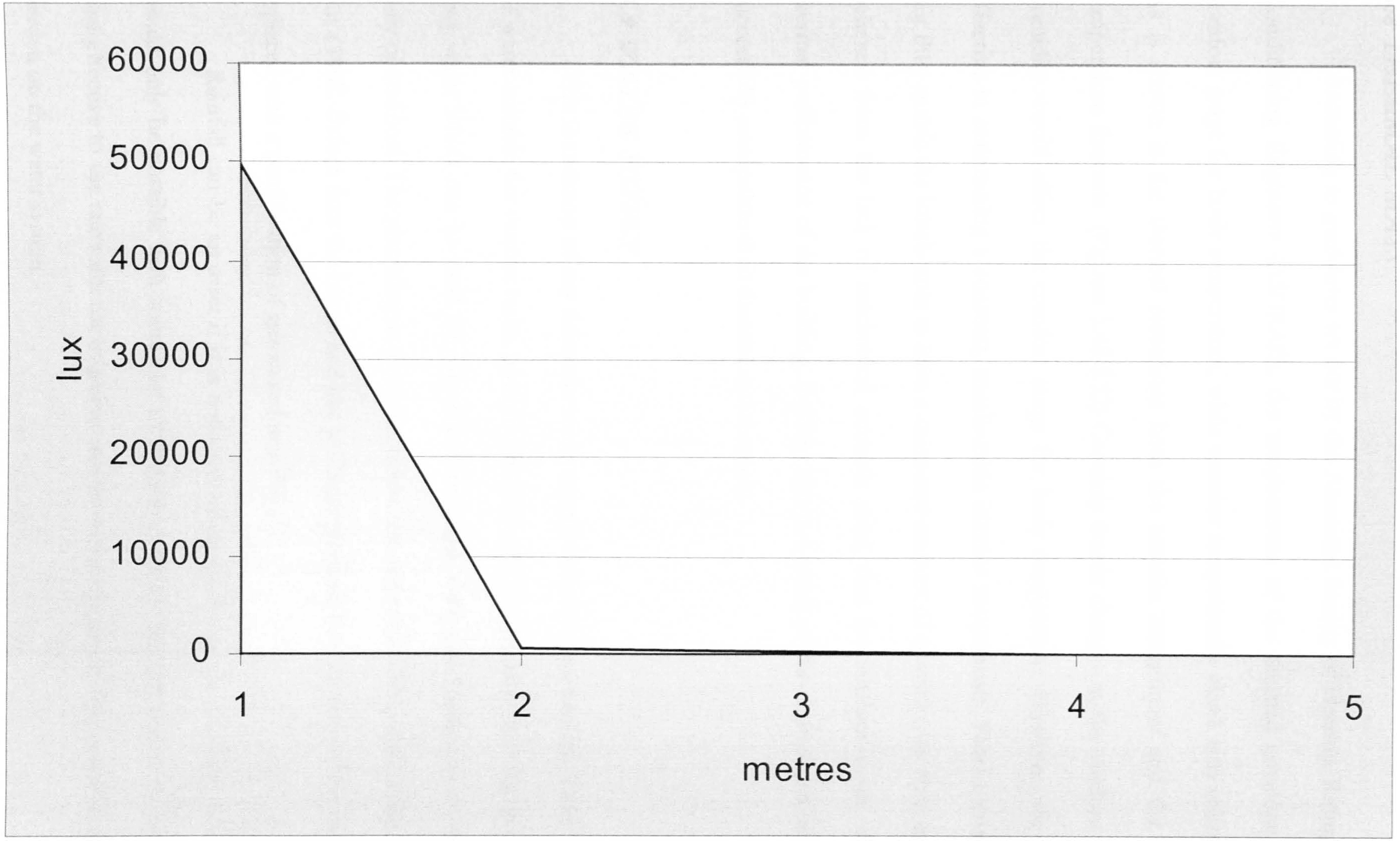

Figure 5.44 Lux reading for the western façade at 3pm, Belmont House.

5.8 THERMAL MASS

According to guidelines set out by the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE), the temperatures of the thermal envelope stay within the comfort range for body temperature, while exterior temperatures climb into uncomfortable levels. As is shown in the thermal recordings both the exterior temperature and the interior window temperature fluctuate. (Figures 5.45-5.52) Certainly drastic changes in the outdoor temperature and humidity would affect the comfort range for body temperature. However, the thermal shell is effective in maintaining a constant, comfortable interior temperature. Passive controls are limited but they enable the inhabitants to have a measured amount of control over their environment. It is believed from the lack of mechanical controls used, that the inhabitants are satisfied with the thermal performance of the building. Perhaps this is a result of the control the inhabitants have to successfully manipulate their thermal environment.

5.9 WATER SUPPLY

The foundation of any domestic water supply must be conservation. There are two qualities of water suitable for various tasks, potable which is used for drinking, bathing and cooking, versus grey water which can be used for toilets and irrigation. Only one bathroom in Belmont House is fully operational. The plumbing in the entire house was replaced *c.*1961, with additional work carried out *c.*1967. Before then the house had not yet been plumbed for hot water. The old lead pipes were replaced with a combination of galvanised and PVC.[26]

Rainfall can be an asset if it is collected off roofs for use as drinking water. However this would only be possible with some sort of filtration system. Instead it may be more practical and cost-effective to use rainwater for irrigation and the swimming pool. This would help to alleviate the burden on the water system.

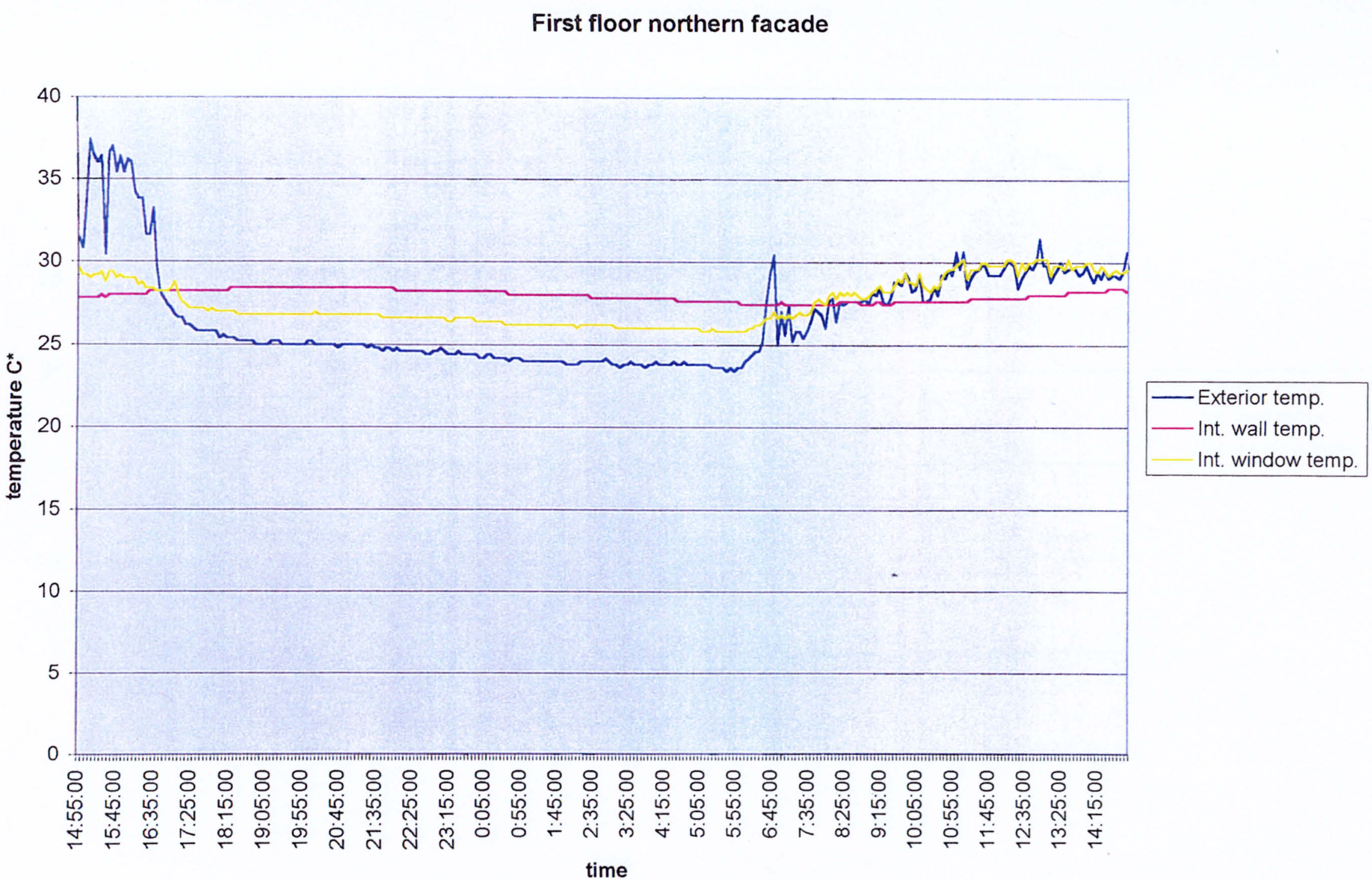

Figure 5.45 Temperature readings for the first floor, northern facade, Belmont House.

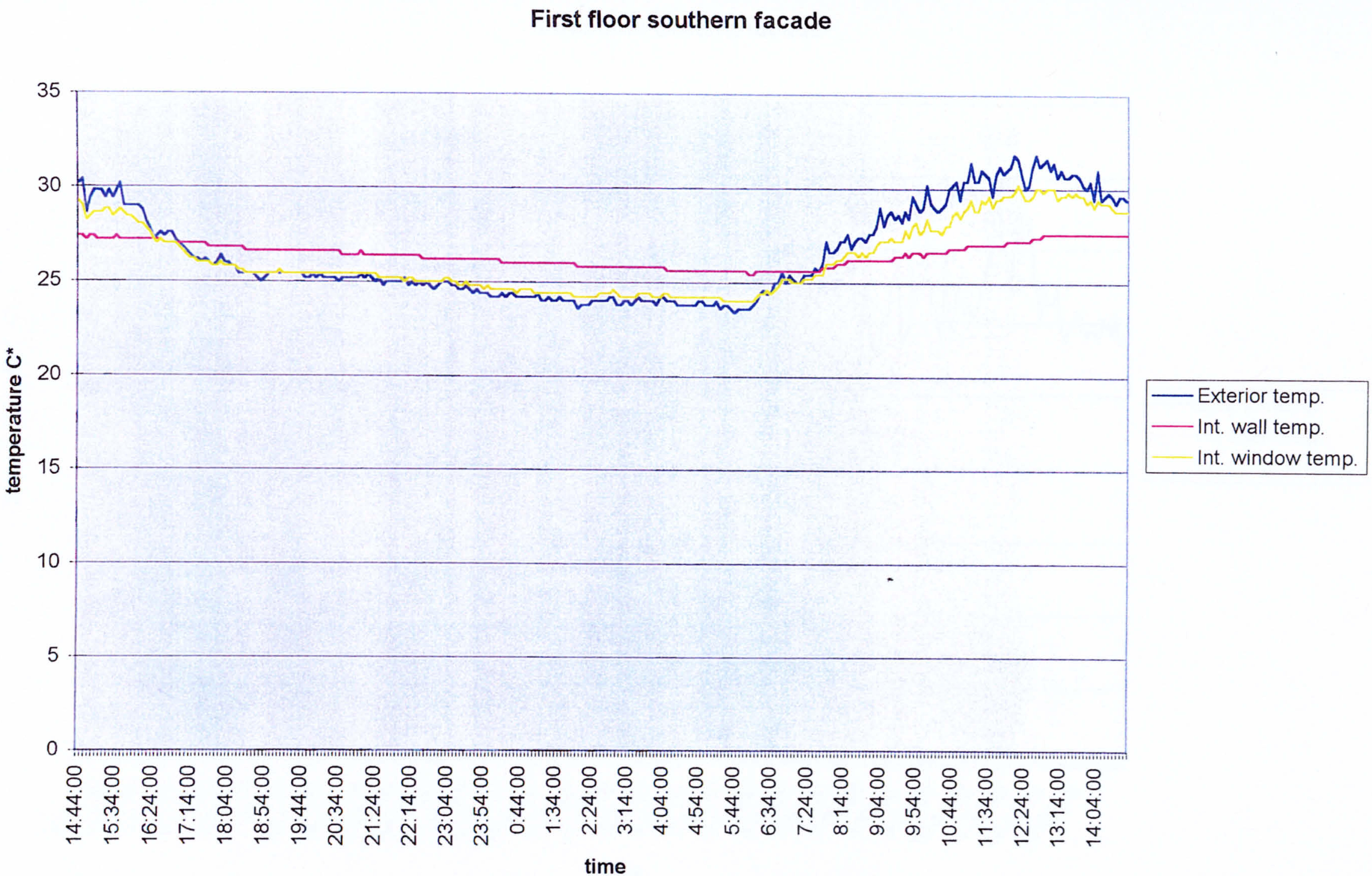

Figure 5.46 Temperature readings for the first floor, southern facade, Belmont House.

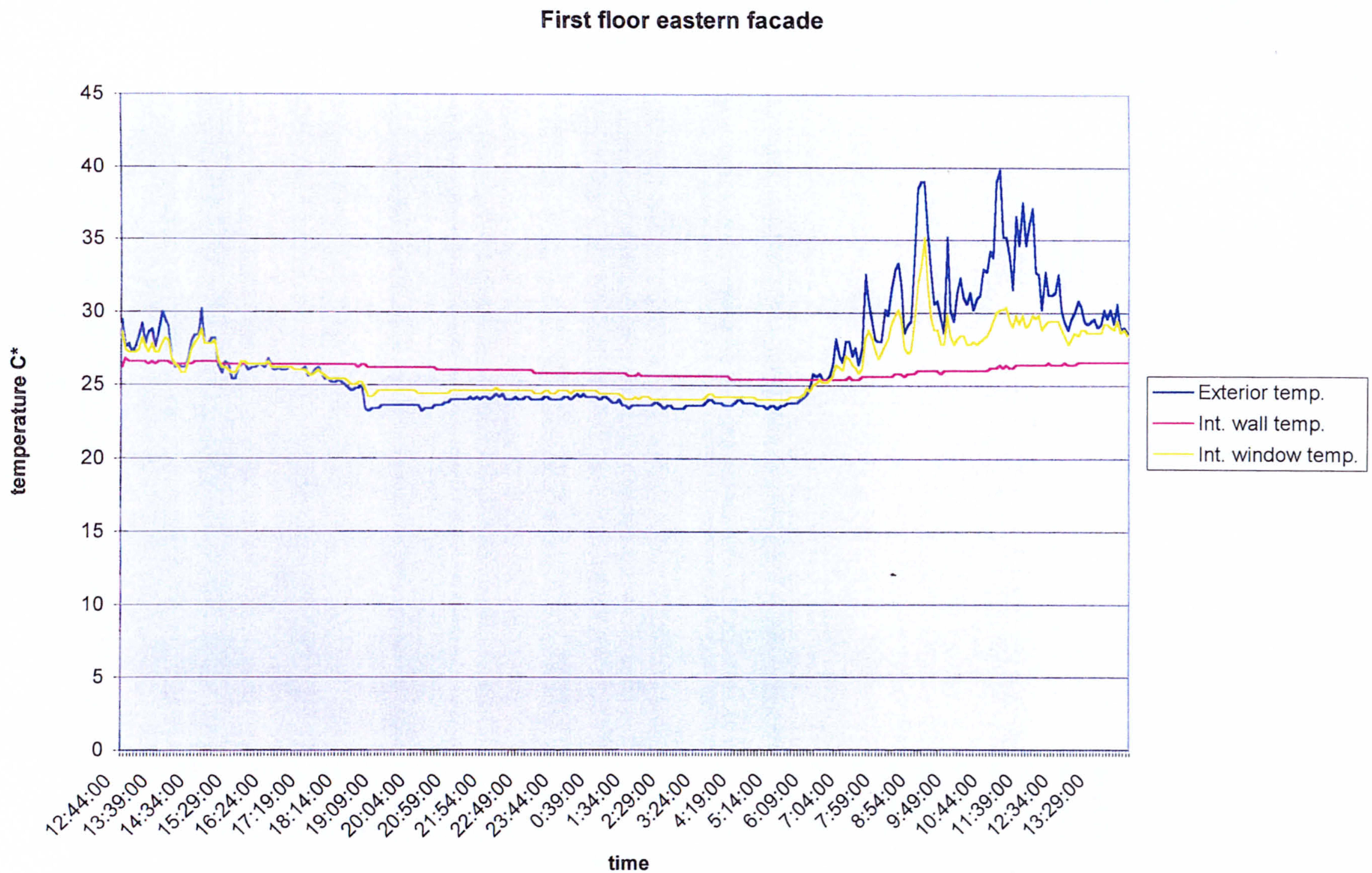

Figure 5.47 Temperature readings for the first floor, eastern facade, Belmont House.

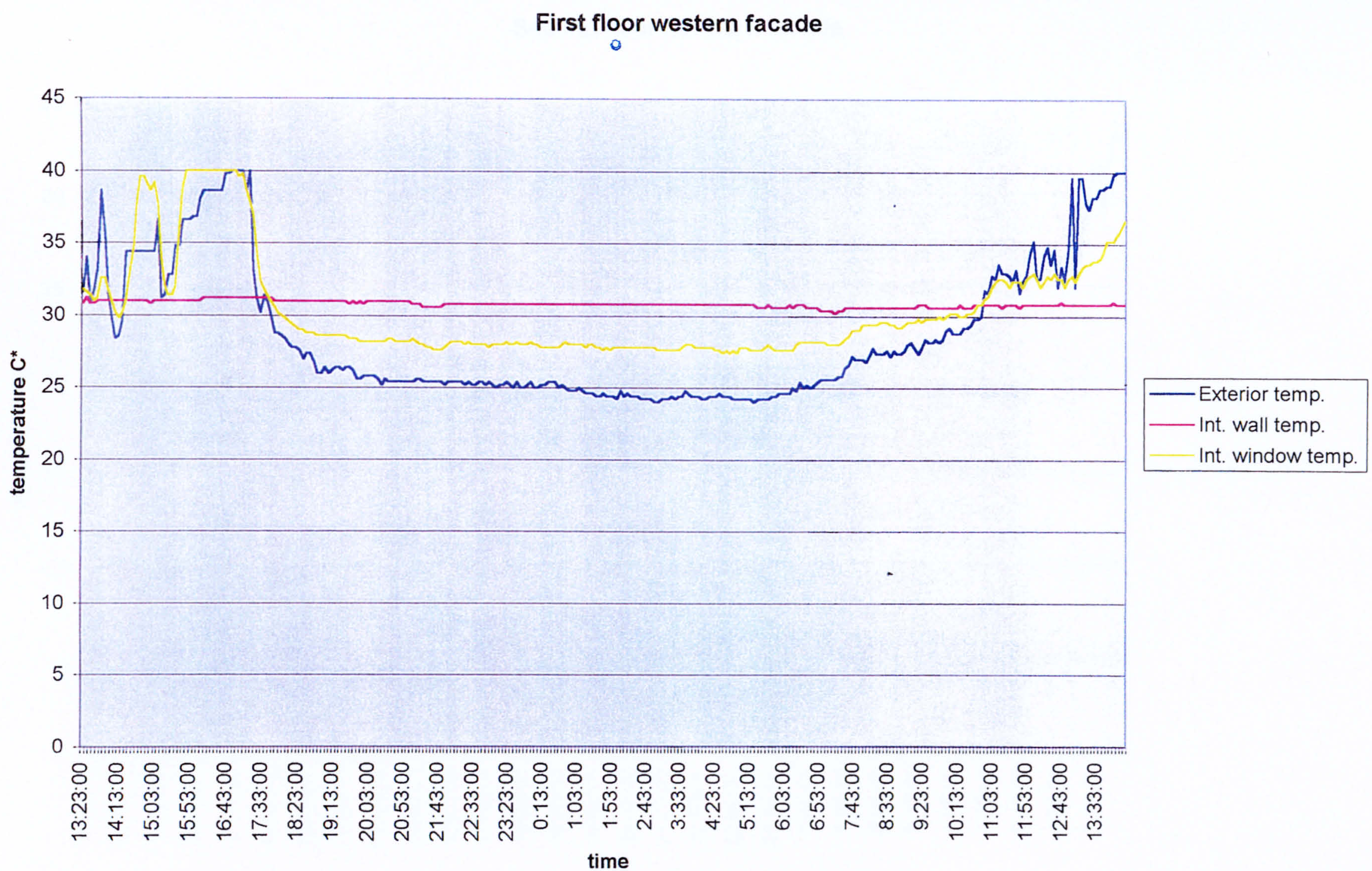

Figure 5.48 Temperature readings for the first floor, western facade, Belmont House.

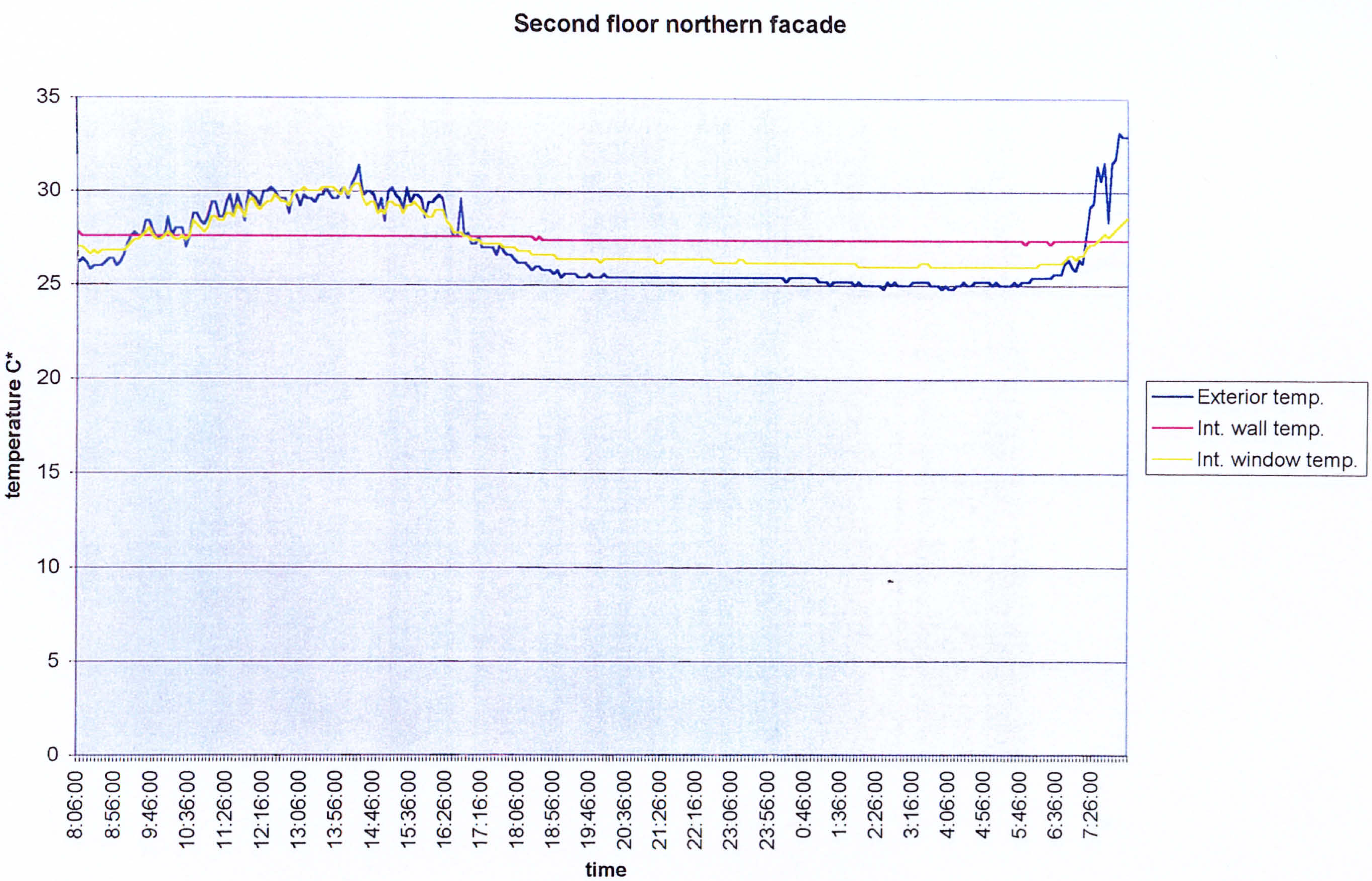

Figure 5.49 Temperature readings for the second floor, northern facade, Belmont House.

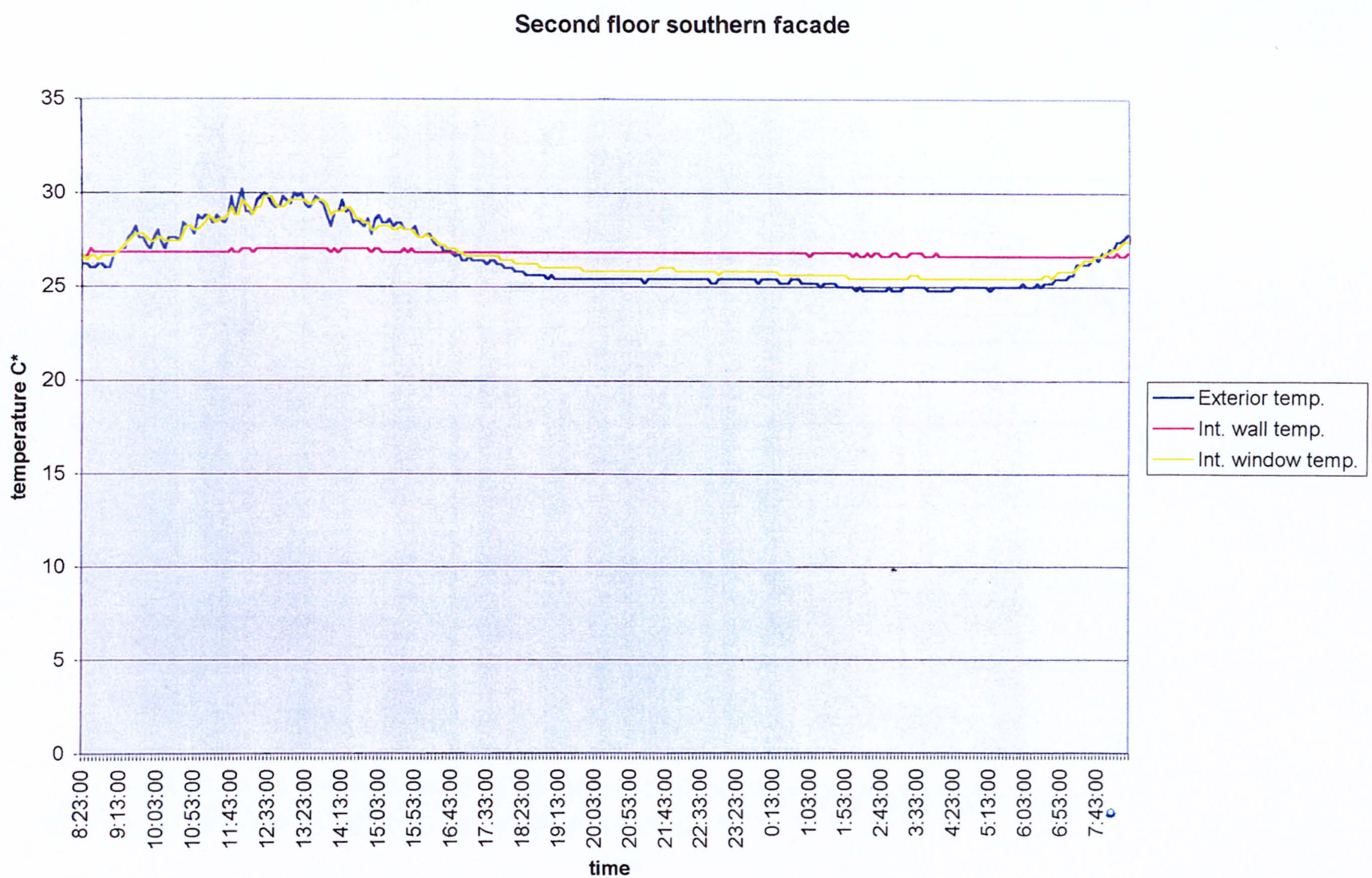

Figure 5.50 Temperature readings for the second floor, southern facade, Belmont House.

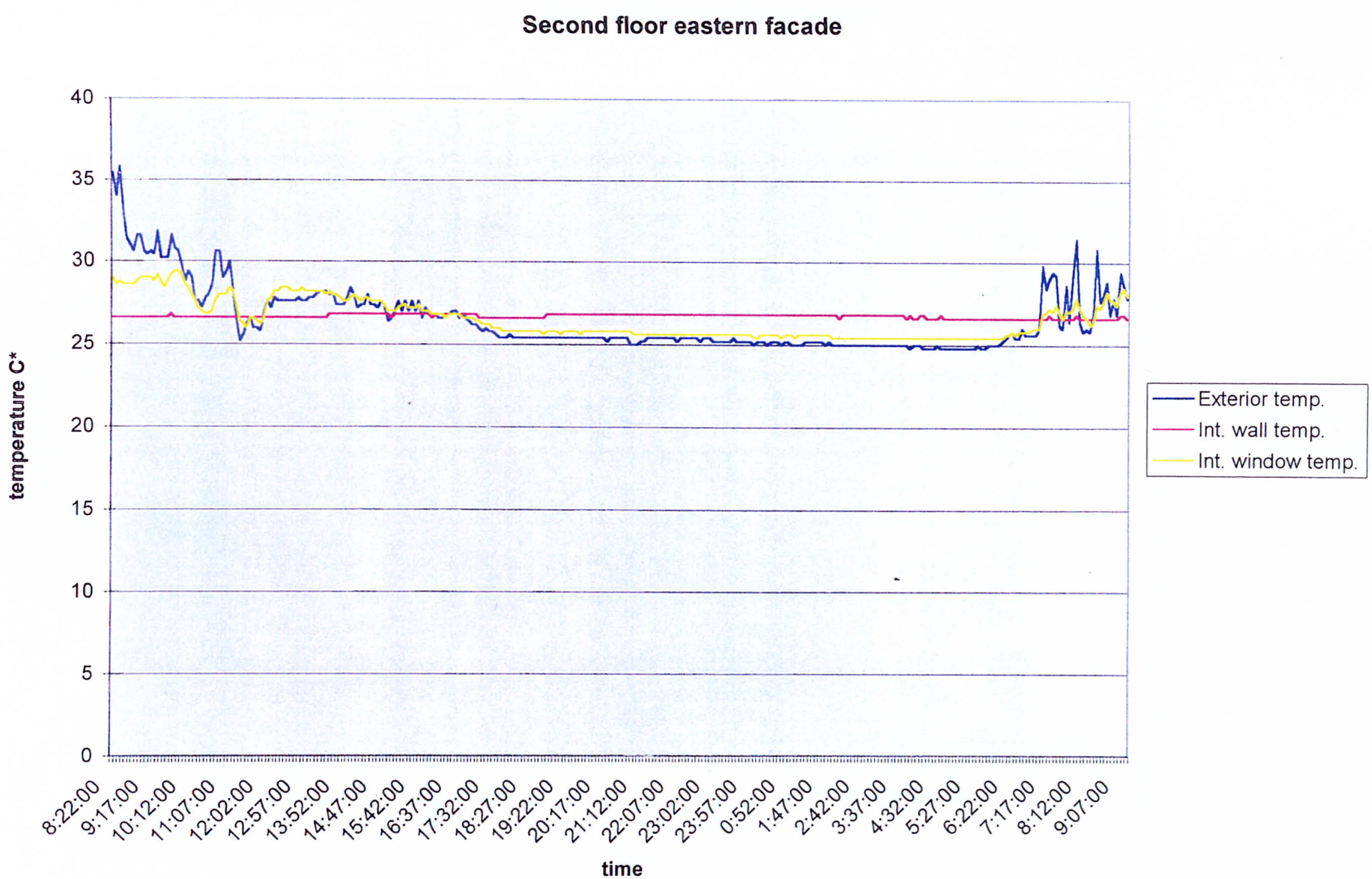

Figure 5.51 Temperature readings for the second floor, eastern facade, Belmont House.

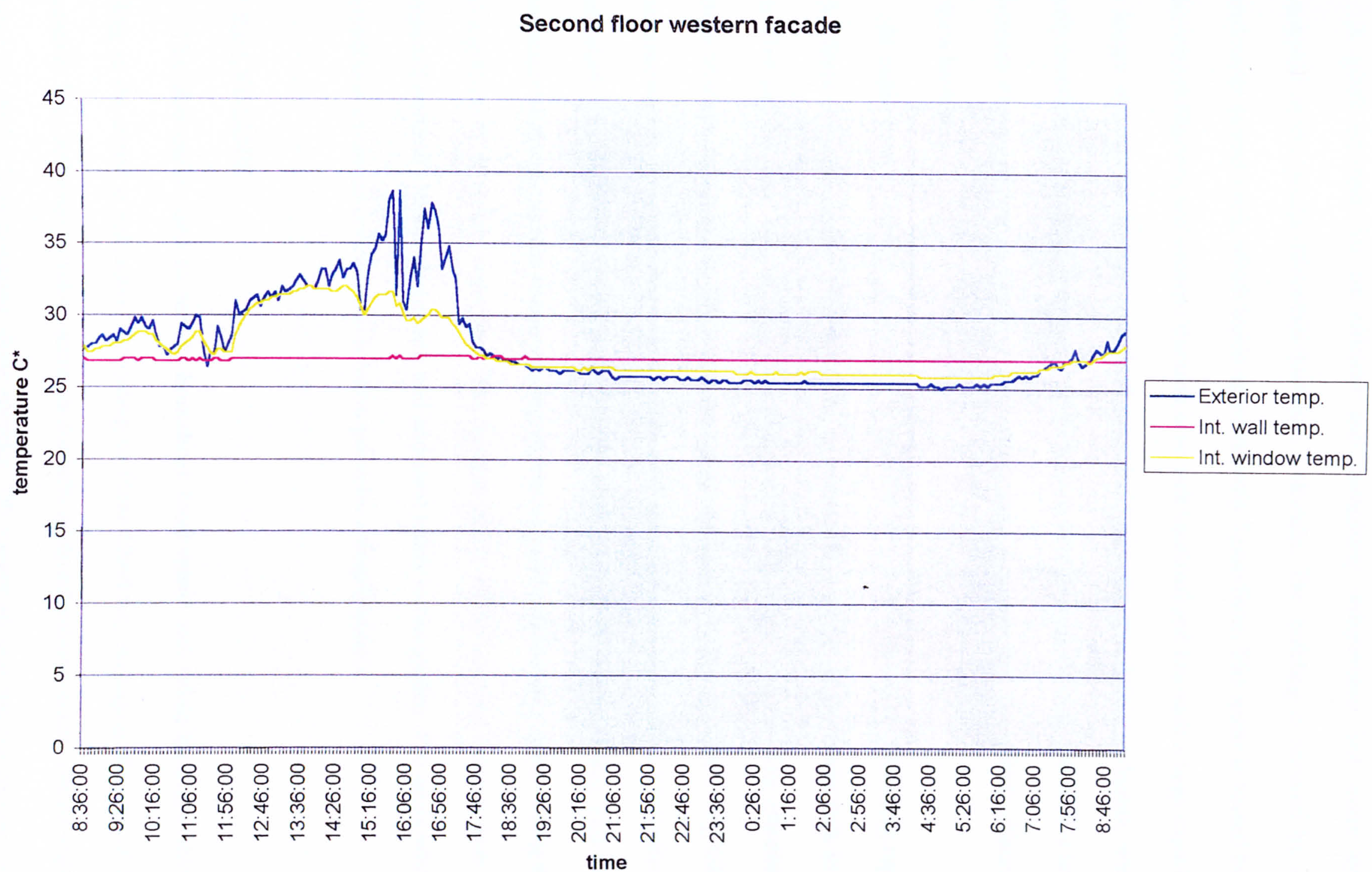

Figure 5.52 Temperature readings for the second floor, western facade, Belmont House.

A good example for an efficient and completely independent hot water system is demonstrated at the Rocky Mountain Institute, Colorado. The building is serviced by a super-insulated water storage tank, which holds approximately 7,ooo litres. The water is heated by a bank of solar water collectors and because the tank is so well insulated and has such a large capacity there is no longer a need for the propane fired modulated capacity instantaneous heater, which was originally installed for back-up purposes.[27] It would not be necessary to maintain such a large tank for Belmont House. However, this is a good example of a system that completely eliminates the need for a backup.

In order to save further on water it is possible to install toilets with a flushing capacity of only 3-4 litres. An intermediate step would be to reduce the capacity of the water tank in existing toilets. This can be done by installing an artificial wall. This method has proven effective in the reduction of water consumption. What may seem a drastic step is the use of composting toilets. The market continues to grow and there are a number of possibilities of the market. One which would be particularly suitable to this project is the 'Biolet' self-contained composting toilet. This toilet does not use water or chemicals and uses a venting system to avoid unpleasant odours. Using this toilet would significantly decrease water use. The system needs to be emptied once a year and the decomposed material can be mixed with soil and used safely in the garden. For areas where water conservation is a primary concern this solution provides a simple answer.

5.10 RECYCLING

The aloe pit is used to recycle household food waste and other biodegradables. Other recycling in the island is subjective. According to Peter Chesham, managing director of Recycling Preparation, Inc., domestic recycling accounts for 10% of their business, while commercial recycling accounts for 90%.[28] This company alone recycles 750 tonnes of non-ferrous metals, i.e. copper, brass, and aluminium. Furthermore, the material to be recycled has to be sent to Miami for processing and smelting, and nets $500,000 (US) per year.[29]

5.11 SUMMARY

In an ideal situation a comprehensive retrofit such as the National Audubon Society renovations, would perhaps demonstrate perfect environmental solutions to the problems outlined. That sort of comprehensive renovation requires deep pockets. In the initial stages of a renovation project concentration is placed on the structure, carrying out repairs and making it sound. As in the case with Belmont House unless there is a demonstrated need it is unlikely that the owner will replace existing appliances with more energy efficient models. So while the introduction of energy efficient and environmentally friendly models to the market shows an understanding of the problem at hand by manufacturers the current situation is unlikely to change until there is widespread replacement of these appliances, which is only likely to happen when the older models fail.

In light of this short-term dilemma it is prudent to look to the least expensive quick fixes which will provide a way of substantially reducing the environmental impacts of certain appliances. A good example would be the use of compact fluorescent light bulbs. As demonstrated in Chapter Two, 'The Built Environment', their use would decrease energy demand over tungsten bulbs by 50%. Clearly this is a measure that can be taken with comparatively little initial expense and there are immediate results. In the long run once these bulbs are being widely used and perhaps if Belmont House does eventually go completely solar, their use will help to decrease the size of the solar generating system required to sustain the residence in the manner to which the owner has become accustom.

While it is readily apparent that Belmont House provides a primary cultural resource to the community, it may not be so apparent that Belmont House has a primary renewable energy resource available. In this instance solar applications, which range from hot water to electric power are suitable for this site.

Cost needs to be considered in relationship to a 'payback' period. In order for the system to be economically cost effective the supposed cost of 'purchased' energy versus the owner's photovoltaic system costs need to be at least equal. Perhaps for Belmont House a solar energy system is not the most economically resourceful route unless excess energy generated could be sold to the power company, which would help to offset the initial cost of the photovoltaic system and bring them into line with the current utility bills.

Perhaps if Belmont House completely converted to solar power and there may be an opportunity to sell excess energy to the utility company, Mr. Goddard may consider including a tracking device which could boost the daily output of the photovoltaic system by as much as 50%.[30] This addition could provide an opportunity to decrease the payback timeframe for the equipment.

It is difficult to estimate the overall cost of a complete conservation project of this nature with the estimated payback of the project for two reasons. First, this is a theoretical project with no budget and currently no plans to followup on the proposed solutions. Secondly, it is difficult to calculate a theoretical cost for this project because of the lack of product availability in the island. Because energy efficient appliances and devices must be imported their use may prove to be cost prohibitive. It is predicted that the payback time for this project would be longer due to these anticipated added transportation costs and duties. If the project is approached in stages it will be possible to realise some good results.

NOTES

1 GOSNER, Pamela, Caribbean Georgian: the Great and Small Houses of the West Indies, Three Continents Press, Washington DC, p. 99.

2 WILDER, Rachel, Insight Guides: Barbados, Langenscheidt Publishing Group, 1992, p. 15.

3 SEALEY, Neil E., Natural Resources in the Caribbean, p. 39.

4 FRASER, Henry and Hughes, Ronnie, Historic Houses of Barbados, Barbados National Trust, Bridgetown, p. 10.

5 The original copper plate engraving is held in the Barbados National Museum.

[6] GOSNER, ref. 1, p. 106.
[7] HOYOS, F.A., Barbados, A History from the Amerindians to Independence, Macmillian Publishers Ltd. Caribbean, p. 47.
[8] GOSNER, ref. 1, p. 102.
[9] IBID.
[10] FRASER, ref. 4, p. 12
[11] FRASER, ref. 4, p. 50
[12] IBID.
[13] IBID.
[14] IBID.
[15] IBID.
[16] GODDARD, Phillip, Interview
[17] VALE, Green Architecture: Design for an Energy-Conscious Future, Thames and Hudson, London, 1991, p. 86.
[18] IBID.
[19] KEIM product information.
[20] GODDARD, ref. 16.
[21] BARBADOS Ministry of Finance and Economic Affairs, Preliminary Draft White Paper on Energy, p. 38.
[22] IBID.
[23] HOPKINSON, Daylighting, William Heinemann Ltd., London, 1966, p. 5
[24] HOPKINSON, ref. 24, p. 221
[25] HOPKINSON, ref. 24, p. 301
[26] GODDARD, ref. 16.
[27] VALE, ref. 18, p. 74.
[28] CHESHAM, Peter, Letter, 30 August, 1996.
[29] IBID.
[30] REAL GOOD TRADING CORPORATION, To Track or not to track, that is the question.

Chapter Six
The Stone Cottage, Castine, Maine, USA

6.1 INTRODUCTION

The Stone Cottage exemplifies the transition many different types of structures have undergone in order to adapt to the owner's needs. Not only does this structure display the transition of styles and tastes, but it also demonstrates how these changes can accommodate the needs of the owners. As with any project there are certain limitations and while there may not be as many as are found in the Barbados case study, there are some. Primarily these limitations are concerned with the preservation of the existing structure.

In the past fifty to sixty years the dilapidated fisherman's cottages and faded summer homes of Castine have been painted and remodelled and now are mostly owned by summer residents. Many of the original structures of the town have been lost to fires and neglect. Subsequently some of them have been rebuilt. The Stone Cottage has been chosen as an example because it is one of the oldest structures in Castine. The original one and a half story structure and foundation was constructed of granite and timber. The Stone Cottage is notable because it contributes to the historic significance of the peninsula upon which Castine is located. The home presents interesting and significant challenges for the preservationist. Perhaps a more difficult challenge is to incorporate green architecture methods into the layout of the home without interfering in the current design. Overall the transition of the Stone Cottage represents an early part of American history that dovetails with an interesting architectural story. The preservationist is presented with an opportunity to examine an eighteenth century structure and to develop a maintenance plan for its continued use.

6.1.1 Geography and Geology

Castine is located on a peninsula along the coast of Maine and is part of Downeast Maine. (Figures 6.1-6.3) The Penobscot River to the west and the Bagaduce River to the east cradle the peninsula. During the British occupation of 1814 a canal was dug. This man-made canal technically creates an island and locals refer to on-neck and off-neck Castine. The terrain on-neck is rather hilly, gently sloping to the rivers on the eastern and western shores. Rock cliffs at the southern end of the peninsula drop off into the Penobscot Bay.

6.2 A BRIEF HISTORY OF CASTINE

Native American Indians wandered the coastal plains and regions of the Penobscot River, Bagaduce River, and the Eggemoggin Reach, before the early European explorers of the sixteenth century. The Europeans came to harvest trees for masts and lumber, and fished and traded with the Indians for furs. The first settlement along the Maine coast was made by the Plymouth Colony of Massachusetts in 1626. According to Ellenore Doudiet, "For nearly one hundred years this trading post or fort was subject to frequent seizures and looting by French, English, and Dutch sometimes under the aegis of legality. During one of these changes of nationality when the fort was surrendered… to Sieur de Grandfontaine, Commander of Acadia, an accurate description of it was made. A portion of this description,' dated August 5, 1670 follows. 'First at the entering in the said Fort, upon the left hand we found a court of guard of about fifteen paces long and ten broad, having upon the right hand a house of the like length and breadth, built of hewn stone and cornered with shingles and above them is a chapel of about six paces long and four paces broad, covered with shingles and built with terras, upon which there is a small turret, wherein there is a little bell weighing about eighteen pounds.' The list continues with an inventory of the encampments armaments and concludes with, 'Lasting about thirty or forty paces from the said fort, there is a

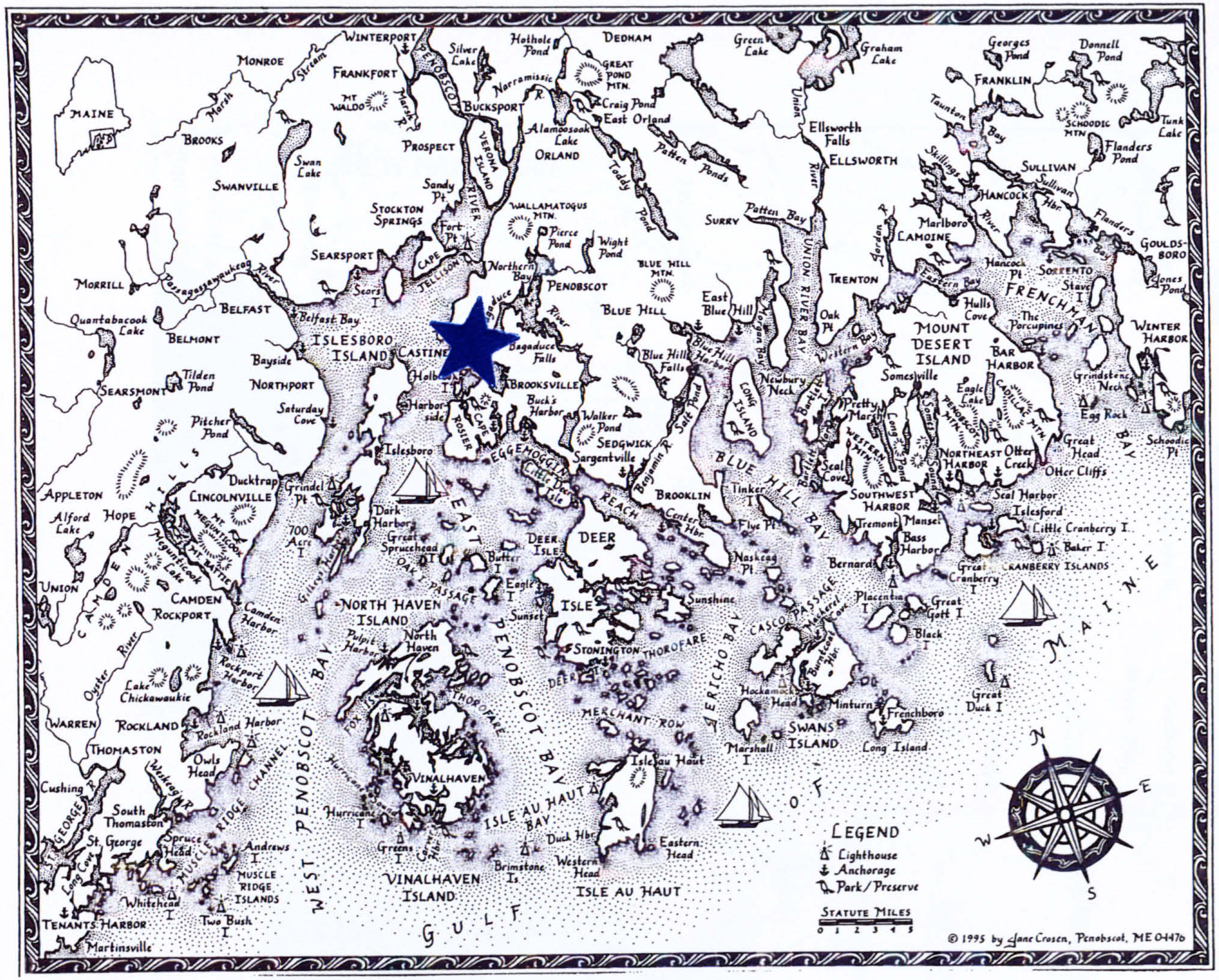

Figure 6.1 Map of Penobscot Bay to Schoodic Point.[i]

[i] Crosen, Jane, 1995.

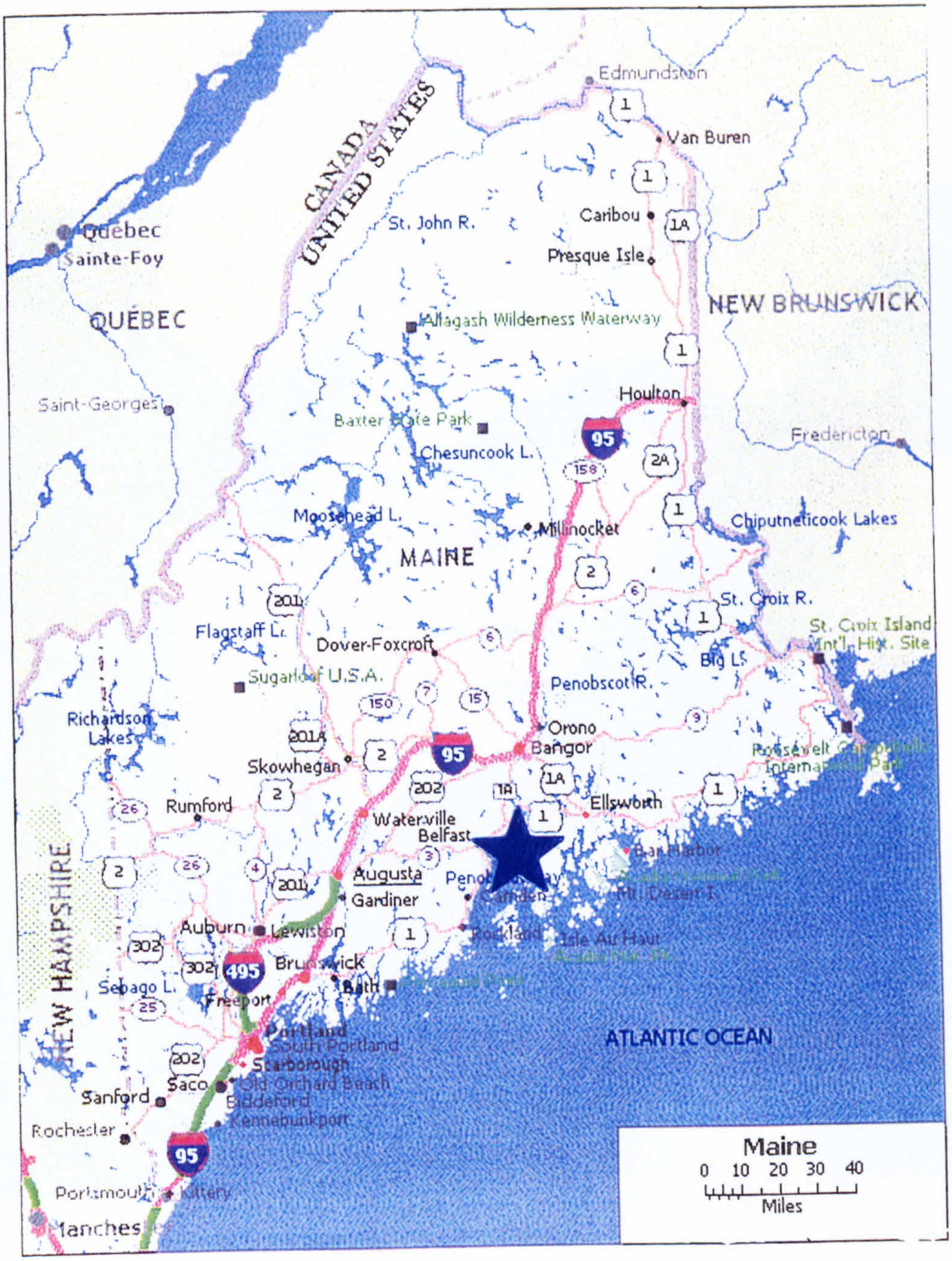

Figure 6.2 Map of Maine[i]

[i] World Sites Atlas, 2002.

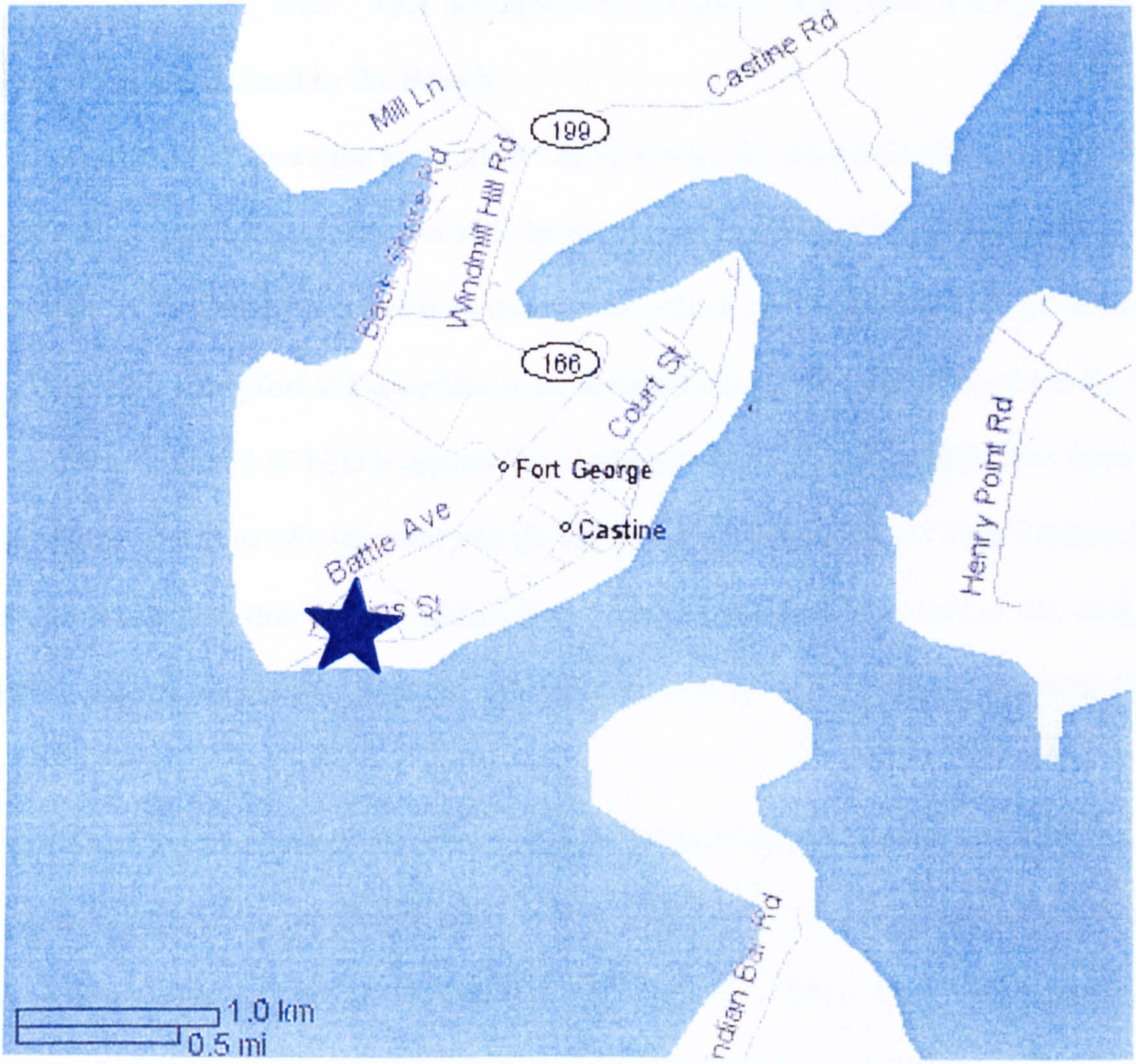

Figure 6.3 Map showing location of the Stone Cottage in Castine.[i]

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[i] Navtech, 2002.

small outhouse, being about twenty paces in length and eight in breadth, built with planks and half covered with shingles which do not serve for any other use but to house cattle. More about fifty paces, from the said outhouse there is a square garden, enclosed with rails in which garden there are fifty or sixty trees bearing fruit."[1] This description is consistent with other descriptions of Fort Pentagouet, which was claimed by the French.

A map of c. 1670 shows the name of Mr. de St. Castin, for whom Castine is named. Having been discharged from the French army in 1667 he must have arrived on the peninsula shortly after.[2] On September 15, 1687 St. Castin wrote to the French official, Meneval, Governor of Acadia, this account, "The [site of the] fort at Pentagouet is an advantageous one for the coast of Acadia. Thirty soldiers would be required to hold it against the continual attacks of the English, who have up to now done all they could to take [the site] and get the [alliance] of the Indians. They [Abenaki] have said that with a little help they could establish four hundred Indians there to defend [the site], more easily still because the English are their own enemies and [the Abenaki] have full confidence in him [the baron]."[3]

The baron's request was denied. Since about 1686 the English had been pressuring St. Castin to relinquish his loyalties to the French and join the British.[4] St. Castin resolutely declined. He did enjoy an amenable relationship with the Abenaki Indian tribe. St. Castin married an Abenaki Indian princess in an Indian ceremony, which was later followed by a Christian ceremony.

The Treaty of Utrecht, 1713, withdrew all of France's power in North America. St. Castin's trading post was abandoned but he continued to live in the area. The Peninsula continued to be recognised as an important military stronghold. In 1759 Fort Pownall was constructed by the British on the western shore of the Penobscot and the land was claimed in the name of the King.[5]

As Revolutionary War activities heated up the British disarmed Fort Pownall in 1775 for fear of it being taken over by rebels.[6] In turn the fort was destroyed by rebels in order to avoid the

British using it as a stronghold. John Perkins, Joseph Perkins, and Mark Hatch, all Tories, took defence matters into their own hands and sent a petition inviting his Majesty's officers in Nova Scotia to take a military position on the Penobscot, thus leading the way for General Gage to erect Fort George.

According to Doudiet as late as 1774 there were only seven houses in now present day Castine and only four of them were framed buildings; the rest were constructed with logs.[7] Castine was predominantly Tory. Many of the inhabitants had moved from Portland, Maine in 1775 when they lost their homes to fire.[8] In 1776 when British troops evacuated Boston several families relocated to Castine.[9] Many felt that the Penobscot River, not the St. Croix was the border between Canada and the United States. This was not to be and in 1783 after peace was concluded Tory refugees moved to St. Andrews, New Brunswick.[10] Some even dismantled their homes and floated them up the coast to St. Andrews.

In June 16, 1779 Colonel Francis McLean landed with over 600 men.[11] It took nearly six weeks before they could begin to mark out the intended fort, because it took that long to clear the heavily forested land and secure their provisions. Once news of the new British force on the Peninsula reached the General Court an American fleet was quickly dispatched under the command of Dudley Saltonstall. British reinforcements were dispatched and when they arrived the American land forces retreated. However, the ships were completely disorganised with warships overtaking transport ships. During the disastrous retreat more than 30 vessels were set alight in order to prevent British capture. Many rebels fled south after the defeat. The British pillaged and burned anything they could find during the next five years of the Revolutionary War.

In 1784 when peace was finally declared many former inhabitants returned to the Peninsula, some rebuilding where they once lived. The British soldiers remained for several days after the peace. However, when an American force did not arrive to take over the British once again burned and destroyed everything they could before evacuating. More families slowly began to return and by the fall of 1784 there were over 600 inhabitants in present day Brooksville, Castine, and Penobscot.[12]

Among the thirty-eight inhabitants on the Peninsula were John Perkins, Joseph Perkins, and Mark Hatch.[13] Once vocal Tories they must have settled their differences with their neighbours. Evidently John Jacob Dice did not, as he sold his land to the Perkins brothers and moved, probably to New Brunswick.

The inhabitants of this region, Majabagaduce, wasted no time, for in 1785 they petitioned for incorporation into a township, Penobscot.[14] Five years later, Lincoln County was divided into three counties: Lincoln, Washington, and Hancock. Penobscot was made the shire town of Hancock county. In 1796 Penobscot was divided into the towns of Penobscot and Castine, with the activities of the county seat remaining for the time being in Castine.[15]

The War of 1812 again brought British occupation to Castine. This time the occupation lasted less than a year. During that time the British repaired and occupied Fort George and dug the British Canal. The Canal was dug primarily to prevent desertion by the troops. On April 25, 1815 after a rather amicable occupation the British evacuated for the last time.

The town of Castine was reconfigured in 1817. Brooksville was expanded with one-fifth of the taxable land in Castine, the same from Penobscot and one-eighth of Sedgwick.[16] In return Castine received one-fourth of the taxable property in Penobscot. Shortly thereafter Maine was admitted to the Union in order to offset the admission of Missouri, a slave state. This brought the balance to 12 free states and 12 slave states in 1820.

In 1838 the County seat was moved to Ellsworth. All of the accompanying businesses and trades followed. While Castine enjoyed the second highest per capita wealth in the United States between 1840-1850, the population and valuation of the town were beginning to decline.[17] In addition to the move of the county seat, more and better roads were being built therefore the need for commercial coastal traffic was diminishing. According to Wheeler, "As navigation in the coastal waters of Maine has become dominated by leisure craft and activities, the days of walking from the lower wharf to the upper wharf on the decks of vessels have long gone by."[18]

The first Normal School opened its doors in 1872. Students boarded in private homes until dormitories were built. In the summer months of July and August these rooms were rented to the growing number of summer visitors. The summer season greatly increased during the mid-twentieth century. Increase in car ownership allowed more transient tourists to visit. Houses were being built specifically as summer homes. In addition, old farmhouses and fisherman's cottages were being bought and remodelled.

In many ways Castine has been able to retain its charm because of its location. However, in the last ten years there has been an explosion in the housing market. This has resulted in a debate among locals and "summer people" about the integrity of the town. Some don't like the changes that prosperity bring and other are not bothered by the changing landscape. Castine has a limited historic preservation ordinance. It is built into the planning code for the town. However, it is a point of contention. It is believed that because the historic preservation ordinance is based on *The Secretary of the Interior's Standards for Historic Preservation Projects* (*SOIS*) it leaves far too much open to a broad interpretation. This author believes that the *SOIS* are problematic. The Castine Historic Preservation Board needs to examine other guidelines that would help to clarify an effective process of historic preservation. The Burra Charter sets out in very clear language precepts for good preservation. Not only does the Burra charter set out clear language, it provides definitions for terms key to the process of preservation. This helps to make sure that the parties following these precepts are clear on an adept process for preservation. By consulting the Burra Charter as a guide and even perhaps adopting it as the framework for the historic preservation ordinance, the process could become far less contentious. Unfortunately in Castine this has become a problem that has rendered the preservation ordinance practically ineffective.

Castine still enjoys and depends on its summer visitors and residents. Traditionally the summer season started with Memorial Day and ended with Labour Day. However in recent years the season seems to extend into the fall when New England foliage is at its peak.

"From today's pleasant, and frequently leisurely and prosperous life, it is not easy to visualise the lively and vital days when lives and fortunes were risked each time a vessel sailed out into the harbour."[19]

6.3 THE STONE COTTAGE, CASTINE, MAINE, USA

As stated earlier the Stone Cottage is believed to be the oldest existing structure in Castine. It can not be highlighted as having had significant influence on the design of later homes in Castine. Instead the Stone Cottage is unique in the evolution of its design. Oddly enough when the house was transformed into a three-story structure, salvaged windows and doors were incorporated by Wood then the homeowner. With some investigation it is apparent that this structure has undergone significant changes to its style and use.

Calef's map of 1779 depicts seven houses on the Peninsula, three cape style and four log cabins, as well as the military strongholds.[20] From the way the structures were drawn it looks as though Calef was trying to depict the structures in perspective. From this point of view it looks as though the Stone Cottage was a one and a half story structure. The possibility of the Stone House being cape style does not fit with the surviving materials and Dice's Dutch origin.[21] It is more likely that the one and a half story structure was of the Dutch Colonial style, which was predominant in New Jersey, Pennsylvania, and parts of New York at that time.

6.3.1 Historical Survey

Because of a lack of oral history and complicated deed records it is difficult to decipher the exact transfer and break-up of the original Dice property. According to deed records John Jacob Dice, a Dutchman and British sympathiser, was the

first owner of the property known as Dice's Head (currently known as Dyce's Head). Dice lived on the lower part of the Peninsula during the English Occupation of 1779. It is believed that Dice and his wife were driven out of Castine after the Revolution War, as they were Loyalists.

In total the land was some three hundred acres, however it is not clear as to how many and what types of structures there were on the property. According to Calef's map of 1779 it appears as though there was a house on the property close to the location of the Stone Cottage. The original date of the Stone Cottage is increasingly unclear. Dice sold the property in what was then known as Majabagaduce in Lincoln County, to Joseph and John Perkins for £400.[22] These two brothers did not live on this land for they had residences further up the Bagaduce River in a more central location in town. Deed records show that the brothers split Dice's land and in 1786 John sold half an acre to Richard Brown on the Majabagaduce River for £150 Halifax currency.[23] This marks the beginning of the split of the three hundred acres originally owned by Dice. Joseph Perkins left his share to his wife Margaret and John left his share to his son Robert.

In 1828 both Margaret and Robert Perkins sold their lots totalling 110 acres on Dyce's Head to Otis Little.[24] Little arrived in Castine in 1794 and married Miss Dorothy Perkins, the daughter of Joseph Perkins.[25] They too had a home in town on Court Street. According to Wheeler, Little was very interested in beautification of the community.[26] He is largely credited with having planted most of the shade trees on Green Street as well as the majority of the elms and maples on Court Street.[27]

Further doubt is cast on the date of the Stone Cottage because the deed records make reference to the stone house that Otis is given credit for having built. William Averill did the joiners work and Fayette Buker did the stone work.[28]

Little rented his land, the Dice's Head Farm, to Zimry Bryant, the second tenant. They made an agreement in 1840 which "specified that Otis Little's farm in this town known by the name of Dice's Head Farm, containing about one hundred acres, with all the buildings thereon, with all the privileges to the same belonging (except the salmon privilege which is not conveyed) for and during the term for three years, or as much longer as they may agree."[29] The agreement was that in exchange for supplying all of the tools necessary for the farm and dairy and all of the cattle and swine which would be appropriate for the summer and winter months, Little was to receive half of the crop, butter, cheese, and butchered livestock.[30] In return Bryant was to take care of all of the upkeep of the farm, making sure that hay was planted and harvested, and that all fences were kept in good repair.[31]

Dorothy Little, Otis' widow, sold the Dice's Head Farm to Joseph Sylvester in 1849 for $1900.[32] In turn he sold the farm to John Witham, Jr. for $1025 in 1858.[33] For quite some time it was referred to as the Witham Farm and some incorrectly attributed Witham with building the Stone Cottage. In 1880 Witham sold the farm for $1200 to William Sargent who in turn sold the Stone Cottage to Phebe Wood, wife of Frank P. Wood.[34] Until this point ownership by a woman was usually as a result of the death of a husband or father. In this instance the deed clearly shows that Phebe A. Wood purchased the Stone Cottage at Dyce's Head from William Sargent for $1035 in 1885 to use primarily as a summer residence.[35] According to a letter from L.B. Wood to F.H. Shelton dated April 12, 1916, it appears as though this is part of the original parcel of land owned by William Sargent. Sargent sold the land in two lots, one to Mr. North and the other to Phebe Wood.

Until this time the Stone Cottage had been a simple one and a half story stone and timber structure with a root cellar. Wood retained the original granite structure and reconfigured the upper floors constructed of timber frame, clad in clapboards and shingles. Later three sides of the house would be clad on the upper stories in birch logs sawn in half. It appears as though when the bark of these logs started to peel-off the logs were painted black and white alternately. Wood had a unique approach to the expansion of his Castine home. He frequented auction sales and the demolition of noted houses in Bangor, Maine fifty-five miles to the Northeast of Castine.[36] He used some of the demolition material in the expansion and renovation of the Stone Cottage. Wood would also purchase second-hand building material and would ship it down the river to Castine where he erected a few summer homes and rented them during the season. This coincided with Castine's growing popularity as a summer retreat.

Phebe Wood died in 1887 and left the Stone Cottage to her husband, Frank Wood.[37] He later remarried and sold it to Helen L. Shelton, wife of Frederick H. Shelton, of Philadelphia in 1903 for $3350.[38] It seems as though Wood sold the Stone Cottage while he retained some of the land, perhaps with one of his summer rentals. The Shelton family used the Stone Cottage and spent most of their summers here. Helen Shelton Coles, their daughter inherited the Stone Cottage in 1939 and owned it until 1977 when the property was sold to Gordon and Betty Lameyer for one dollar.[39] The Stone Cottage is now owned by Roger and Betty (Lameyer) Gilmore.

F.H. Shelton was interested in collecting artefacts from the Penobscot region. There is a cannon on the property positioned to guard the mouth of the Bagaduce River. According to Wheeler, the cannon is a twenty-four pounder and is ten feet long, weighing 4,900 pounds.[40] The cannon is from the Revolutionary War and according to the Annual Report for the Town of Castine from 1924-25, the cannon was to remain on the property as long as any of his (Shelton's) blood owned the premises.[41] According to Charles F. Collins, a Castine native, "the cannon was moved from Fort Ticonderoga, New York to Boston at the beginning of the Revolutionary War. In 1807 General Knox brought it to Castine where it was put into place by oxen, first at Fort Madison and subsequently at the Stone Cottage."[42] The cannon was owned by the U.S. Ordnance Department until 1884 when the ownership was transferred to Frank Wood of Bangor. When Shelton purchased the Stone Cottage in 1903 the cannon was transferred with the property. In 1921 Shelton formally sold the cannon to the Town of Castine for one dollar, so that Castine would legally own it and the cannon would remain in the possession of the town forever.[43]

The Stone Cottage's exterior and interior are distinctly different. The exterior is comprised of four different finishes which appears were used at the whim of Wood, the person credited with making the most extensive alterations. The house is comprised of two sections, the first and largest section being the original foundation and first floor constructed of granite. The upper stories of this section, as with the rest of the house, are timber frame construction. Half-hewn birch logs have been laid over shingles on the eastern and western façades. (Figures 6.4, 6.5) The upper storeys of the southern façade are clad in clapboards. (Figure 6.6) The northern façade is shingled with the exception of the pediment which has been finished in untreated half hewn birch logs. (Figure 6.7) The second section was most likely a carriage house and is currently used for storage and contains a bedroom on the upper floor.

As one can see the windows and doors do not match, supporting the claims that Wood incorporated salvaged building material. In one instance on the eastern façade painted half-hewn birch logs have been used to fill in and perhaps balance the window which may have been out of proportion to the rest of the features on this façade. (Figure 6.4)

The house can be entered from four areas on the main floor. The main entrance is to the west through the living room. However, this is not the original entrance. This space is open to the formal dining area to the north and leads into the sunroom to the south. (Figures 6.8, 6.9) The living

Figure 6.4 Eastern façade showing the half-hewn birch logs and granite first floor.

Figure 6.5 Western façade showing the formal entrance and part of the sunroom.

Figure 6.6 Southern façade showing the white clapboards.

Figure 6.7 Northern façade showing the unfinished shingles and birch clapboards.

Figure 6.8 Oak panelled dining room.

Figure 6.9 Sunroom.

and dining spaces are dominated by a central chimney, which opens into the living room. (Figure 6.10)

The space in this first floor configuration is very cosy. The ceiling height is low, approximately seven feet high. However, this is not the original ceiling. The Gilmores recently had some repair work done due to a leaky pipe.[44] When the ceiling was opened they found that the ceiling had been dropped about a foot.[45] The beams which appear to hold the ceiling in place, do just that, appear to hold it in place. They are not supporting structures but are purely decorative.

There is access from the dining room to a breakfast room, which is used for storage and as an informal eating area. (Figure 6.11) The kitchen is to the rear with access to the second floor and outside. (Figure 6.12) The access to the second floor leads to the 'through' room as this room provides the bridge to what would have been separate quarters for the butler and maid/cook and is over the carriage house.

The main staircase leading from the living room leads to a hallway off of which the master bedroom, through room, two guest bedrooms, a bathroom, and the third floor are accessed. (figures 6.13-6.16) The front guest bedroom and master bedroom are connected and share a sunroom overlooking the mouth of the Bagaduce River.

A steep stair off the main hallway accesses the third floor. (Figure 6.17) The third floor houses two more bedrooms and a bathroom. (Figures 6.18 and 6.19)

6.3.2 Material Survey

It is believed that originally the Stone Cottage was a one and a half story farmhouse with a root cellar. The foundation and first floor are constructed of granite. The half storey is a timber frame and clad in clapboards or shingles. During the late nineteenth or early twentieth century the second and third stories were added in timber frame. Initially the upper stories were shingled,

Figure 6.10 Main staircase and fireplace.

Figure 6.11 Breakfast room.

Figure 6.12 Second floor access to the kitchen.

Figure 6.13 Second floor hallway.

Figure 6.14 Master bedroom.

Figure 6.15 South facing guest bedroom.

Figure 6.16 Guest bedroom.

Figure 6.17 Stairs to the third floor, note the steep risers.

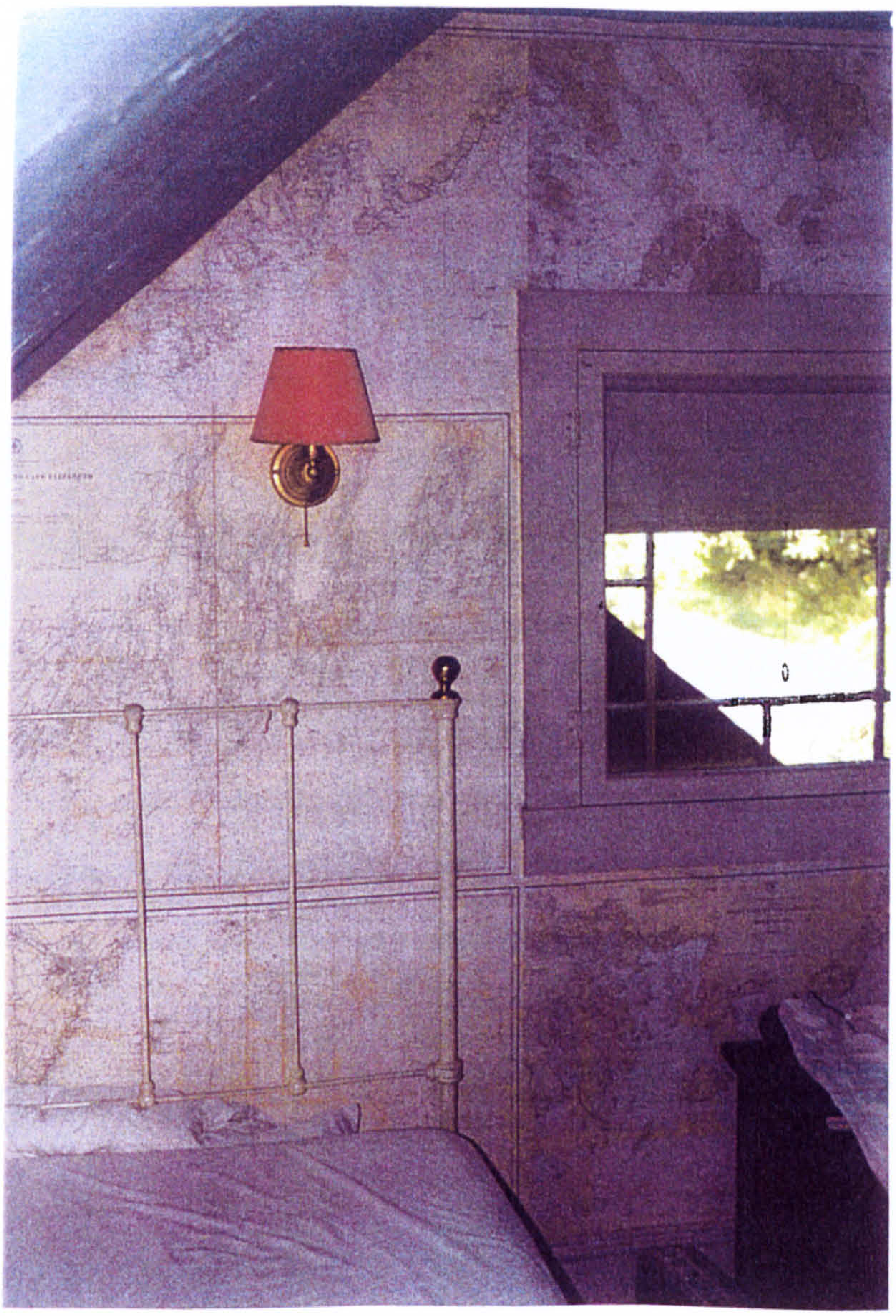


Figure 6.18 Northern third floor guest bedroom.

Figure 6.19 Southern third floor guest bedroom.

however, during the early twentieth century parts of the house on the upper levels were sided in rough sawn birch logs, cut in half lengthways. It is believed that originally the logs were left exposed to the elements, but as the bark started to peel the logs were painted black and white alternately.

The first floor has plaster and timber ceilings, the second floor has timber ceilings and the third floor plaster ceilings. The main structure is roofed in asphalt shingles and the floors and support structures throughout the home are wood. The roofs on both of the sunrooms are made of copper. (Figure 6.20)

The Stone Cottage is fabricated primarily from granite fieldstones and timber. The interior finishes vary from plaster to wallboard. The structure appears to be sound. However, the interior finishes on all of the floors may be hiding damage, in particular moisture damage. This is difficult to assess until the problems present themselves. For example the floor in the breakfast room had become according to the current owner, 'springy', which would suggest rot or deterioration in the floor joists. Instead of having the joists replaced the Gilmores have opted to shore up the floor structure with a series of jacks. At least half a dozen have been put into place and seem to have solved the problem temporarily. The concern is that this is a temporary solution to a problem, which will continue to get worse. In addition, since the Gilmores have owned the house part of the foundation on the eastern wall had fallen out.[46] The fieldstones were put back in place and are held together with concrete.

6.4 BUILT ENVIRONMENT: DESIGN AND THE ENVIRONMENT

There were many lessons to be learned by the early settlers who were building structures in North America. Building styles, techniques and materials which had been suitable in their home countries were ineffective in this new country of harsh extremes in climate.

Figure 6.20 Copper used on the first floor sunroom roof.

Structures in the beginning tended to be simpler and rougher than their European counterparts, partly because of the Puritan views being brought with the early settlers and partly because everything had to be made by hand with rough tools. The configuration of rooms changed with the fireplace placed at the core of the building rather than on an exterior wall. This transition in the layout of the building permitted the early settlers to diffuse the abuse the elements could bestow, particularly during a harsh Maine winter.

Initially inhabitants of the Stone Cottage had to deal with the climate year round. Winter being the harshest of the seasons with temperatures reaching below freezing, snow drifting, and the winds howling, buildings needed to be sound, warm, and dry. The fireplace was the only way to provide a constant source of comfort. Although spring, summer, and fall are far more temperate and enjoyable, it is certainly possible to need the fireplace during any one of these seasons.

It is necessary to manipulate both the temperature and humidity in order to maximise comfort levels when the climate becomes uncomfortable. This was primarily done when the Stone Cottage was used year round. Since the Stone Cottage has been used primarily as a summer residence since c.1885 very little mechanical manipulation of the primary climate controls has been necessary. Should the homeowner decide at a later date that they desire year round occupancy significant improvements must be made in order to make the house comfortable and economically feasible during the winter months. This study will address the passive design advantages of the Stone Cottage for both cold and hot weather.

6.4.1 Temperature

A) Comfort

Temperature controls during the winter months are vital. It is more a matter of survival rather than purely a matter of comfort. The floor plan of the Stone Cottage is segmented and laid out on a southeasterly axis. On the ground floor the three main rooms, living room, dining room, and breakfast area are centred on the chimney. Therefore the important living areas have been consolidated, which would have been important when trying to conserve heat. The kitchen is to the rear, but this does not seem to have been the original configuration. It is believed that the kitchen would have initially been a part of the condensed living area. However, with the transition into a summer residence the kitchen has become separate, perhaps to minimise the affects of cooking in the summer heat.

The sunroom is off the living room and runs the breadth of the house. There are mature pines, birches, and mountain ash that shade the house, primarily to the north, east, and west. On the southwestern exposure of the first floor sunroom there is a mature lilac bush which also provides ample shading. The second floor layout is more segmented. The corner bedrooms can be cross ventilated to minimise high summer temperatures. The thermal mass is minimised on the upper levels, but on the first floor the solid enclosure is quite substantial. This may seem contrary to any effective plan for dealing with hot temperatures. However, the masonry stays cool throughout the summer and is aided by the mature trees that shade the exterior.

6.4.2 Sun

A) Comfort

The sun is an asset in these northern climes, even during the summer. The mature natural vegetation along the northern, eastern, and western façades diminish the intensity of the direct sunlight. In addition, the deep eaves further shade the upper storeys. In this case it is the southern exposure which is most vulnerable. This would have been an advantage during the winter months when passive solar gain would have been substantial on the southern exposure. In turn the thermal mass, the granite walls, would have held the heat and the black roof shingles would also have aided any passive solar gain.

The main roofing material is asphalt shingles. For the most part the exterior walls blend into the surrounding area. The masonry and painted half hewn birch logs work well together. The southern façade of white clapboards and masonry are a more striking combination. Overall the house looks as though it is hunkered into the landscape and vegetation.

6.4.3 Wind

A) Comfort

In this climate wind and ventilation are both an asset and a liability. The layout of the Stone Cottage uses controlled ventilation as an advantage in most of the sleeping quarters during the summer months. The wind during the winter months poses a problem, as it can strip heat away from a building. Because of the Stone Cottage's location at the mouth of the Bagaduce River overlooking Penobscot Bay it is subjected to the brunt of brutal Nor'easters. The trees act as somewhat of a buffer, but they do not protect the southern exposure which really gets beaten by the elements.

6.4.4 Moisture

A) Comfort

Humidity controls in the Stone Cottage have been based on controlled ventilation, i.e. opening windows and doors. Until now this has been the most effective way to passively deal with excessive humidity. When this does not meet the required comfort levels auxiliary circulation is recommended. Window and ceiling fans should be able to cope with meeting these needs. It is rare even during the worst Maine summers for fans not to be sufficient. At most the unusually hot weather will last for two weeks.

B) Structure

It is a concern that excessive moisture has caused damage that is not yet apparent. The deterioration of the floor joists under the first floor is believed to be caused by excess moisture in the basement. The joist beams felt damp to the touch and the jacks which have been put into place to shore up the joists have rusted into place. A problem with the construction of the Stone Cottage is that problems are unknown until deterioration presents itself visibly or physically. Certainly this is quite a concern in relation to the soundness of the structure of the building.

It should be noted that because of the Stone Cottage's location at the mouth of the Penobscot and the lack of protection on the southern façade the house is left exposed to not only the wind, but also the driving rain. This added moisture is a concern. During the summer while the house is open there is the opportunity for ventilation. However, during the winter months when the house is closed and shuttered the build-up of moisture in the house is a concern. It is during this time that it is feared the worst unseen damage is being done.

6.5 SOLUTIONS

The most significant problem to solve is that of a deteriorating support structure. This problem has been solved, temporarily. However it would be wise to carry out further investigation and perhaps consider major repairs to the foundation and floor joists before things deteriorate further. If the problem is allowed to continue unchecked then other structural problems may develop. Only when this problem has been fully addressed would it be wise to carry out other preservation projects and at that point incorporate efficient technology, devices, and materials.

In the case of repairs made to the structural system it is suggested that for engineering purposes and longevity steel I-beams be used in combination with new wood floor joists. It is possible that the foundation walls were dry-stacked and over the years have been repaired with concrete. This means that extensive repairs to the foundation and structural supports become necessary and more complicated. It is likely that a new foundation will need to be built before the remainder of the structural repairs can be carried out. It is inevitable that other repairs to the structure will need to be made. It is suggested that the same materials and finishes be used to make the necessary repairs..

In addition to the structural repairs necessary, it is suggested that all of the windows and doors be examined and when needed repaired. This includes the sunrooms. Although during the winter the house is closed and shuttered, it is felt that moisture in the house reaches a peak because of leaky ineffective windows. The wood in most of the windows has warped therefore preventing a tight fit. Should this problem be solved it would alleviate some of the damage associated with moisture gain and retention. It was observed that there are some spots in the basement and the attic space, which need to be repaired. Any other areas that are not tight or sound should be examined and repaired as necessary.

These areas need to be repaired in addition to the structural work that has been suggested. If not there will be continued problems as a result of excess build-up of moisture in the house. Certainly the damage occurs over an extended period of time. However, by addressing the problem now a considerable amount of damage can be avoided.

At this point because the Stone Cottage is predominantly used seasonally it is not prudent to go ahead with a plan to winterise it. Because of the prior year round use it is believed that the ground floor has relatively efficient thermal mass. However, it is felt that the upper floors are not suited for year round use at this time. Should winterisation become necessary, a comprehensive plan that details the entire process should be completed.

6.5.1 Appliances

Since the use of the Stone Cottage is seasonal the electricity use will vary. For the most part during the season there are consistently at least two residents. However, demand will fluctuate depending upon the number of guests. Because the occupancy fluctuates the possibilities for an installation of a photovoltaic system or wind powered system are slim. As with Belmont House the cost would be prohibitive, in order to expect any gains from such an installation consumption needs to be higher.

An EPA sponsored program, Energy Star, gives ratings and recommendations for household appliances and their operating efficiency. The program is a useful tool in order to assist with purchasing new appliances.

A) Cooking

All cooking is done with electrical appliances; stove, oven, and microwave. In terms of control this is not the best option because the temperature of electric stoves and ovens are hard to regulate. In addition, carbon dioxide emissions for electricity versus gas in cookers is 2.4 times greater.[47] However they provide the option for easy conversion to an independent photovoltaic system from the electricity grid.

B) Hot Water

The hot water heater is electric. For the most part hot water is always on hand, but there is the possibility of running out when the capacity of the tank has been exceeded. Again there is the problem with CO2 emissions however; there is the advantage of easy conversion to a passive solar system.

C) Lights

It is suggested that compact fluorescent bulbs be used to replace the traditional tungsten bulbs as needed. The cost of replacing all of the tungsten bulbs at once can be high, as the compact fluorescent bulbs cost on average $10USD each. However, estimates show that each compact fluorescent bulbs will save on average $40USD worth of energy over their lifetime.

D) Refrigerators and freezers

In a perfect world units that use hydrocarbon technology would replace the refrigerator/freezer unit. To be practical it is unlikely that the unit will be replaced until it wears out. Upon investigation, the Greenfreeze and CFC technology mentioned in Chapter Five, 'Belmont House', is not available in the United States.

The units the Energy Star program recommend are not based on the alternative technologies which have become available in Europe during the last five years. Instead the program bases the ratings on better insulation, more efficient compressors, improved transfer surfaces and temperature and defrost mechanisms.[48]

E) Washing Machine

According to the EPA's Energy Star program there are two designs which provide efficient washing methods, front-loading and top-loading. The front-loading method relies on the tumble action of the machine to create friction which in turn helps to wash clothes with less water. The top-loading machines use sensor technology to monitor the water temperature as water fills the basin, however this would require more electricity. In order to reduce water consumption in the top-loading machines, the clothes are sprayed with a high powered rinse instead of soaking clothes in a basin full of water to remove soap residue.

As has been discussed in Chapter Two, 'The Built Environment' front-loading washing machines are the most efficient. As was the suggestion at Belmont House, the washing machine could be connected to a solar hot water heater in order to decrease the energy demand. In addition, because the Stone Cottage is a seasonal summer home solar drying would greatly reduce the amount of energy used for drying clothes when the weather permitted.

F) Dishwasher

For this household it may be sufficient to wash dishes by hand when there is not a house full of guests. When it is necessary to use the dishwasher it should only be run at full capacity and during off-peak hours. The Energy Star program also provides guidelines for dishwashers. The machines recommended are designed with sensors to save electricity and hot water. These dishwashers have internal electric heaters that heat the water suitably for washing dishes.

6.6 GOVERNMENT INCENTIVES AND POLICY

Currently there are no local, state, or federal government incentives or policies, which would encourage the homeowner to decrease their energy consumption. As pointed out the Environmental Protection Agency has implemented the Energy Star program that makes recommendations available to the public for household appliances that are efficient.

6.7 LIGHT PENETRATION

Activity is primarily centred in the sunroom, which benefits from an optimum amount of natural light for the greater part of the day. However, lighting levels in the remainder of the house need to be sufficient enough so that household tasks and recreational activities may be enjoyed.

Direct skylight and light reflected from the ground will be the greatest determinants affecting the amount of interior daylighting. As outlined earlier, the Stone Cottage is heavily shaded by mature trees and bushes. This will affect both the amounts of direct skylight as well as light reflected from the ground. (Figures 6.21-6.29) There is only one structure in close proximity to the Stone Cottage, but it is screened with mature trees so it does not factor into the amount of light reflected from vertical surfaces. On the whole only the southern façade is clearly exposed to direct skylight and light reflected from the ground and water.

The first floor decoration is primarily dark oak, both the floor and panelling in the dining room. The reflectance property of the dark wood is probably in the region of 1%. Hopkinson, et al categorise the reflectance property of dark black, the wood being so dark that in fact it looks dark black, at 1%.[49] The walls are painted white and therefore rate a reflectance value of 85%. However, the wall surface area is minimal in comparison to the dark wood. The dark decoration greatly affects the first floor reflectance values. In turn low luminance levels for the dining room are registered. During the day daylighting levels in the dining room and living room are not sufficient for specific

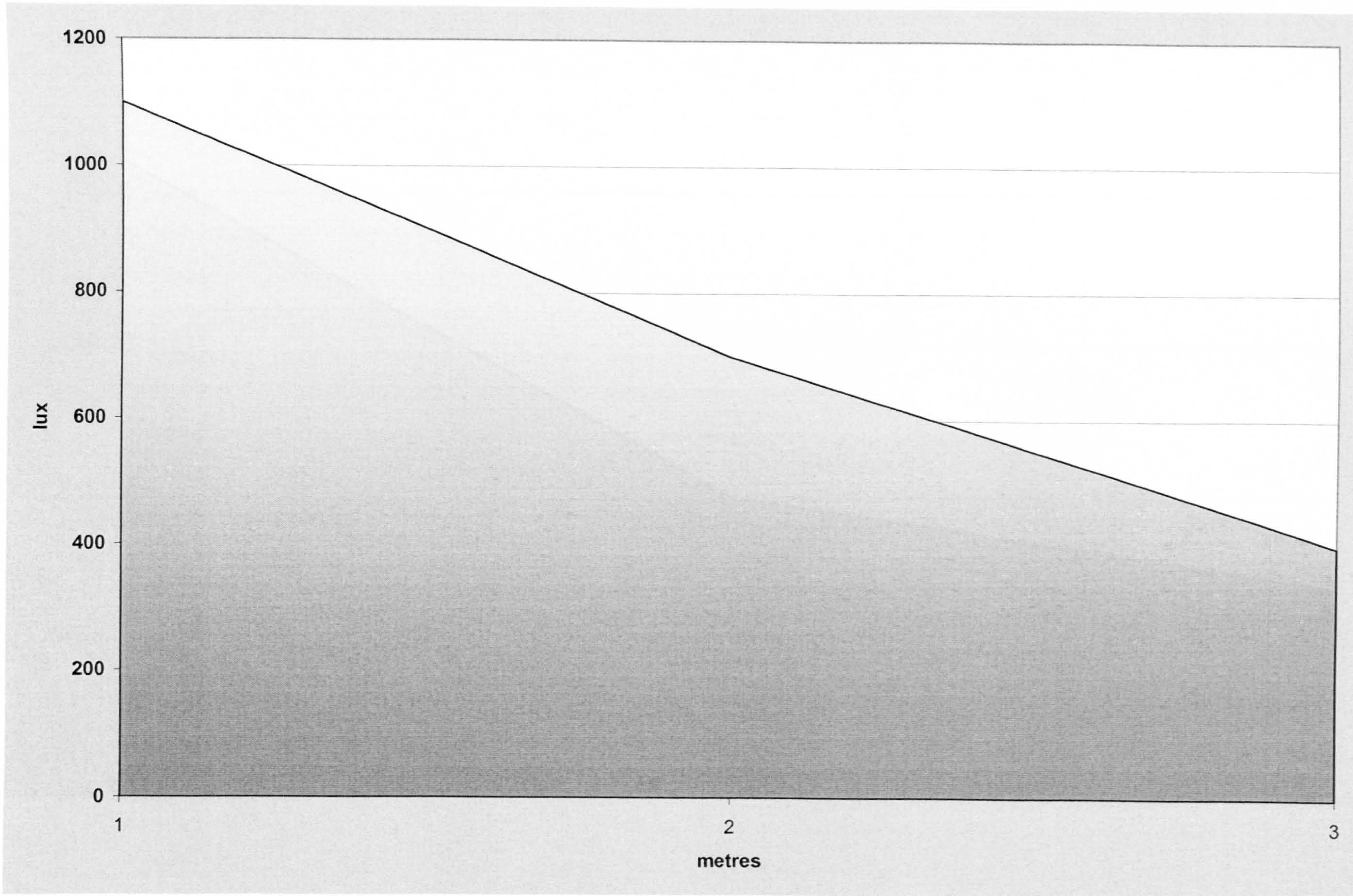


Figure 6.27 Lux reading for the southern façade at 11am, the Stone Cottage.

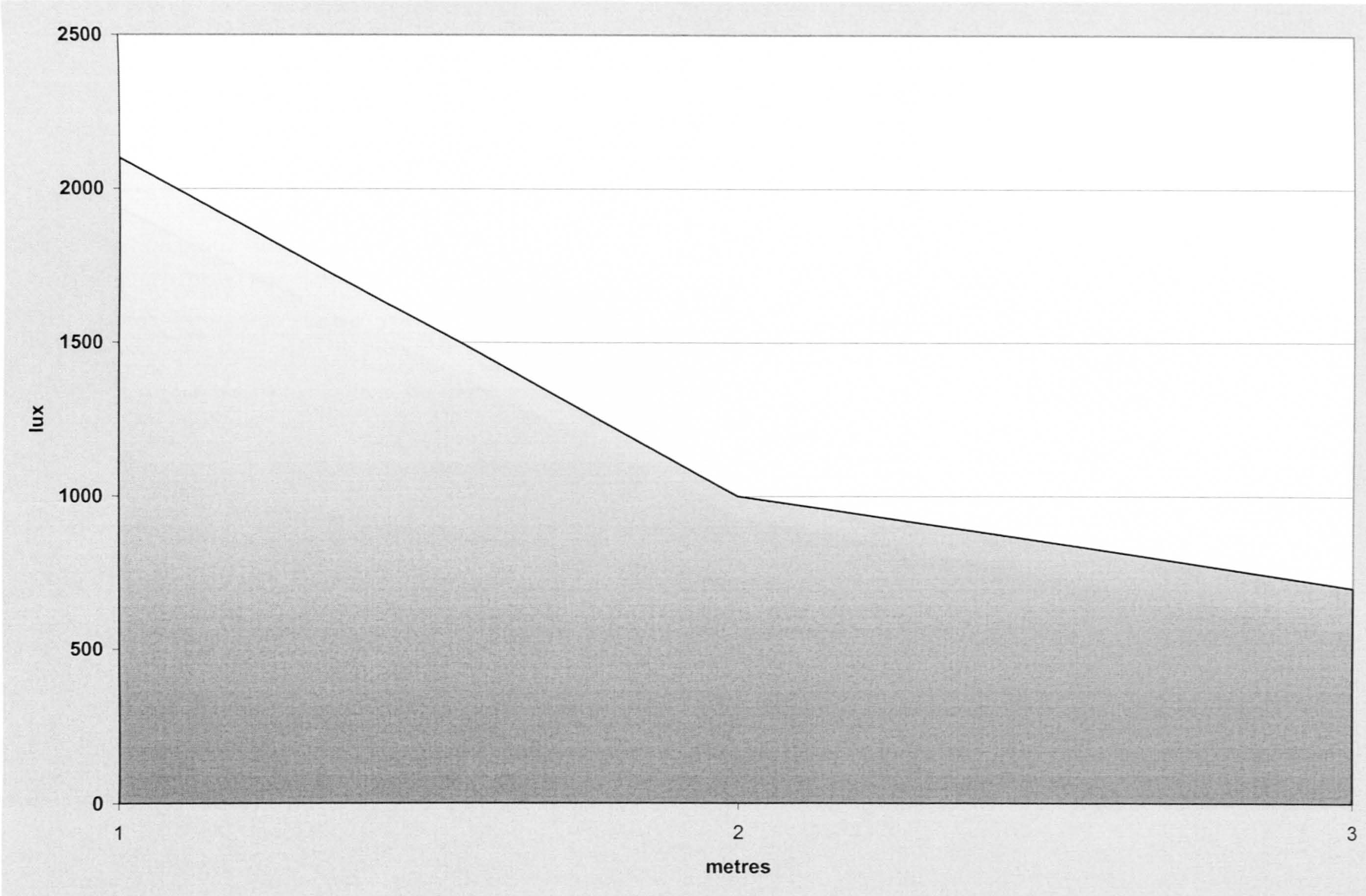


Figure 6.28 Lux reading for the southern façade at 1pm, the Stone Cottage.

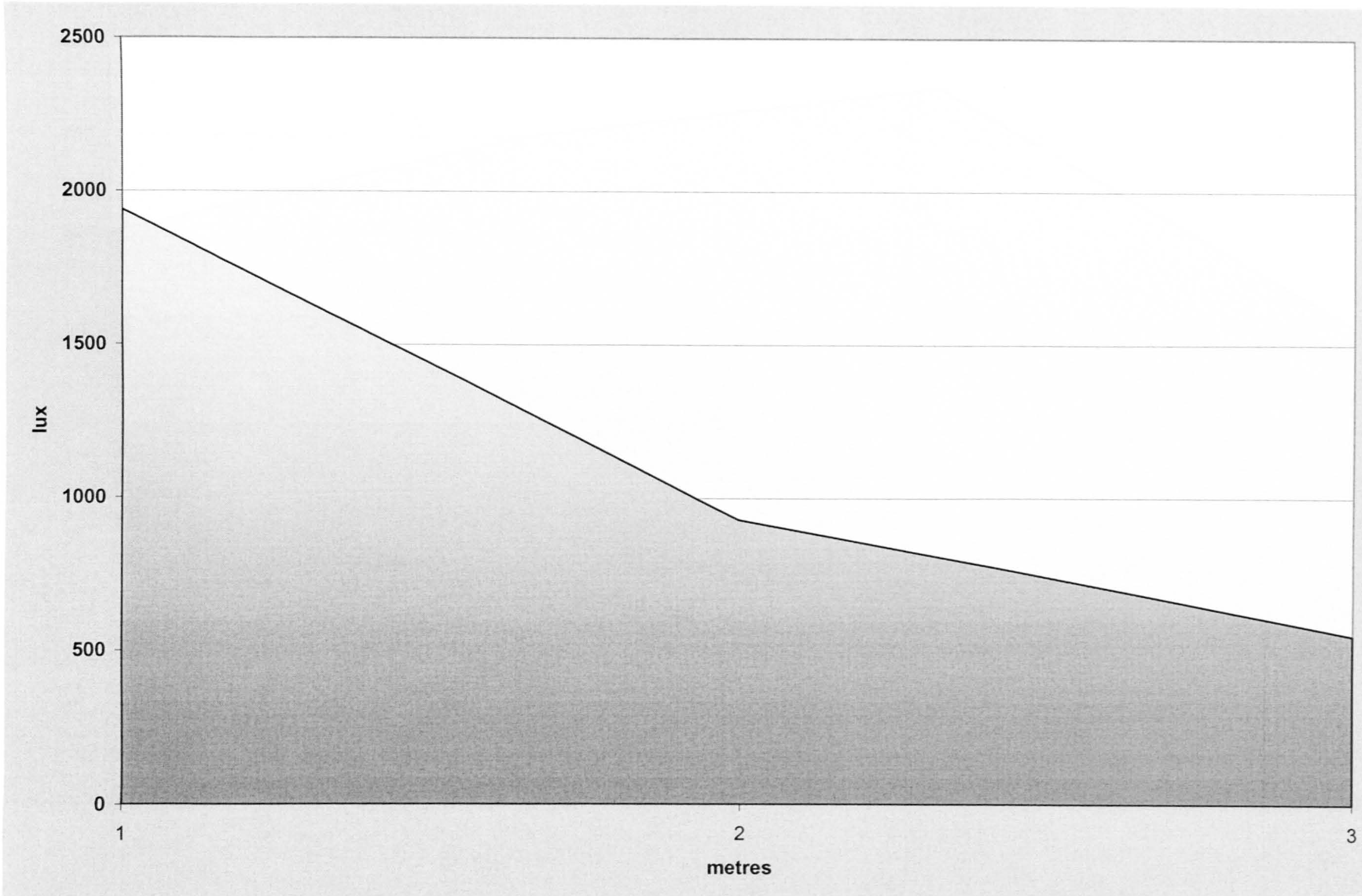


Figure 6.29 Lux reading for the southern façade at 3pm, the Stone Cottage.

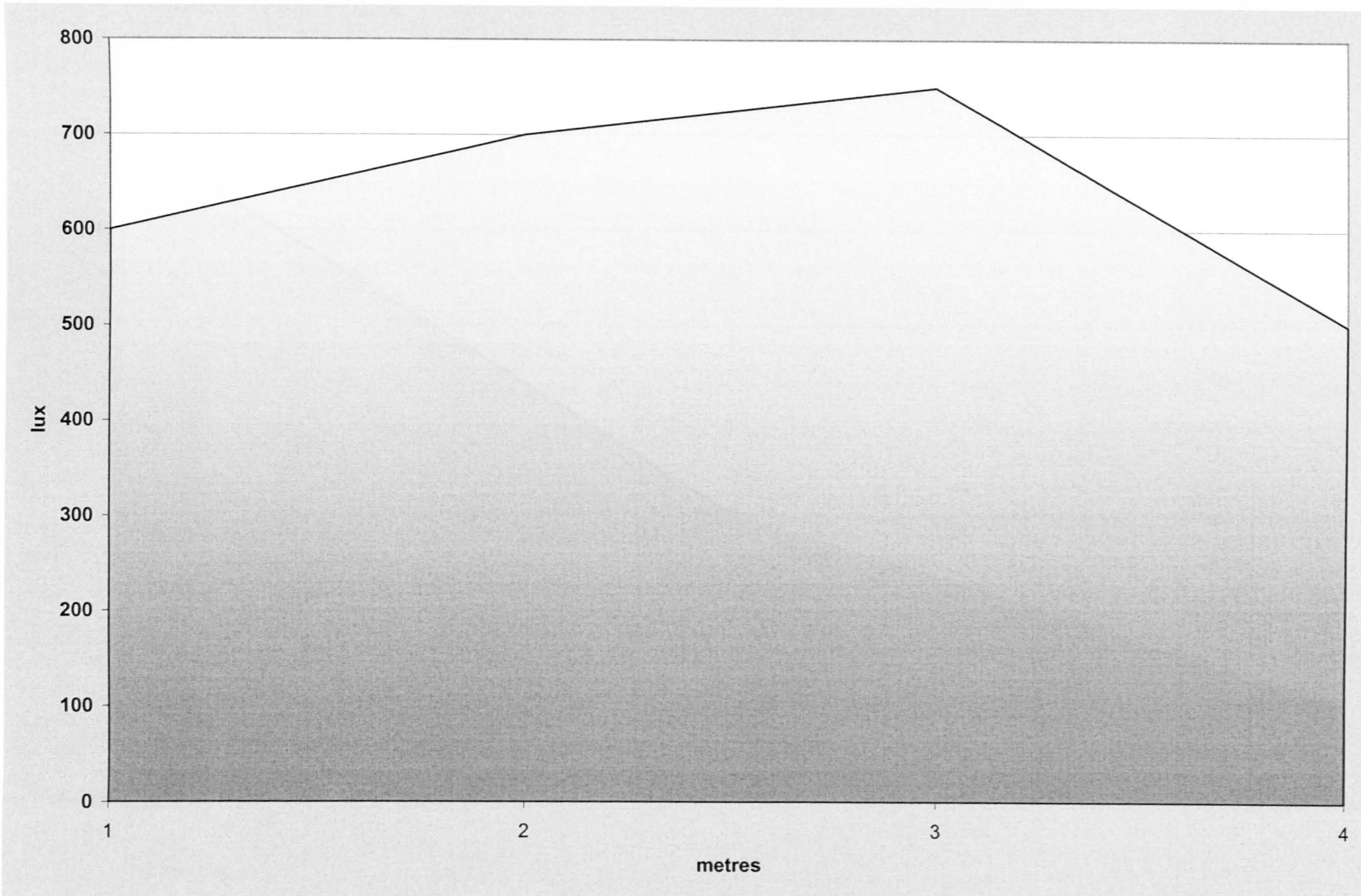


Figure 6.30 Lux reading for the eastern façade at 11am, the Stone Cottage.

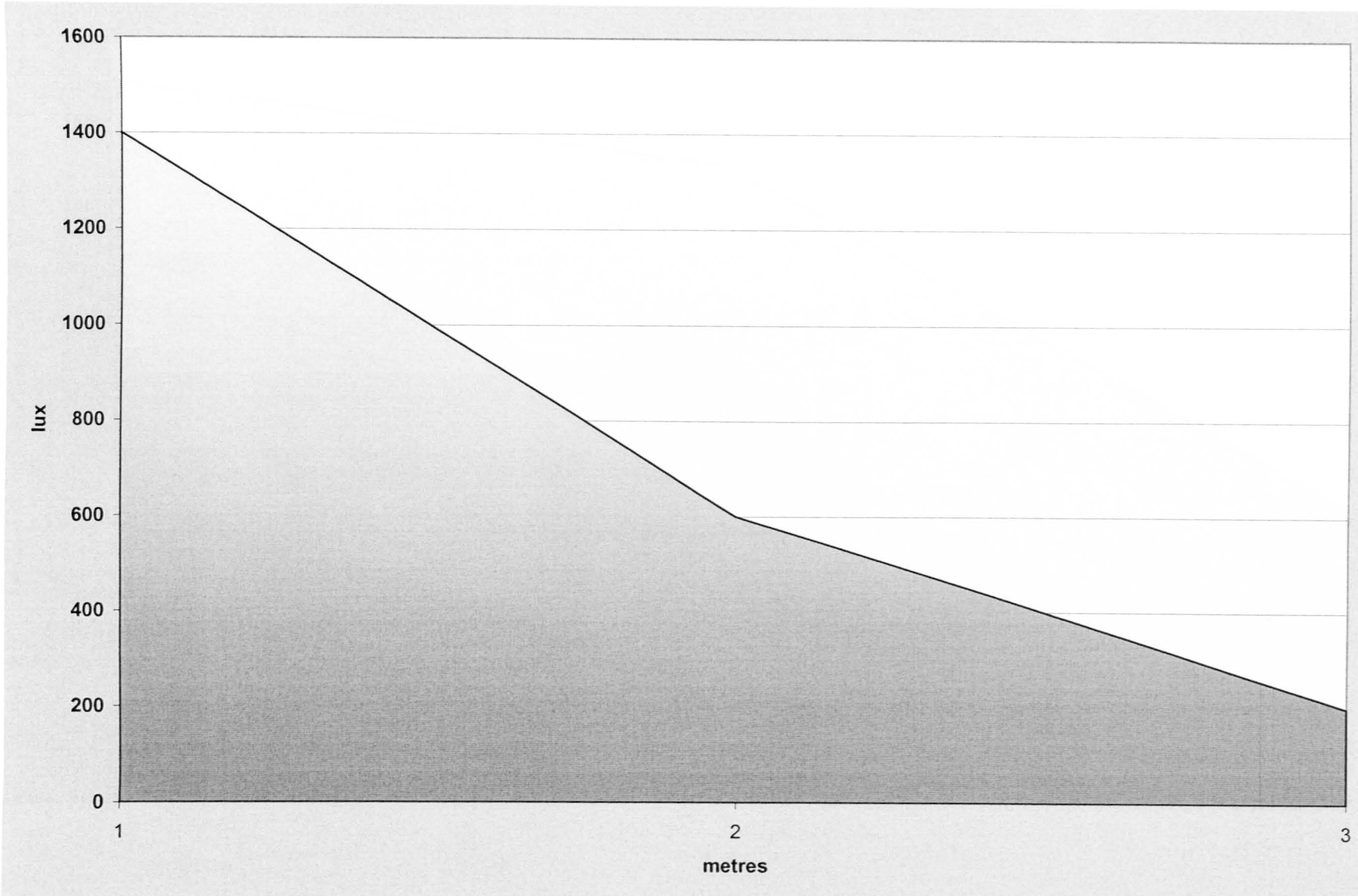


Figure 6.31 Lux reading for the eastern façade at 1pm, the Stone Cottage.

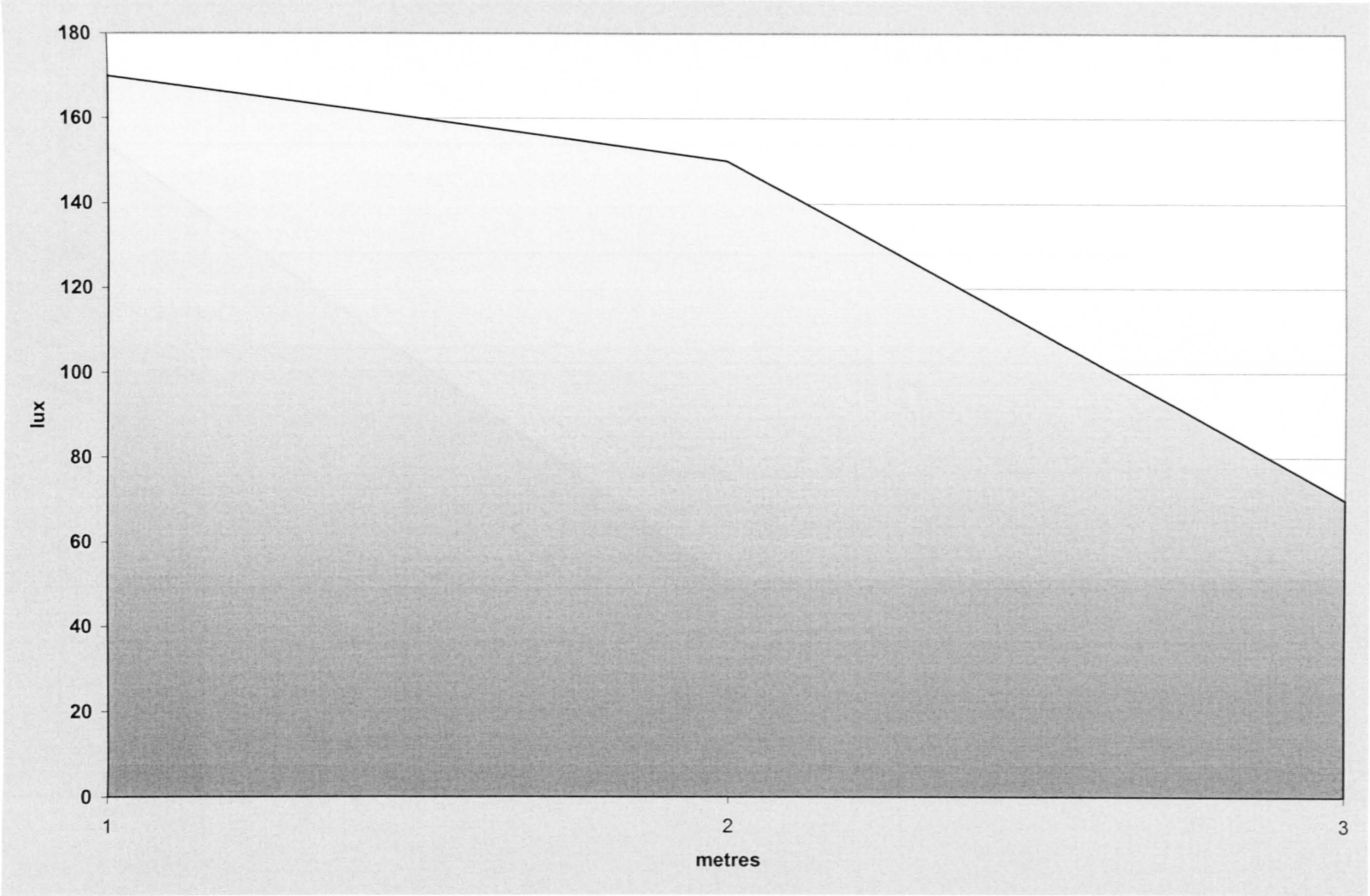


Figure 6.32 Lux reading for the eastern façade at 3pm, the Stone Cottage.

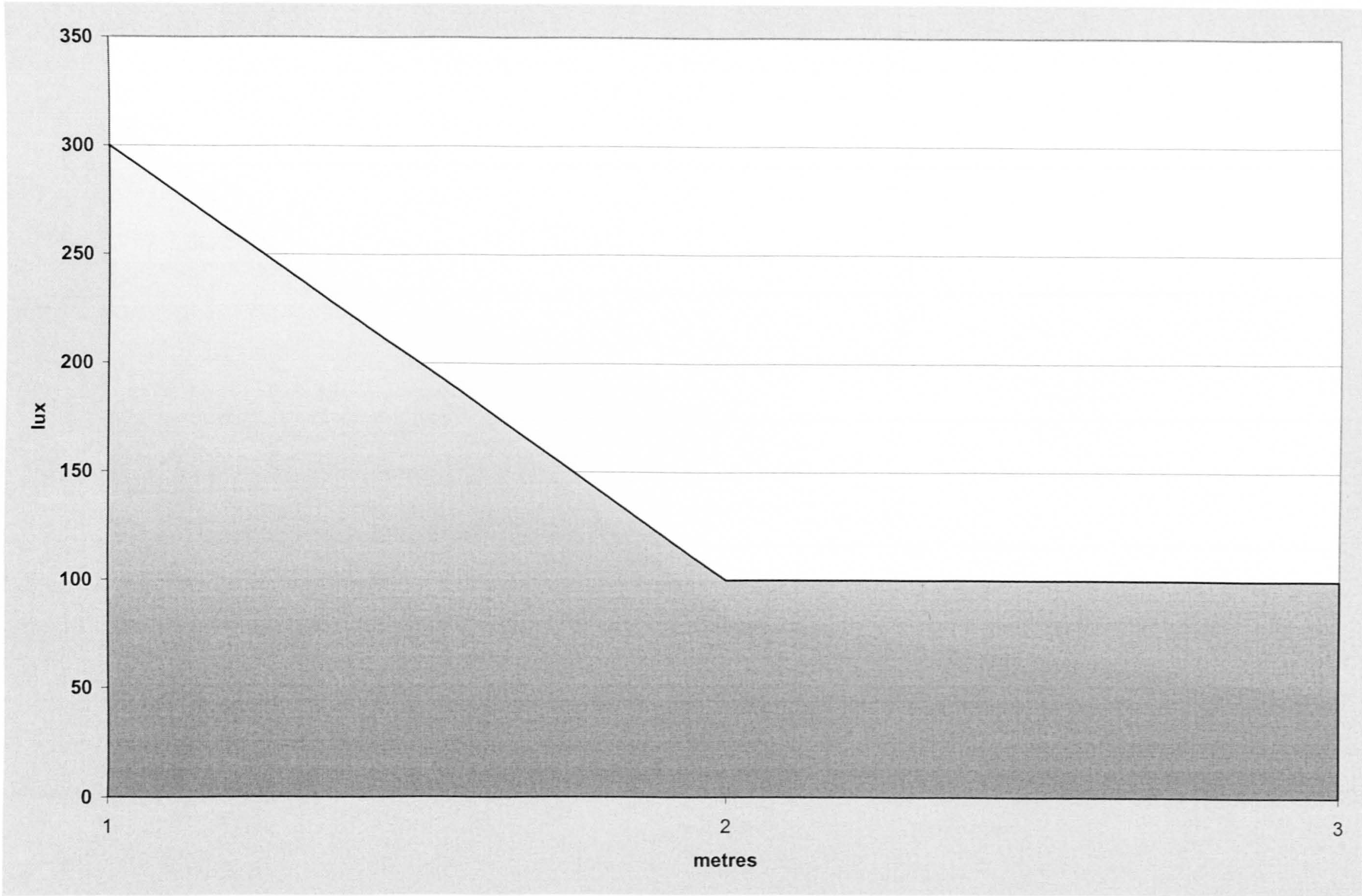


Figure 6.33 Lux reading for the western façade at 11am, the Stone Cottage.

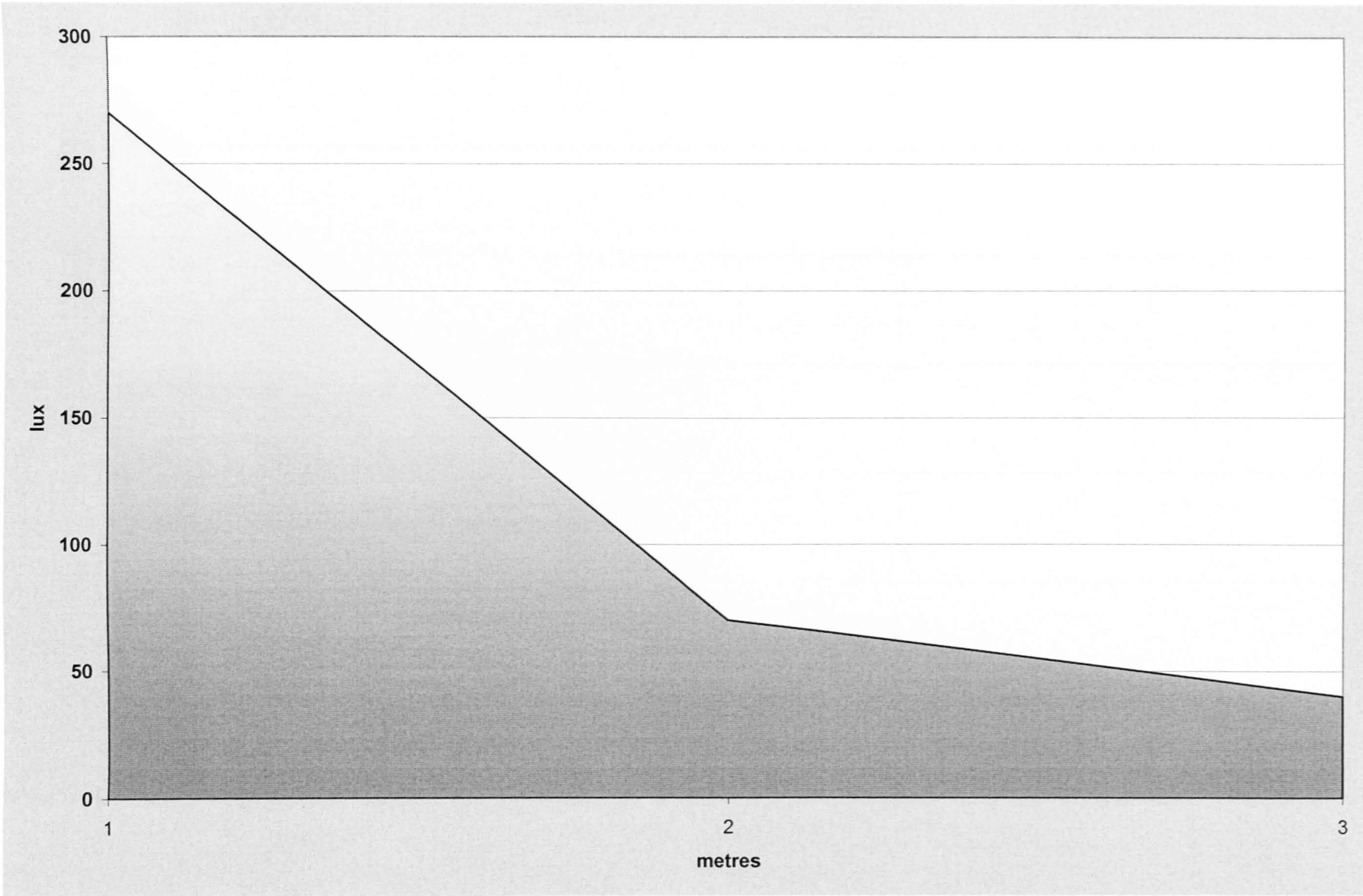


Figure 6.34 Lux reading for the western façade at 1pm, the Stone Cottage.

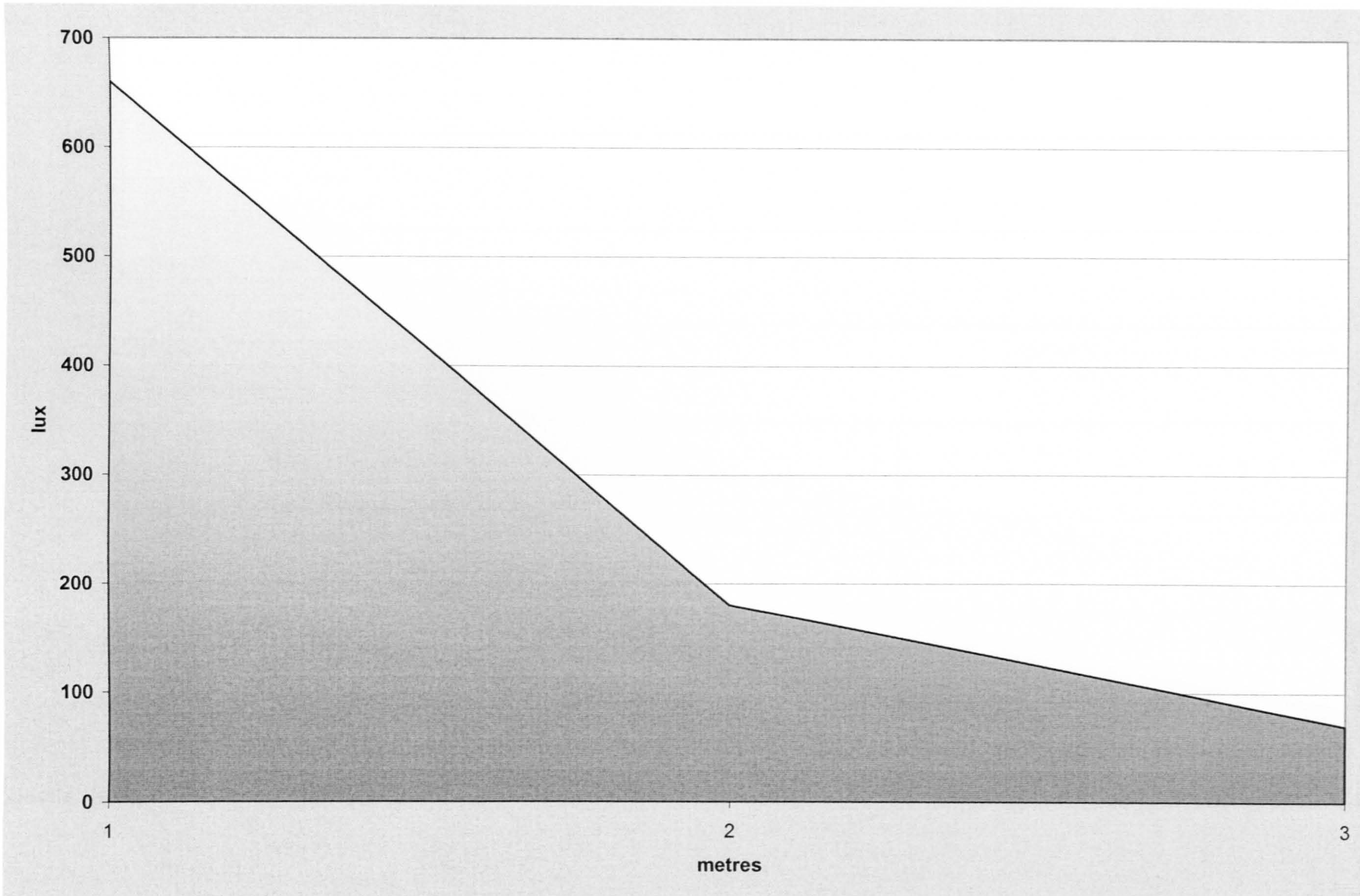


Figure 6.35 Lux reading for the western façade at 3pm, the Stone Cottage.

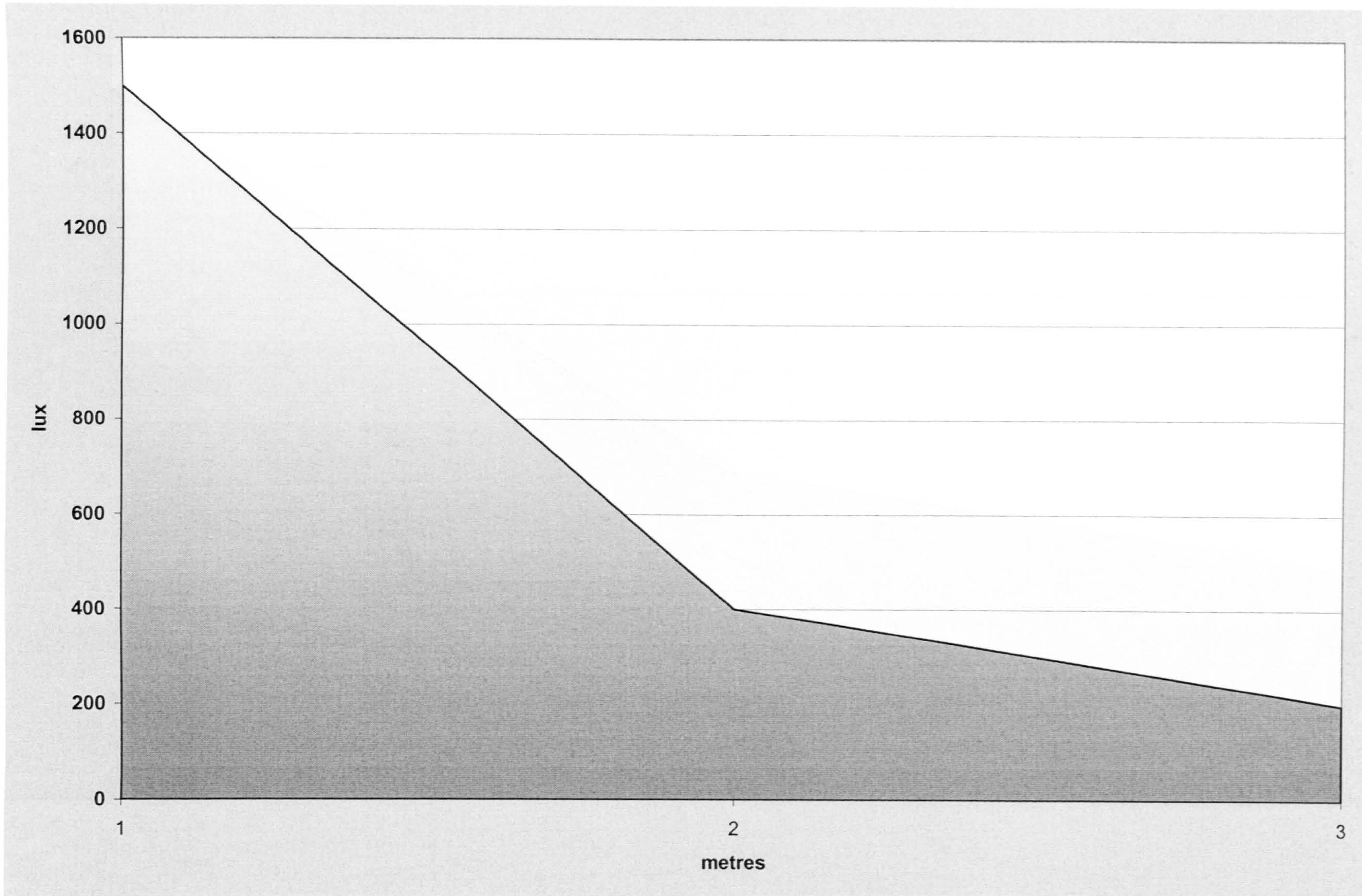


Figure 6.36 Lux reading for the northern façade at 11am, the Stone Cottage.

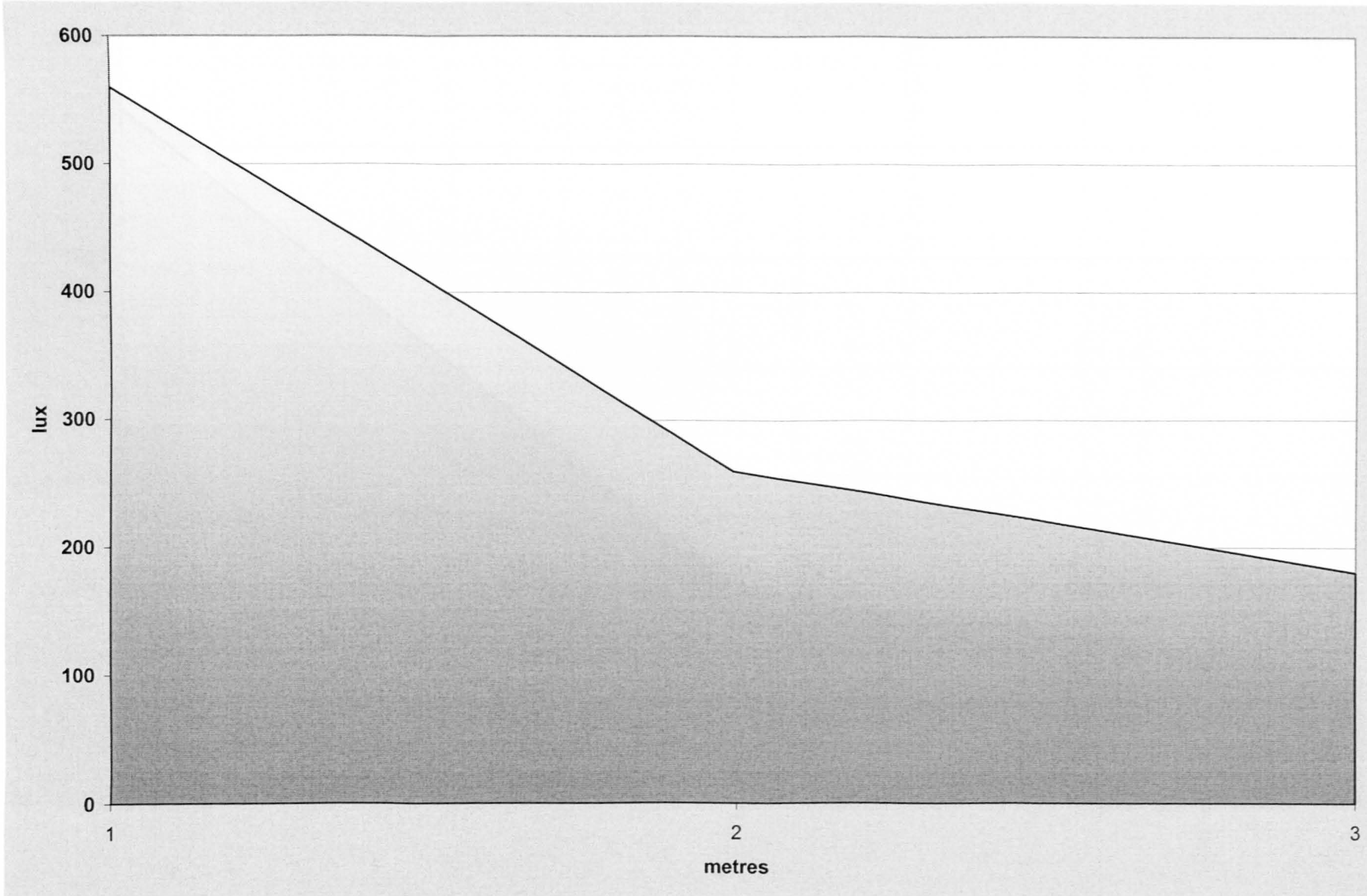


Figure 6.37 Lux reading for the northern façade at 1pm, the Stone Cottage.

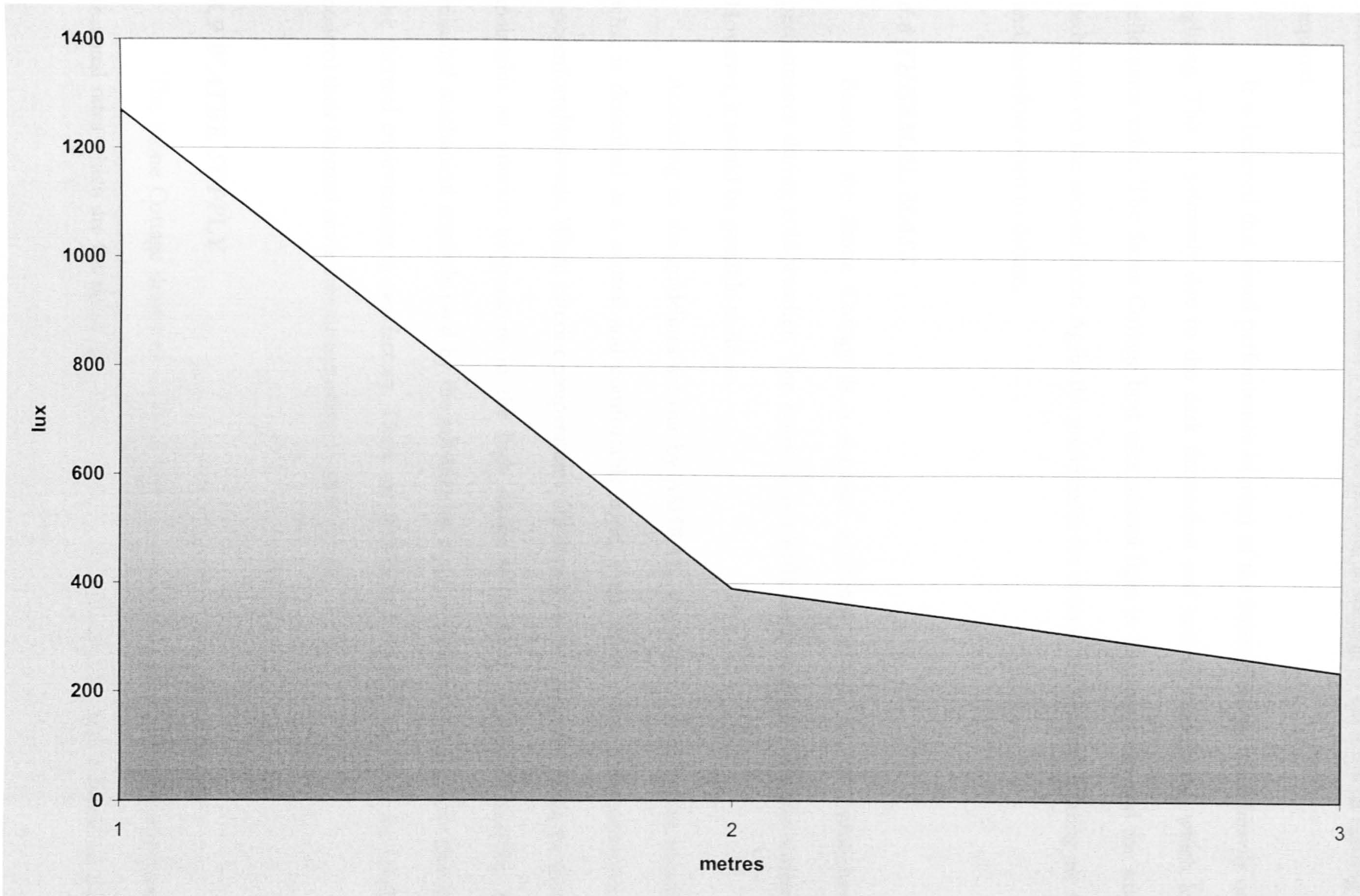


Figure 6.38 Lux reading for the northern façade at 3pm, the Stone Cottage.

tasks. Certainly in the afternoon and evening as the sun is starting to set artificial lighting would be required.

It is believed that visual performance in most of the Stone Cottage relies heavily on artificial lighting. This is primarily due to the dark decoration and lack of daylighting, which lowers the reflectance value. The Stone Cottage best uses natural light in the sunrooms and the south-facing bedrooms on the second floor. Again the preferences for natural and artificial lighting are subjective and therefore open to debate.

6.8 THERMAL MASS

Because the Stone Cottage is a summer residence it will not be scrutinised for its performance during cold weather. The house is not sufficiently equipped for the winter months. However, it would be possible to do so.

According to the guidelines set out by ASHRAE, the interior temperature remains within what is described as a neutral and comfortable zone, even when exterior temperatures dip into uncomfortable levels. While exterior temperatures fall during the evening and night the thermal shell maintains an interior temperature in the high sixties to seventy. (Figures 6.30-6.35) There are minimal mechanical controls used by the inhabitants. So it is believed that because this is the case the thermal environment is satisfactory. There are sufficient controls that allow the inhabitants to control their thermal environment according to their needs.

6.9 WATER SUPPLY

The Stone Cottage draws its water supply from the town of Castine. This is based on the seasonal rates which are for up to five months usage. In addition, this rate is based on a minimum

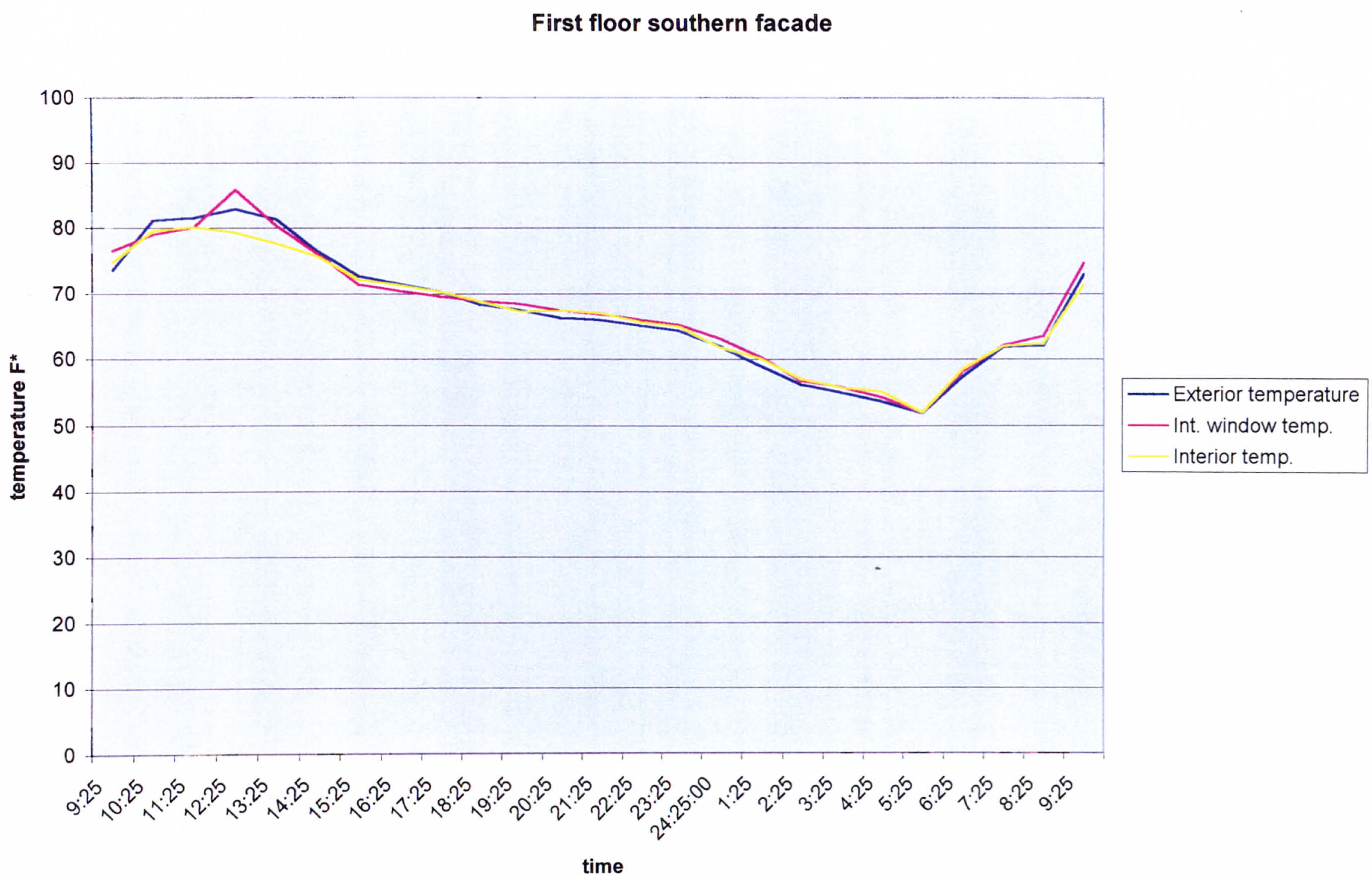


Figure 6.21 Temperature readings for the first floor, southern facade, the Stone Cottage.

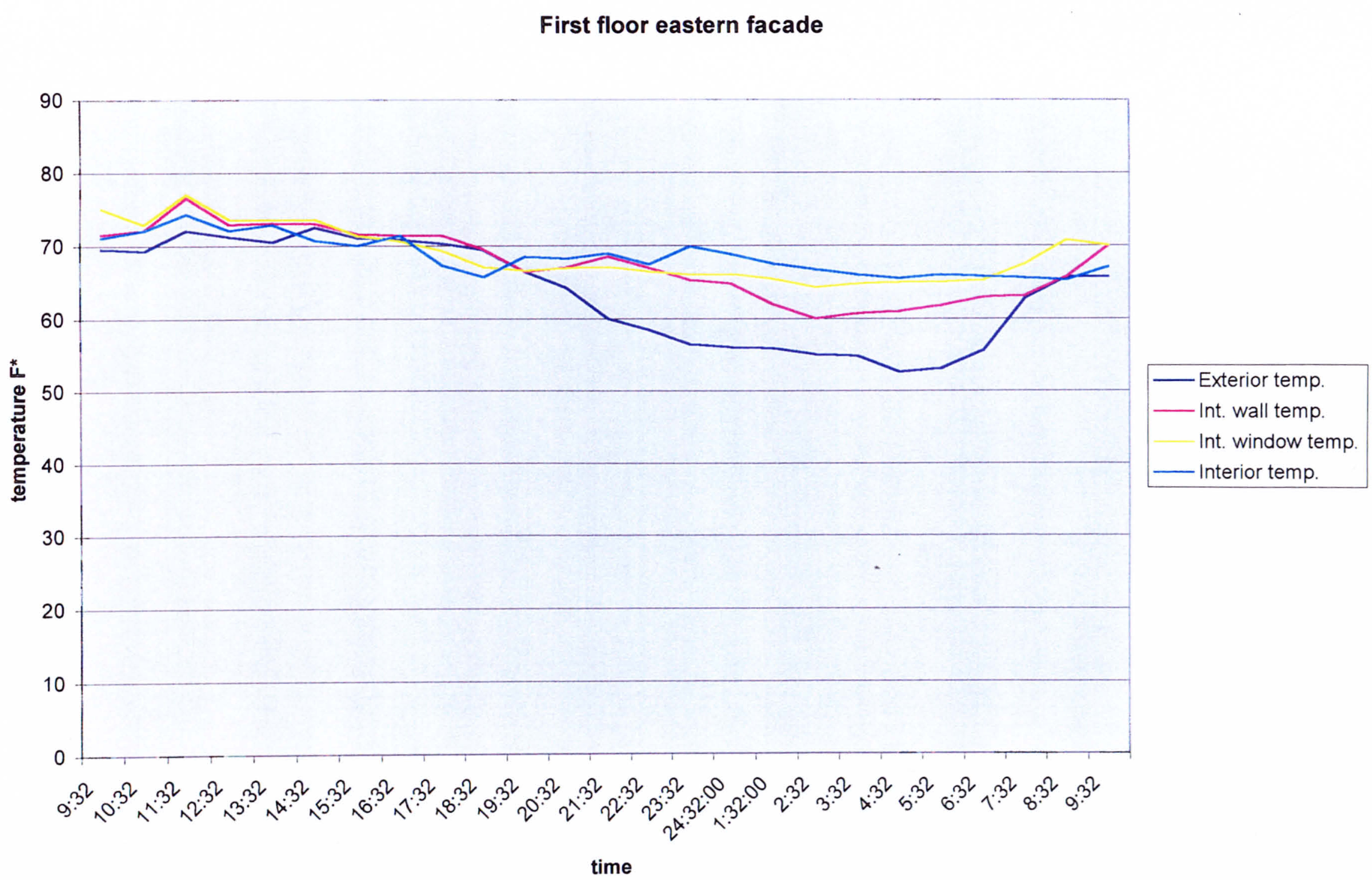


Figure 6.22 Temperature readings for the first floor, eastern facade, the Stone Cottage.

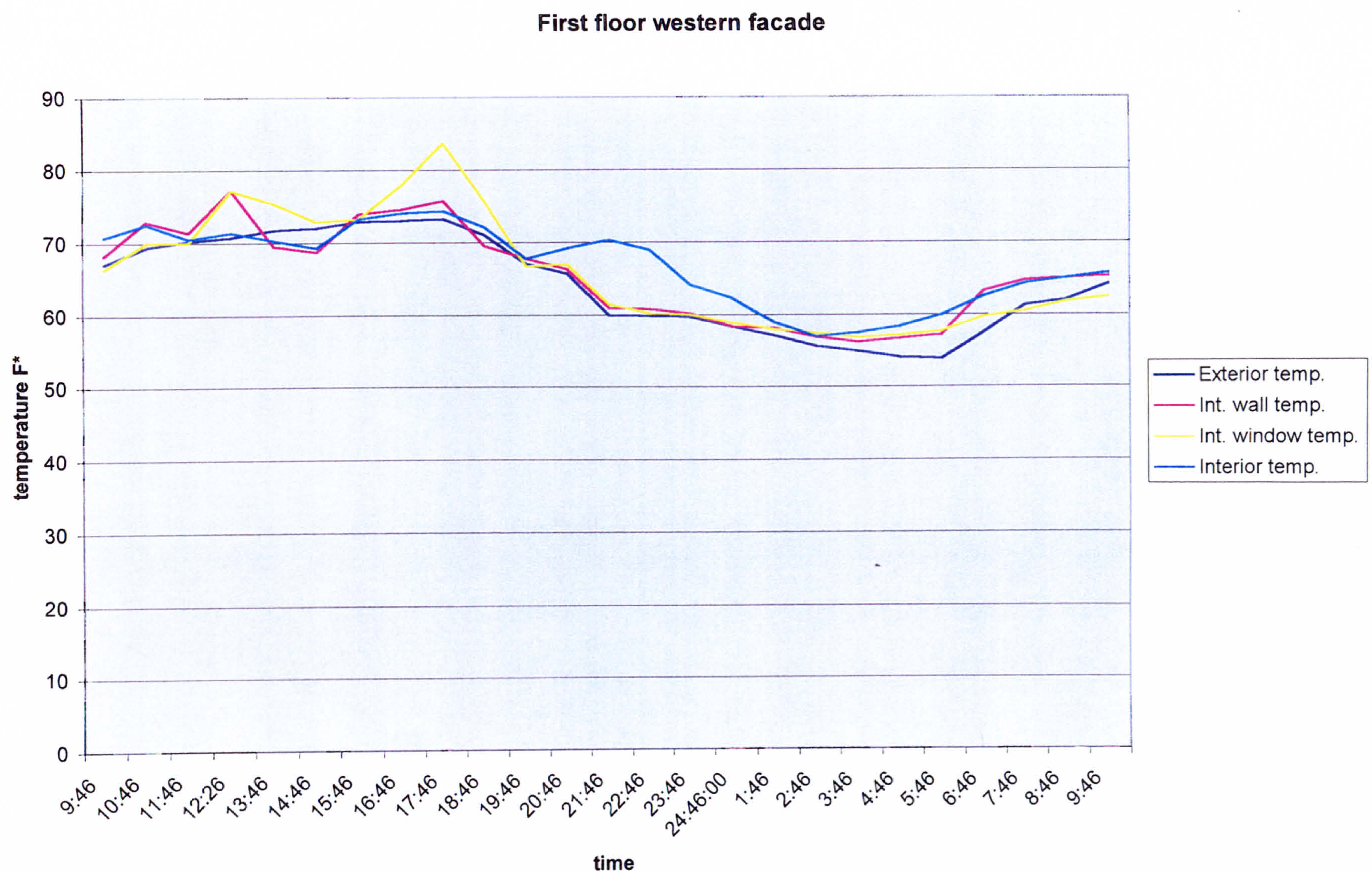


Figure 6.23 Temperature readings for the first floor, western facade, the Stone Cottage.

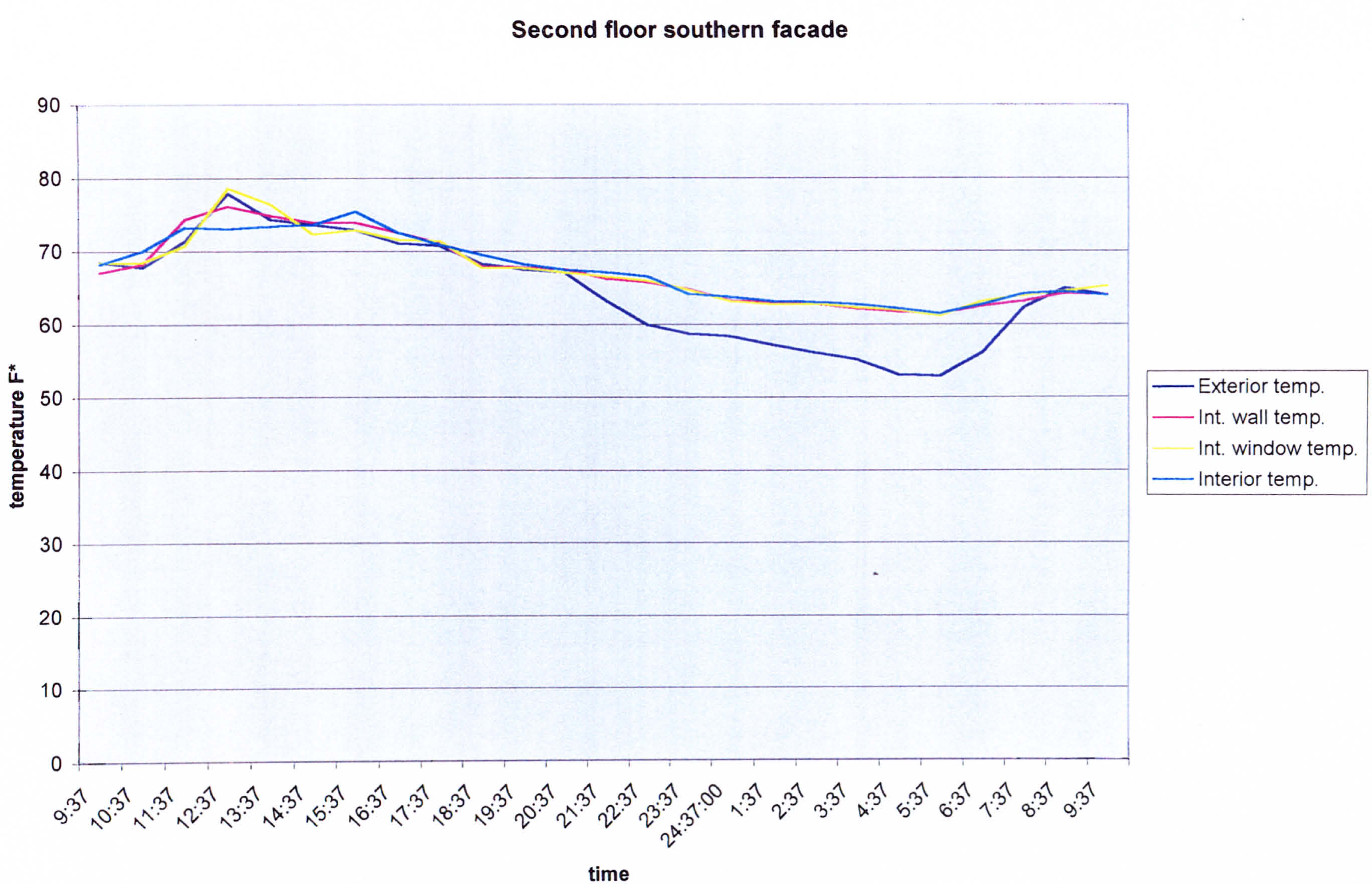


Figure 6.24 Temperature readings for the second floor, southern facade, the Stone Cottage.

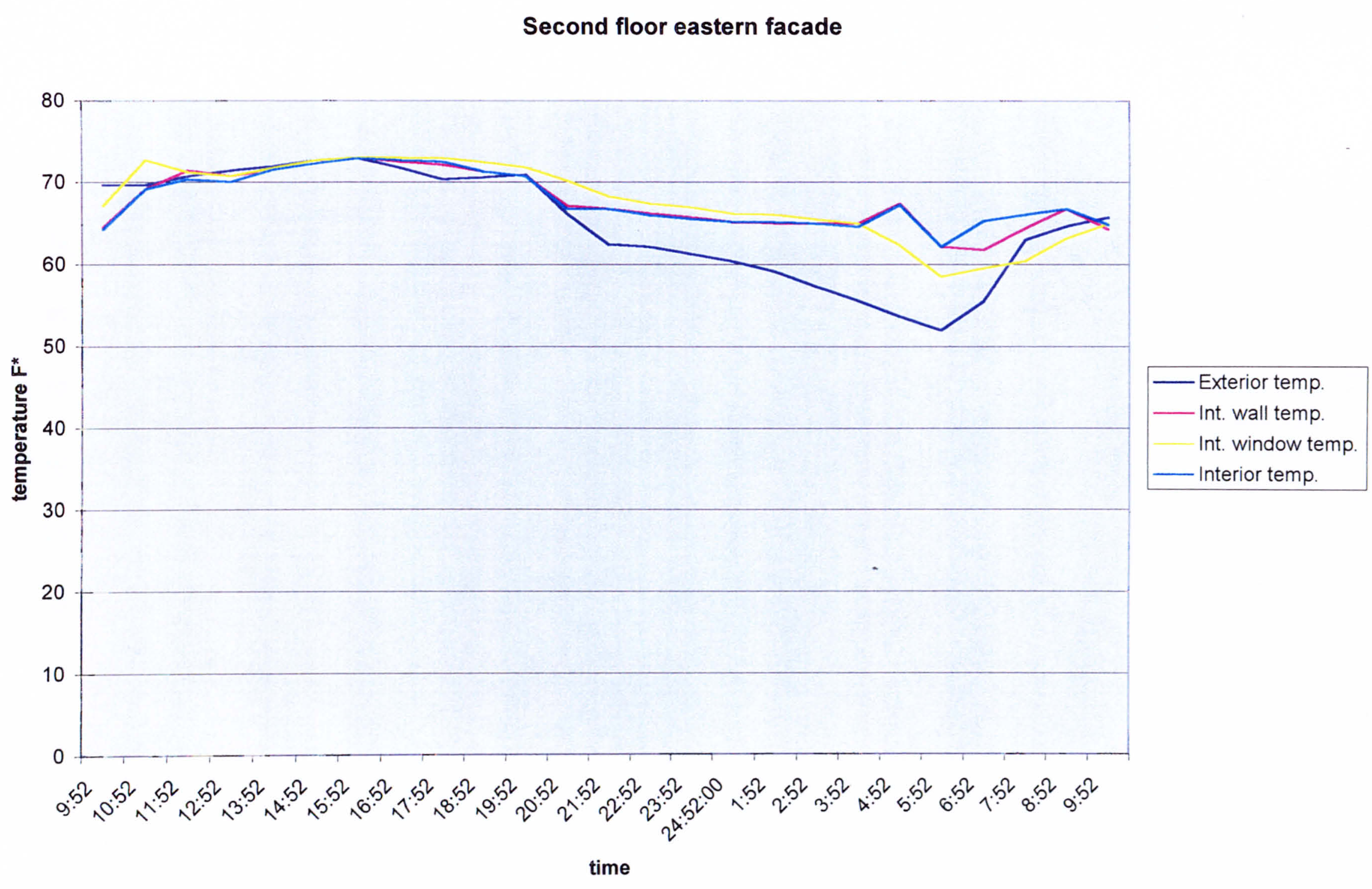


Figure 6.25 Temperature readings for the second floor, eastern facade, the Stone Cottage.

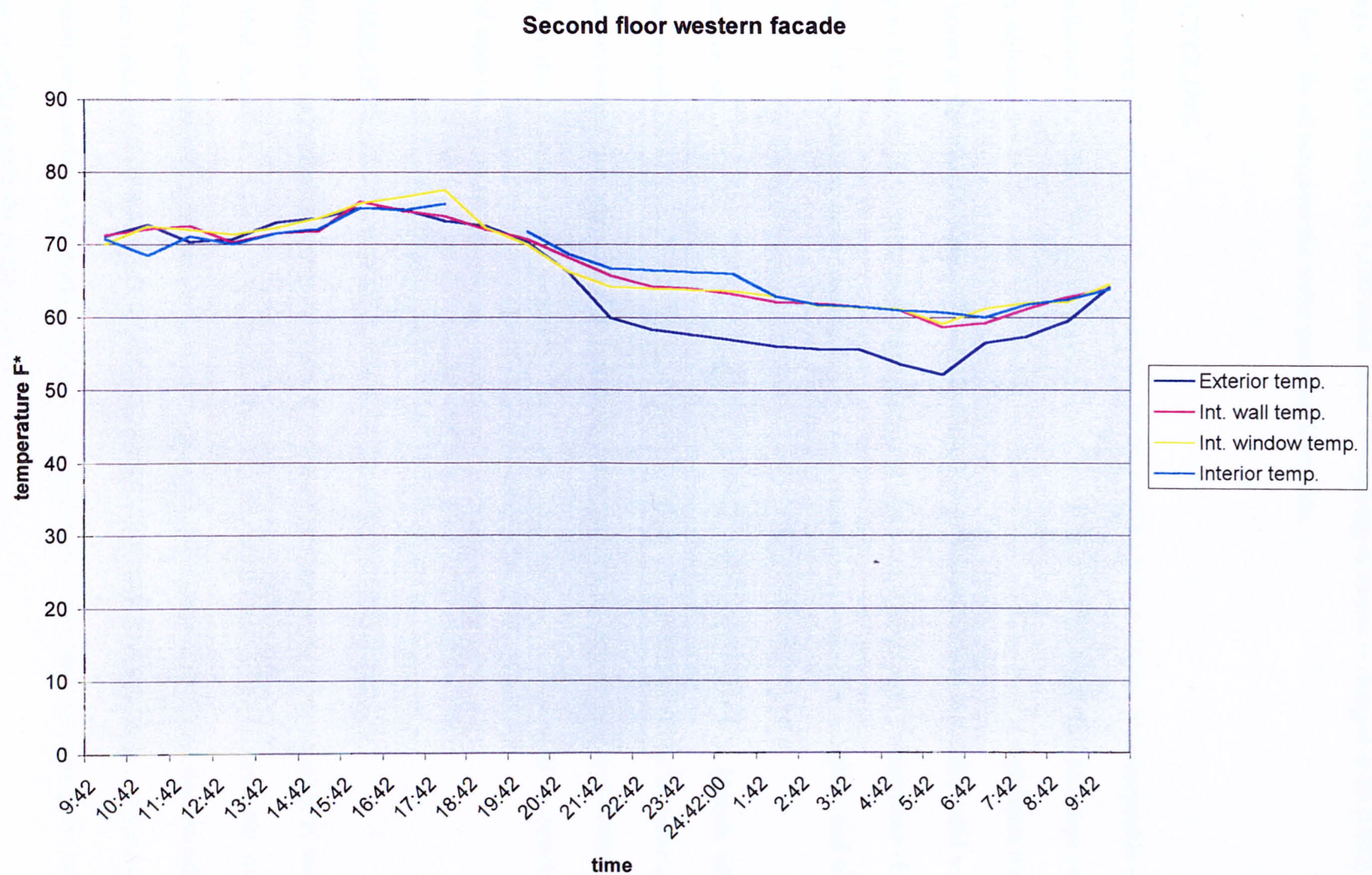


Figure 6.26 Temperature readings for the second floor, western facade, the Stone Cottage.

meter charge of $252 (USD) for 1,100 cubic feet.[50] Everything in excess is charged at $3 (USD) per 100 cubic feet.[51] By all accounts the water provided is potable.

6.10 RECYCLING

The town of Castine does have recycling facilities available to residents. Non-recyclable solid waste is collected every Monday and recyclable matter is collected the first and third Mondays of the month. In addition residents are allowed to dispose of their own waste at their convenience during specified hours at the transfer station. Residents must pay to dispose of non-recyclable solid waste; 50¢ for up to 15 gallons or 18 pounds and $1 for up to 30 gallons or 36 pounds.[52] There is no charge for disposing of recyclables; newsprint, cardboard, boxboard, #2 plastic, tin cans, glass, and office paper.

Because the town charges for garbage disposal, it would be in the best interest of the homeowner to reduce the amount of non-recyclable solid waste as much as possible. In order to do so it is recommended that any vegetable matter be used for composting as well as continuing to recycle all of the aforementioned products. The composted matter could be used to enrich the garden and trees on the property.

6.11 SUMMARY

When an individual homeowner undertakes a comprehensive preservation project, such as the National Audubon Society renovation, the process takes time. The cornerstone to any preservation program is to make the structure sound and in this case it will involve a new foundation and further stabilisation of the structure. The sacrifice being made is the replacement of the original granite fieldstone foundation for perhaps a concrete foundation. It is a trade-off, losing the original foundation in order to save the entire structure.

In terms of replacing existing appliances, it is unlikely that more energy efficient models will be installed until the current models are replaced. This makes it difficult in the short term to increase the efficiency of the house, but these obstacles should not prevent the application of other energy efficient technologies, materials, or devices. Ideally the house could draw its required energy from an independent source, such as a solar installation. However, the current owners would object to this modernisation, as it would not be an original or authentic addition to the structure. This has been an approach that has maintained the integrity of the building, but attention to improved efficiency should not be sacrificed.

The Stone Cottage represents a part of the rich history found in Castine. It is essential to preserve these types of buildings while making them appropriate for modern living. The process involves being sensitive to the existing structure and not compromising the integrity of the building. However, there are certain procedures that must be permitted in order to preserve the building, for example replacing the foundation. Every measure should be taken to preserve the building as it is, realising that there are portions of the building that must change in order for its continued use.

NOTES

DOUDIET, Ellenore W., Majabigwaduce: Castine, Penobscot, and Brooksville, Castine Scientific Society, Castine, 1978, p. 1.

[2] DOUDIET, ref. 1, p. 4.

[3] TAYLOR, Aline S., The French Baron of Pentagouet: Baron St. de Castine and the struggle for Empire in Early New England, Picton Press, Camden, 1998, p. 71.

[4] TAYLOR, ref. 3, p. 72.

[5] DOUDIET, ref. 1, p. 4.

[6] IBID.

[7] IBID.

[8] DOUDIET, ref.1, p. 7.

[9] IBID.

[10] IBID.

[11] DOUDIET, ref. 1, p. 6.

[12] DOUDIET, ref. 1, p. 7.

[13] IBID.

[14] WHEELER, George A., History of Castine, Penobscot, and Brooksville, Maine, Burr & Robinson, Bangor, 1875, p. 66.

[15] DOUDIET, ref 1, p. 7.

[16] DOUDIET, ref. 1, p. 8.

[17] WHEELER, ref. 14, p. 205.

[18] WHEELER, ref 14, p. 206.
[19] DOUDIET, ref. 1, p. 1.
[20] A copy of Calef's map of 1779 is available at the Wilson Museum, Castine, Maine.
[21] ADAMS, Brian, interview September, 11, 2000, assistant to the curator, Wilson Museum, Castine, Maine.
[22] Hancock County Registry of Deeds, Book 16, Page 277.
[23] Lincoln County Registry of Deeds, Book 18, Page 244.
[24] Hancock County Registry of Deeds, Book 53, Page 194 and Book 39, Page 23.
[25] WHEELER, ref. 14, p. 173.
[26] WHEELER, ref, 14, p. 192.
[27] IBID.
[28] DOUDIET, ref. 1, p. 75.
[29] IBID.
[30] IBID.
[31] IBID.
[32] Hancock County Registry of Deeds, Book 86, Page 143.
[33] Hancock County Registry of Deeds, Book 108, Page 475.
[34] Hancock County Registry of Deeds, Book 110, Page 112.
[35] Hancock County Registry of Deeds, Book, 112, Page 321.
[36] WHEELER, ref. 14, p. 370.
[37] Hancock County Will Book 310, Page 427.
[38] Hancock County Registry of Deeds Book 322, Page 358.
[39] Hancock County Registry of Deeds Book 1302 Page 552.
[40] WHEELER, ref. 14, p. 161.
[41] Annual Report, Town of Castine, 1924-25.
[42] Story told by Charles F. Collins, Rockport, Maine – a Castine native – told to Roger and Betty Gilmore.
[43] WHEELER, ref. 14, p. 16.
[44] GILMORE, Betty & Roger, interview, August 21, 2000.
[45] IBID.
[46] IBID.
[47] ENVIRONMENTAL STANDARD: Homes for a Greener World
[48] US Department of Energy, Office of Energy Efficiency and Renewable Energy, July 2001.
[49] HOPKINSON, Daylighting, William Heinemann Ltd., London, 1966, p. 5.
[50] Schedule of water fees, Town of Castine, April 1, 1995.
[51] IBID.
[52] Rules and Regulations Recycling and Solid Waste, Town of Castine, September 2000.

Chapter Seven
Discussion

The case studies with their limitations can at best verify or reject the proposal set forth in the 'Introduction'. However, the research can provide the basis for the proposal of the following. The examinations of both Belmont House and the Stone Cottage have served two purposes. First the examination theorises that by adapting green building methods and considering the far reaching effects and implications of the technologies and materials used the green building preservation approach could conceivably provide solutions to the global environmental dilemma. The aim was to provide the homeowners with a comprehensive plan that could be instituted in phases to increase the "greenness" of their property. These strategies were suggested for implementation in differing degrees in regard to the individual idiosyncrasies of each project. It is important to remember that each project will present its own set of complications and limitations based on any numbers of externalities. In addition, this same approach could conceivably provide for civic societies the ability to increase their independence. Further examinations are necessary.

It is worth noting that there are different stages of the process and that any efficiency improvement, no matter how modest is important. The perception is that if green building preservation were to become the norm the collective result would be the proof needed to confirm the perceived benefit to the environment and municipalities.

It is valuable to recognise that there are immense amounts of resources invested in the existing built environment and that the rehabilitation and upgrading of the existing built environment plays a far more pivotal and crucial role than the creation of new architecture. It is obvious that there are not the available resources to recreate the built environment for every generation and as far as the preservation of the texture and history of the built environment goes it would simply be irresponsible. Overall the issue of recycling can be as simple as recycling demolition materials or as complex as recycling entire buildings and their space. Natural processes in themselves are very efficient. It is the process of decay and regeneration which we should attempt to replicate in all orders of life.

Often alterations necessary to a building's rehabilitation or renovation can obliterate the original structure. This is clearly a dilemma for those involved with building preservation. First, when applying the 'green' method the primary concern would be the amount of resources used. This does not consider the historical significance of a building. In many instances modern alterations are not compliant with preservation dictates. Take for example the Audubon House, recently this downtown neighbourhood has been designated as a new preservation district in Manhattan. Interestingly enough the preservationists lobbying for this designation used the Audubon House as an example of the preservation possibilities for this community. However, had permission been required for the renovations and alterations carried out they never would have been able to apply even a fraction of the technologies they employed because the preservationists would have considered that NAS would have severely altered the original integrity of the building.

Quite often preservation groups hamper the integration of an existing structure with modern technological demands. While in most instances historic structures are thermally efficient there are ways in which that efficiency can be increased. These are solid parts of our communities which if they work efficiently, while contributing to the texture and fabric of the community, will be successful.

There are a number of projects that are be considered prime examples of sustainable design. Take for example the Conde Nast building in New York City, designed by Fox & Fowler; Colorado Court in Santa Monica, California and designed by Pugh + Scarpa Architecture; or Solar Tube in Vienna, Austria and designed by Driendl Architects. All of these buildings are exceptional examples of sustainable architecture. Notably these are new projects possess all of the miracles of modern construction and technology, but do not attempt to solve the dilemma of the existing built environment. They do not help to provide any motivation for preserving our existing built environment through green building preservation. One could say that it is "easy" to design a sustainable building from the ground up, without the restrictions or idiosyncrasies of an existing building, let alone a preservation project.

In 2001 The National Building Museum in Washington DC, launched a major exhibition titled, "TEN Shades of Green". The exhibition featured green architecture and its possibilities. Of the ten structures represented not one of them was a residential structure nor were any of them green building preservation projects. Every structure represented was a new commercial building. This is possible for a number of reasons: commercial structures allow for bigger concepts to be realised; they come with bigger budgets; and because they typically represent the face of a corporation there is a good deal of publicity to be had by building the biggest, boldest, and most efficient building. For all of these reasons commercial structures are economically feasible. On the other hand residential structures that are touted as being the most efficient and cutting edge tend to be new construction designed and built for wealthy clients. These structures tend not to be designed for the "average joe". One may find a handful of public works projects that fit this bill.

In May, 2006, The National Building Museum will launch another exhibition geared toward green architecture. This time it will feature "The Green House". Of the twenty-nine residences featured, twenty-four are individual residences and five are multi-family residences. All of these projects are new construction. Certainly they are excellent examples of green architecture and design, but none of them address the problems of green building preservation. Again, it is hard not to imagine that new design does not present the same host of challenges that a green preservation project would present. We are not in a position to recreate our entire built environment. As a society we will continue to be faced with ever-growing dilemmas regarding our natural environment until we confront the issues of preserving and using what we have head on.

It is also worth discussing the number of books on the market that make a stab at tying the preservation process to sustainability. Unfortunately these publications do not find a way to truly strike a balance between preservation and sustainability. Upon review of the material it became evident that preservation was nearly always sacrificed for sustainability or efficiency. For example, this was notable in "The Whole House", written by Pat Boerer and Cindy Harris, their premise is a good one. However, upon examination of the examples given it was clear that details were sacrificed. Unfortunately in the process of changing these details the building loses the essence that makes it worthy of preserving in the first place. For example, when windows are replaced it is important to replace like with like, otherwise the essence of the façade is lost in the process of preservation. Any preservationist will tell you that the soul of a building is in the windows, among other things. Changing the windows changes the fundamental design of the exterior of the structure. It has been determined that there are ways to preserve the details of the original building while attending to the needs of the occupiers in an environmentally sensitive manner. One does not need to be sacrificed for the other. Therefore, it is necessary to evaluate every part of the process in order to make balanced decisions based on the needs of the project and the occupier. This is why it can be such a difficult balance to strike, but not impossible.

An energy efficient strategy can be implemented for any building preservation project. Perhaps this is easier in a residential project because the owner-occupier has direct control over the measures taken. Of course it takes initiative on the part of the owner to see these measures through. Initially simple energy conservation methods, such as changing light bulbs and reducing water use, can be implemented. As there is an increased need for implementing further measures then those steps can take place, for example, replacing appliances. Once these measures are in place then the owner can begin a comprehensive plan for more complicated efficiency measures. Of course this process depends upon the owner's goals for efficiency.

The historical significance of a building should not override any attempt to preserve and utilise the structure, however consideration should be given to the outcome of the project in order to maintain some of the original integrity of the building in relationship with its neighbourhood. Certainly there will be exceptions such as, museum quality renovations, public houses, and government properties. When the alterations are to preserve a structure and continue its use, every attempt should be made to make the alterations compatible with the existing structure, although if this can not be done the project should not be abandoned solely for this reason. Recycling of buildings and building materials are both significant parts of the history of architecture.

A building renovation project that incorporates a significant amount of green technology is still a phenomenon. Take for example the Audubon House. This project incorporated green technology in every aspect of its renovation. In the last few years interest in this project has declined and in the eleven years since its completion there have been very few buildings which emulate these goals. The extent to which the National Audubon Society completed this project requires more intuitive responsibility and creativity than ordinary architects, designers, and developers have been accustomed to. This approach is a significant threat to the status quo of traditional development management.

One still finds that there is a division between successful sustainable design and successful preservation projects in housing. Take for examples the work of Gaia Architects, based in Scotland. Of the individual homes listed, they are classified as either new construction that upholds an exemplary sustainable model or preservation of the finest degree, without mention of any kind of green building preservation incorporated. A few of the listed buildings projects incorporated reclaimed roof slates or other building materials, but none of the descriptions listed mention any major sustainable approach. It seems as though even the architecture firms that are actively engaged in a variety of projects have yet to put into practice real green building preservation strategies.

There are many firms world-wide that focus on making sustainable design the cornerstone of their practice, The Croxton Collaborative, Pugh + Scarpa Architects, Gaia Architects to name a few. However, it seems as though there has been a concentration on commercial design. When it comes to residential design the environmental and preservation strategies tend to be compartmentalised. In the US the building industry is voluntarily looking to the USGBC for guidelines. This is an encouraging beginning, but in terms of green building preservation there is a long way to go. As stated earlier, it will be a while yet before the LEED Homes guidelines are established.

Green building preservation provides us with the fusion of two fields, which have been thought incompatible in the strictest sense. By pursuing this change we are engaging in the defeat of our modern habits of consumption and waste by the rebirth of a process which is ingrained in our human being. In order to effectively instil the changes to our design processes, among many other things, we must disrupt our old patterns of behaviour and actively replace them with new patterns of behaviour that are compatible with working toward a sustainable future. As we will see the process of guaranteeing a sustainable future involves all disciplines and requires a multi-dimensional resolution involving all aspects of modern society. It is perceived that architecture in all of its disciplines creative and scientific can have a fundamental impact on whether or not mankind will be able to attain a sustainable future.

The division in the field of architecture is apparent. Originally architecture was a field which allowed and required the interaction of the arts and technology in order to realise the requirements for the successful construction of a building. Perhaps it has been the explosion of specialised technologies which has increased the split between the architect and engineer and successively the arts and sciences. (Figure 7.1)

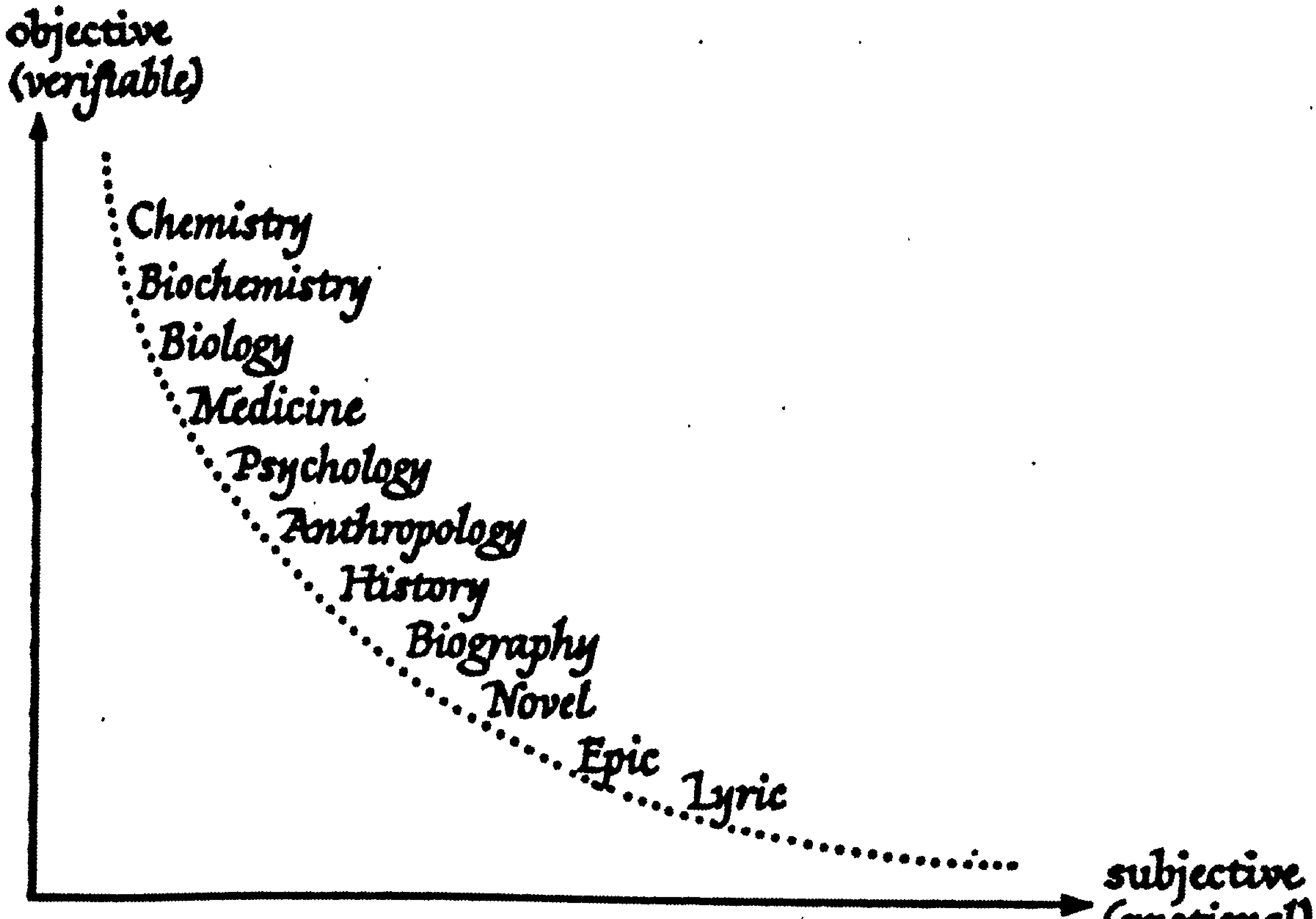


Figure 7.1 Koestler's Diagram of Transition.[i]

[i] Reprinted from Arthur Koestler's, The Act of Creation.

Both art and science are cumulative processes, it is only when a line of thought is thoroughly exhausted does the intuitive creative process take-over and out of this we discover new associations of different frames of reference. The indication of true ingenuity is originality and once these original associations are created they become part of the common realm of knowledge. New discoveries in both the arts and sciences draw on the intuition of the unconscious mind. According to Koestler, "The scientist, traumatised by discordant facts, the artist by the pressures of sensibility... share on different levels the same superflexibility enabling them to perform adaptation of a second order, rarely found in the ordinary routines of life."[1] Conclusions or theories are thereby created through contradictions, chaos and scepticism. In regard to this research, initially the data do not fit neatly together, we acknowledge the beauty of our global history which as a living history does not conform with the required levels of sustainability of the planet's natural history. The interaction of the proposed frames of reference as they have been introduced are intended to result in the preservation of an historic aesthetic experience and the natural environment. The purpose is to create a new attitude in developing our intuitive nature and work toward a sustainable presence.

Discovery works as both a destructive and constructive force. Fixed patterns of habit are destroyed in order to create new associations. Through the course of the discovery process other associations are discovered and created and in effect elaborated upon in order to increase the benefits and triumphs of the discovery. The synthesis of green architecture and historic preservation creates the field of green building preservation which with its new dimensions presents significant changes for other fields. However, the multi-dimensional approach is best understood from the community level. Significant concrete changes are best realised at a community and individual level because policy making from the global level is laborious and slow.

It is important to note that the evolution of ideas is not a smooth process without controversy. Ideas will only evolve through controversy, debate, and even confusion. For example, there are critics who believe that the environmental changes we are facing can be attributed to historic environmental changes rather than full on anthropogenic influences. Only through the full processes of debate in an open unbiased forum will concepts and theories evolve to their full potential. This process is critical to fuelling the next stage in the creative act of innovation in regard to the pursuit of sustainability. Throughout this process unusual and controversial bisociations may appear.

Beauty and truth are inseparable. It is evident that humanity requires beauty even in the most mundane of daily living. Mankind relishes created beauty, which has been created solely for our indulgence however it is intuitively linked to our natural beauty – both of which are at risk of being lost without some serious intervention and re-valuation of priorities. The environmental dilemma poses a threat only when spelled out in finite terms and absolute truths. It is an absolute truth that we will not be able to guarantee a sustainable future if we do not change our habits and patterns of living. Perhaps this seems too theoretical – "alarmists" have been siting truths about our "stockpiles" of natural resources, the state of our environmental health, food and water supplies, and so forth. Once this so-called alarm is raised communities and individuals have taken measures to make changes so these dire predictions do not come true. As a result of these warnings some destruction and losses have been thwarted. In addition, these warnings have served another purpose – they have been instrumental in enticing us to look at long-term comprehensive changes required in all aspects of our civil society so that we may work toward guaranteeing a sustainable future.

Habit and in turn convenience force us into rigidity or a false sense of stability. We will find that habit does not allow or help us to think in inventive ways. It is the intuitive process that enables us to determine what is significant, what needs to be changed, and ultimately change. However, change is what poses a threat to our habits and sense of stability.

In order to understand how solutions will work it is imperative to recognise that in most all instances problems felt in one region are created in another. We must have a firm handle on the delineation of regions. The reductionist strategy to focus solely on fixing the problem does not take into account the whole system and is what causes further disruptions. As we enter the era of globalisation we are becoming multidisciplinary by virtue of necessity. The premise that we must view the whole system, the planet, in order to cure the individual instead of solely seek solutions to individual problems is at best complex and fragmented. It is clear that we live in a global society with serious ramifications for the future if the negative regional impacts are not dealt with seriously. The loss of natural systems and natural resources is beyond monetary parity.

It must be recognised that development has to be limited in terms of the carrying capacity of ecosystems and natural resources. While there are obvious restraints in relation to the limits it is possible for the human condition to improve in spite of those limits, based on the relationship of humanity to the environment rather than purely on economic systems.

In the current climate in the US this individual must be a self-starter and independent. The prevailing attitude to 'green' methods is a rather disinterested one. The economy is good and fuel has for a long time been cheap and in many ways the West is detached from the consequences of their living standards. Human needs must be weighed against human wants. If approached in a creative manner the need should never arise to sacrifice human need.

Certainly preserving local cultural history is important. It is thought that green building preservation can be justified if it is proved to enable civic societies greater independence and autonomy. As with anything, cost analysis is always a key element to planning. There are two perceived benefits to green building preservation methods. First, the salvage and recycling of the existing built environment, which maintains the texture of the community. Second, this approach makes a conscientious effort to include and appreciate the impacts of humanity on the environment.

If this approach is encouraged the methods and products discussed should become mainstream, therefore enabling a larger market to reduce their negative environmental impact. It must be noted that in many instances it does not take a large budget and drastic measures to reduce energy use and emissions. The least expensive approach is a little education, some common sense, and a little motivation.

We will only be able to accomplish the strategies as they are laid out if we begin the change at home. While we've discussed many options for moving toward a sustainable future, the only way to make significant advances is to start with these applications in residential buildings and by doing so it is thought that the changes would translate into lifestyle changes.

Our relationship to the planet is unsustainable in all regions. Our knowledge regarding our relationship to the planet increases in direct relationship to our biological knowledge of the processes and effects of our being. The divide between individual values and community challenges and their relationship to quality of life and the economy of the global market is growing. This relationship is not purely dependent upon financial processes. Global, globalisation and world are terms firmly based on anthropogenic perspectives. They do not include the other life forms with which we share the Earth.

The human race has become a global species without the assurance of a sustainable future. Our invention of technological forces has unleashed unknown and unnatural occurrences. Mother Nature is not a force that can be controlled, although we can as we have seen have a significant impact. We must learn to live within the limits of the laws of nature. If we do not learn to co-habituate with other species within the laws of nature we will eventually become extinct. Our political and economic systems work in very narrow timeframes, ignoring the long-term ramifications of prolonged ecological damage. As the corporate giants work toward sustainability their monopoly of government subsidies continues to prevent a significant shift to sustainability from taking place. For example, perhaps rather than enabling energy companies to operate in a cookie-cutter manner, their approach to providing energy to communities should be evaluated to first incorporate the most suitable form of primary renewable energy. So then these companies would be utilising the most appropriate energy source for the region based on the available resources, rather than importing resources which are foreign to the region.

> "The search for alternative energy sources and the implementation of conservation measures have been foremost in the focus of energy policy development since the onset of the crude oil price increases of the early 1970s. The difficulty with alternative energy and conservation however is that world-wide interest and activity tend to fluctuate in tandem with the fluctuating world crude oil prices. Developing countries in particular however need to put in place comprehensive plans for the development of alternative energy and energy conservation in their economies since they are much more vulnerable to energy price fluctuations than those of their more developed counterparts."
>
> ~ Barbados Ministry of Finance and Economic Affairs, Energy and Natural Resources Division

Time and again the West has had the opportunity to set the stage for a reduction in both consumption and emission. It is important to note that the focus needs to be reduction. However, it would seem as though the industrial world has already become too dependent upon a fossil fuel driven economy to let go. Since this appears to be the case currently, we must be creative and attempt to find a solution to our own dependence upon fossil fuels. Approaching the problems from a community building perspective will yield positive results.

For the most part a slow march toward fuel independence would be an economic win for all regions. Developing countries have much to gain by preserving hard currency and increasing their stakes in the international market by reducing and ideally, eventually eliminating the need for fossil fuel imports. Now of course this only addresses those countries, which do not export fossil fuels as their main commodity. Certainly for those countries exporting fossil fuels this train of thought poses a problem. However if these countries would now realise how the needs of the market are going to change then they may be able to position themselves as the leaders in these alternative fields.

> "Under a World Bank funded energy conservation study launched in 1983 it was estimated that the overall energy conservation potential of the country was 14 to 17% of total energy used at a capital cost of approximately $13.1 million (B'dos). It was estimated that this would result in a savings of $8.4 million (B'dos) annually. A detailed final report on this project was submitted in June 1985. The major goal of the project was to develop a national energy conservation initiative, which included the training of personnel in various energy conservation areas and the conducting of technical assessments of energy conservation projects. The overriding purpose of the project was to reduce the foreign exchange expenditure on petroleum products."
>
> ~ Barbados Ministry of Finance and Economic Affairs, Energy and Natural Resources Division

Global treaties and agreements processes are slow and cumbersome. National and corporate interests hamper these global processes. Real change of the magnitude needed will only occur from the grassroots up. If corporate entities only recognise monetary power they will have to yield to the growing demands from the public. Although this is not the only way toward a sustainable change – it is a start.

It must be recognised that most modern architecture, transportation, and food production have been created and are dependent on the view that fossil fuels are economical and their supply is inexhaustible. While seemingly economical, the true costs associated with the use of fossil fuels encompass among other things mining that displaces habitats, forest cover and farmland; oil spills that foul beaches, marine environments, ground water, and air pollution. These processes seem dislocated from individual human practices. The reality is that if fossil fuel consumption continues unchecked more exploration and extraction will be made necessary. This will result in higher economic and environmental costs. Generating more energy by burning more coal, gas, and oil continues to contribute to the major source of atmospheric contamination, which in turn may effect global warming, climate change, acid rain, and smog. This impacts and damages water bodies, ground water, soil, crops, wildlife and habitat, and human health. Therefore then the true cost of continued fossil fuel use is not solely a calculable economic burden, but also is a negative environmental impact. It is important to note that fossil fuel consumption ranks as the primary ecological issue however there are other hazardous processes and materials which need to be reduced and removed from our system. Reduction and removal of these materials from popular use will move us closer to a sustainable balance.

By identifying and acting on opportunities for building preservation there are a number of factors which would emerge: minimal environmental disruption, reduced resource consumption, recycled material waste, and identification of opportunities for the reuse and recycling of construction debris. In addition, by looking to building preservation the responses, successes and failures, of previous generations are addressed and examined. This analysis allows us to learn how 'time-tested' approaches to local building styles, systems and materials performed with natural systems. Therefore in the long run, by actively pursuing a program of green building preservation we are maintaining the special quality of the place and extending the payback of the embodied energy and materials, which results in actively reducing our impact.

NOTES

1 KOESTLER, Arthur, The Act of Creation, Penguin Books, London, 1964. p. 462.

Conclusion

It has become obvious during the course of the research that while green building preservation is an appropriate method to save historically significant structures this is also an appropriate way to salvage structures of lesser note. It has been a struggle in this research to consider parameters for those buildings "worthy" of saving. One could be in the position to try to salvage all structures if the recycling element of the process is allowed to dominate. Therefore it is important to create a balance between the environmental and architectural merits. Perhaps this balance is too difficult, as it is subjective and instead of searching for the perfect balance one should examine each project on a case by case basis looking for the advantages and disadvantages to the community. It is these idiosyncrasies which make a project unique and contribute to the texture of the community.

The primary focus of the research is to weave the notions of environmental building preservation into the residential building sector. By doing so it is thought that an increased environmental consciousness in our homes would spill into all sectors of our lives. As we have seen the environmental dilemma is an event which crosses all national boundaries, sectors of society, and disciplines. No one is isolated from the effects of environmental degradation. The research has attempted to demonstrate how interwoven and complicated the environmental predicament is for society to grapple with. By presenting the subject in this manner it is hoped that development processes will evolve which will effectively deal with these issues as they arise. There is potential for communities around the globe to benefit. Currently self-starters and local groups have proven to be most effective at consciously developing an environmentally sensitive plan in order to meet their local needs. They recognise the benefits of protecting the local environment and supporting the local economy in all of its sectors. These changes and benefits can not be left for industry and governments to originate. Their processes are slow, cumbersome and based solely on profit.

Green building technology is still a relatively new phenomenon. In many instances the process of integrating historic preservation with green building technology is theoretical. In the current climate it takes a leap of faith and an intuitive sense to create a project which will be successful in all aspects: aesthetically, environmentally, and economically. Currently all of those issues need to be addressed, although balanced consideration is not usually given. For example, economic factors will almost always outweigh any environmental consideration because environmental protection and awareness still seem to be a foreign concern and our methods are still based primarily on an economic method. Western Society is accustomed to an environmental dislocation from everyday living and unfortunately if the developing world continues on the same path of 'development' they will too. Solutions at the local level will contribute to the solutions of the global environmental dilemma and in the grand scheme these local solutions will spur changes to the national and international global political movements and processes.

There are three areas that can provide a comprehensive plan to the greening of the existing built environment. Every effort should be made to reduce waste; reduce energy consumption; and to research and introduce non-toxic materials to the built environment.

Waste reduction can be implemented by recycling the built environment, sorting and recycling demolition materials and implementing a recycling plan in the building. All of these basics measures must be supported and encouraged by municipalities. It is important to note that it might be necessary to levy fines for non-compliance with recycling ordinances. It is unlikely, particularly within the construction industry, that a recycling plan would be implemented voluntarily unless there are significant monetary implications. However, the proper support services must be available for a comprehensive recycling program to take place.

In recent months there seems to be a lot of lip service given to the need to reduce the need for fossil fuels. The discussion can vary, anything from a decrease of foreign fossil fuels to the need to increase the use of renewable sources of energy to save the planet have become popular political fodder. Foreign sources aside, it is imperative to introduce renewable sources of energy. Eventually it should be the goal to present building owners with the option to be completely energy independent. The technology exists, however there are some preconceived notions that need to be dispelled before any significant gains can be made to encourage energy independence.

Finally, there needs to be a close examination of the materials being used within the construction industry. It is believed that with the increase of raw recycled materials there should be an increase in the availability of building materials with a high proportion of post-consumer content. (This thesis, for example, is printed on 100% recycled paper) While there is certain to be an increase in availability, one should also examine traditional building materials and consider their potential. This speaks to the balance that can be struck between traditional building materials and modern technology. If a variety of strategies are fulfilled within each of these three areas it is clear that we will be able to move toward the goals of preserving the natural environment while preserving our built environment.

It is evident that any of these three strategies can reduce the energy consumption (albeit to different extents) and in turn the environmental impact of buildings. A program which integrates both building preservation and green architecture and design can provide significant benefits to local communities and in turn the environment. By providing an efficient and cost effective method of building preservation, communities will be able to preserve their character and integrity while providing solutions to the environmental dilemma. The goal of the effort is to eventually weave these notions into everyday life, so for future generations the integration of building preservation and green architecture is seamless. Perhaps by doing so one could create a more meaningful life devoid of many of the disposable notions we harbour today.

In order to measure the economic successes and failures of a green building preservation project it would be useful to be able to carry out the work on a practical level. Rather than base the research on theoretical financial considerations. While the research stands on its own merit theoretically it would be helpful to have a concrete basis for the economic realities. The research draws on noted financial markers and costs. However a concrete living example would be ideal. The Audubon House provides some of this, however this is a commercial example – and the research is designed to focus on residential structures. In addition, it would be helpful to track an array of disciplines and how they impact each other. As has been discussed a reductionist strategy does not acknowledge the intricacies of the environmental dilemma. A closer examination of the overlapping of disciplines is necessary to fully understand what lies ahead and how the changes necessary for a sustainable future can be attained.

The initial premises set out in the 'Introduction' are achievable and certainly some of the mechanisms are in place to do so. What we must realise is that it will take a change in the mindset of political leadership in order for any real measured success to be gained in this area. Until that time the only way to spearhead change is through individual motivation and local grassroots leadership. For those committed to the process, the commitment stems from a sense of duty and moral obligation, notions which are purely subjective. There are two factors which need to be addressed in order to further identify the challenge. First, historically Western society has disregarded its place in Nature. We continue to lose our battles for control over Mother Nature and are reminded of our insignificant place. While our place in the grand scheme is rather small we are capable of imposing significant change. Second, we face the loss of familiar space which helps to maintain order and identity in our communities.

In the next few years it is anticipated that there will be an increase in the acceptance and utilisation of green building preservation on all levels, in an effort to maintain and improve the existing built environment. We have seen how this can significantly impact how we live and maintain our natural environment. Perhaps we are coming closer to integrating an environmentally conscientious approach into our everyday lives and in doing so we are preserving ourselves through a respectful understanding of our lives and the environment.

Appendix A

Kyoto Protocol Status of Ratification as of 2 July, 2002

COUNTRY	SIGNATURE	RATIFICATION OR ACCESSION	REMARKS	% of emissions
1. ANTIGUA AND BARBUDA	16/03/98	03/11/98 (R)		
2. ARGENTINA	16/03/98	28/09/01 (R)		
3. AUSTRALIA*	29/04/98			
4. AUSTRIA*	29/04/98	31/05/02 (R)		0.4%
5. AZERBAIJAN	—	28/09/00 (Ac)		
6. BAHAMAS	—	09/04/99 (Ac)		
7. BANGLADESH	—	22/10/01 (Ac)		
8. BARBADOS	—	07/08/00 (Ac)		
9. BELGIUM*	29/04/98	31/05/02 (R)		0.8%
10. BENIN	—	25/02/02 (Ac)		
11. BOLIVIA	09/07/98	30/11/99 (R)		
12. BRAZIL	29/04/98			
13. BULGARIA*	18/09/98			
14. BURUNDI	—	18/10/01 (Ac)		
15. CANADA*	29/04/98			
16. CHILE	17/06/98			
17. CHINA	29/05/98			
18. COLOMBIA	—	30/11/01 (Ac)		
19. COOK ISLANDS	16/09/98	27/08/01 (R)	(4)	
20. COSTA RICA	27/04/98			
21. CROATIA*	11/03/99			
22. CUBA	15/03/99	30/04/02 (R)		
23. CYPRUS	—	16/07/99 (Ac)		

Key: (R)Ratification (At)Acceptance (Ap)Approval (Ac)Accession
* denotes Annex I Party to the United Nations Framework Convention on Climate Change

COUNTRY	SIGNATURE	RATIFICATION OR ACCESSION	REMARKS	% of emissions
24. CZECH REPUBLIC*	23/11/98	15/11/01 (Ap)		1.2%
25. DENMARK*	29/04/98	31/05/02 (R)[1]		0.4%
26. DJIBOUTI	—	12/03/02 (Ac)		
27. DOMINICAN REPUBLIC	—	12/02/02 (Ac)		
28. ECUADOR	15/01/99	13/01/00 (R)		
29. EGYPT	15/03/99			
30. EL SALVADOR	08/06/98	30/11/98 (R)		
31. EQUATORIAL GUINEA	—	16/08/00 (Ac)		
32. ESTONIA*	03/12/98			
33. EUROPEAN COMMUNITY*	29/04/98	31/05/02 (Ap)	(1) (7)	
34. FIJI	17/09/98	17/09/98 (R)		
35. FINLAND*	29/04/98	31/05/02 (R)		0.4%
36. FRANCE*	29/04/98	31/05/02 (Ap)	(2) (8)	2.7%
37. GAMBIA	—	01/06/01 (Ac)		
38. GEORGIA	—	16/06/99 (Ac)		
39. GERMANY*	29/04/98	31/05/02 (R)		7.4%
40. GREECE*	29/04/98	31/05/02 (R)		0.6%
41. GUATEMALA	10/07/98	05/10/99 (R)		
42. GUINEA	—	07/09/00 (Ac)		
43. HONDURAS	25/02/99	19/07/00 (R)		
44. ICELAND	—	23/05/02 (Ac)		0.0%
45. INDONESIA	13/07/98			
46. IRELAND*	29/04/98	31/05/02 (R)		0.2%
47. ISRAEL	16/12/98			
48. ITALY*	29/04/98	31/05/02 (R)		3.1%
49. JAMAICA	—	28/06/99 (Ac)		
50. JAPAN*	28/04/98	04/06/02 (At)		8.5%
51. KAZAKHSTAN	12/03/99			

Key: (R)Ratification (At)Acceptance (Ap)Approval (Ac)Accession
* denotes Annex I Party to the United Nations Framework Convention on Climate Change

COUNTRY	SIGNATURE	RATIFICATION OR ACCESSION	REMARKS	% of emissions
52. KIRIBATI	—	07/09/00 (Ac)	(6)	
53. LATVIA*	14/12/98			
54. LESOTHO	—	06/09/00 (Ac)		
55. LIECHTENSTEIN*	29/06/98			
56. LITHUANIA*	21/09/98			
57. LUXEMBOURG*	29/04/98	31/05/02 (R)		0.1%
58. MALAWI	—	26/10/01 (Ac)		
59. MALAYSIA	12/03/99			
60. MALDIVES	16/03/98	30/12/98 (R)		
61. MALI	27/01/99	28/03/02 (R)		
62. MALTA	17/04/98	11/11/01 (R)		
63. MARSHALL ISLANDS	17/03/98			
64. MAURITIUS	—	09/05/01 (Ac)		
65. MEXICO	09/06/98	07/09/00 (R)		
66. MICRONESIA (FEDERATED STATES OF)	17/03/98	21/06/99 (R)		
67. MONACO*	29/04/98			
68. MONGOLIA	—	15/12/99 (Ac)		
69. MOROCCO	—	25/01/02 (Ac)		
70. NAURU	—	16/08/01 (R)		
71. NETHERLANDS*	29/04/98	31/05/02 (Ac)[3]		1.2%
72. NEW ZEALAND*	22/05/98			
73. NICARAGUA	07/07/98	18/11/99 (R)		
74. NIGER	23/10/98			
75. NIUE	08/12/98	06/05/99 (R)	(5)	
76. NORWAY*	29/04/98	30/05/02 (R)		0.3%
77. PALAU	—	10/12/99 (Ac)		
78. PANAMA	08/06/98	05/03/99 (R)		

Key: (R)Ratification (At)Acceptance (Ap)Approval (Ac)Accession
* denotes Annex I Party to the United Nations Framework Convention on Climate Change

COUNTRY	SIGNATURE	RATIFICATION OR ACCESSION	REMARKS	% of emissions
79. PAPUA NEW GUINEA	02/03/99	28/03/02 (R)		
80. PARAGUAY	25/08/98	27/8/99 (R)		
81. PERU	13/11/98			
82. PHILIPPINES	15/04/98			
83. POLAND*	15/07/98			
84. PORTUGAL*	29/04/98	31/05/02 (Ap)		0.3%
85. REPUBLIC OF KOREA	25/09/98			
86. ROMANIA*	05/01/99	19/03/01 (R)		1.2%
87. RUSSIAN FEDERATION*	11/03/99			
88. SAINT LUCIA	16/03/98			
89. SAINT VINCENT AND THE GRENADINES	19/03/98			
90. SAMOA	16/03/98	27/11/00 (R)		
91. SENEGAL	—	20/07/01 (Ac)		
92. SEYCHELLES	20/03/98			
93. SLOVAKIA*	26/02/99	31/05/02 (R)		0.4%
94. SLOVENIA*	21/10/98			
95. SOLOMON ISLANDS	29/09/98			
96. SPAIN*	29/04/98	31/05/02 (R)		1.9%
97. SWEDEN*	29/04/98	31/05/02 (R)		0.4%
98. SWITZERLAND*	16/03/98			
99. THAILAND	02/02/99			
100. TRINIDAD AND TOBAGO	07/01/99	28/01/99 (R)		
101. TURKMENISTAN	28/09/98	11/01/99 (R)		
102. TUVALU	16/11/98	16/11/98 (R)		
103. UGANDA	—	25/03/02 (Ac)		
104. UKRAINE*	15/03/99			
105. UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND*	29/04/98	31/05/02 (R)		4.3%
106. UNITED STATES OF AMERICA*	12/11/98			
107. URUGUAY	29/07/98	05/02/01 (R)		

Key: (R)Ratification (At)Acceptance (Ap)Approval (Ac)Accession
* denotes Annex I Party to the United Nations Framework Convention on Climate Change

COUNTRY	SIGNATURE	RATIFICATION OR ACCESSION	REMARKS	% of emissions
108. UZBEKISTAN	03/12/98	12/10/99 (R)		
109. VANUATU	20/11/98	17/07/01 (Ac)		
110. VIET NAM	—			
111. ZAMBIA	05/08/98			
TOTAL	84	74	—	35.8%

Key: (R)Ratification (At)Acceptance (Ap)Approval (Ac)Accession
* denotes Annex I Party to the United Nations Framework Convention on Climate Change

DECLARATIONS

(1) **European Community:**

"The European Community and its Member States will fulfil their respective commitments under Article 3, paragraph 1, of the Protocol jointly in accordance with the provisions of Article 4."

(2) **France:**

"The French Republic reserves the right, in ratifying the Kyoto Protocol to the United Nations Framework Convention on Climate Change, to exclude its Overseas Territories from the scope of the Protocol."

(3) **Ireland:**

"The European Community and the member States, including Ireland, will fulfil their respective commitments under Article 3, paragraph 1, of the Protocol in accordance with the provisions of Article 4."

(4) **Cook Islands:**

"The Government of the Cook Islands declares its understanding that signature and subsequent ratification of the Kyoto Protocol shall in no way constitute a renunciation of any rights under international law concerning State responsibility for the adverse effects of the climate change and that no provision in the Protocol can be interpreted as derogating from principles of general international law.

In this regard, the Government of the Cook Islands further declares that, in light of the best available scientific information and assessment on climate change and its impacts, it considers the emissions reduction obligation in Article 3 of the Kyoto Protocol to be inadequate to prevent dangerous anthropogenic interference with the climate system."

(5) **Niue:**

"The Government of Niue declares its understanding that ratification of the Kyoto Protocol shall in no way constitute a renunciation of any rights under international law concerning state responsibility for the adverse effects of climate change and that no provisions in the Protocol can be interpreted as derogating from the principles of general international law.

In this regard, the Government of Niue further declares that, in light of the best available scientific information and assessment of climate change and impacts, it considers the emissions reduction obligations in Article 3 of the Kyoto Protocol to be inadequate to prevent dangerous anthropogenic interference with the climate system."

(6) **Kiribati:**

"The Government of the Republic of Kiribati declares its understanding that accession to the Kyoto Protocol shall in no way constitute a renunciation of any rights under international law concerning State responsibility for the adverse effects of the climate change and that no provision in the Protocol can be interpreted as derogating from principles of general international law."

(7) **European Community:**

"The European Community declares that, in accordance with the Treaty establishing the European Community, and in particular article 175 (1) thereof, it is competent to enter into international agreements, and to implement the obligations resulting therefrom, which contribute to the pursuit of the following objectives:

- **preserving, protecting and improving the quality of the environment;**
- **protecting human health;**
- **prudent and rational utilisation of natural resources;**
- **promoting measures at international level to deal with regional or world wide environmental problems.**

The European Community declares that its quantified emission reduction commitment under the Protocol will be fulfilled through action by the Community and its Member States within the respective competence of each and that it has already adopted legal instruments, binding on its Member States, covering matters governed by the Protocol.

The European Community will on a regular basis provide information on relevant Community legal instruments within the framework of the supplementary information incorporated in its national communication submitted under article 12 of the Convention for the purpose of demonstrating compliance with its commitments under the Protocol in accordance with article 7 (2) thereof and the guidelines thereunder."

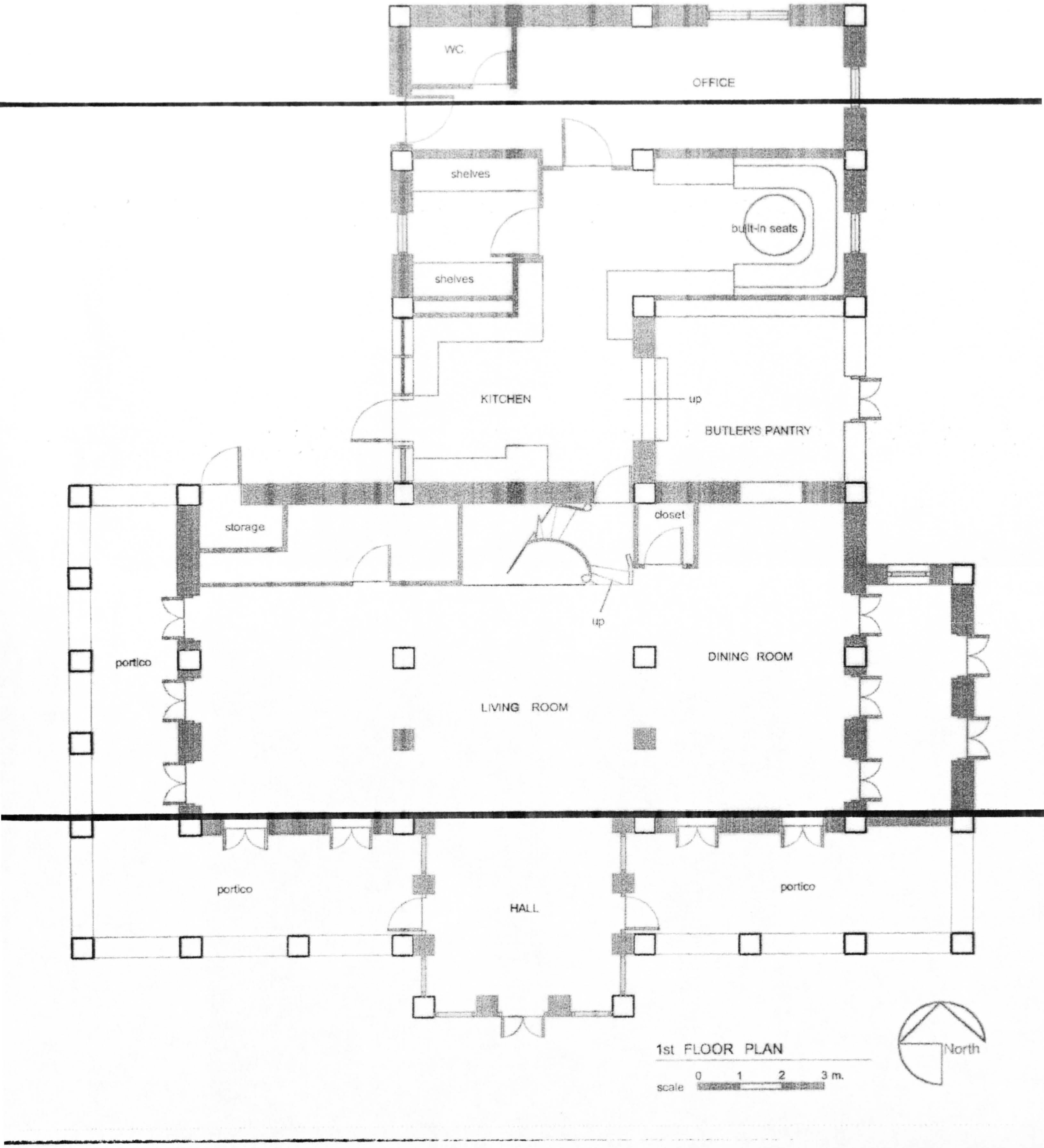
(8) **France:**

"The ratification by the French Republic of the Kyoto Protocol to the United Nations Framework Convention on Climate Change of 11 December 1997 should be interpreted in the context of the commitment assumed under article 4 of the Protocol by the European Community, from which it is indissociable. The ratification does not, therefore, apply to the Territories of the French Republic to which the Treaty establishing the European Community is not applicable.

Nonetheless, in accordance with article 4, paragraph 6, of the Protocol, the French Republic shall, in the event of failure to achieve the total combined level of emission reductions, remain individually responsible for its own level of emissions."

Appendix B

Belmont House Floor Plans

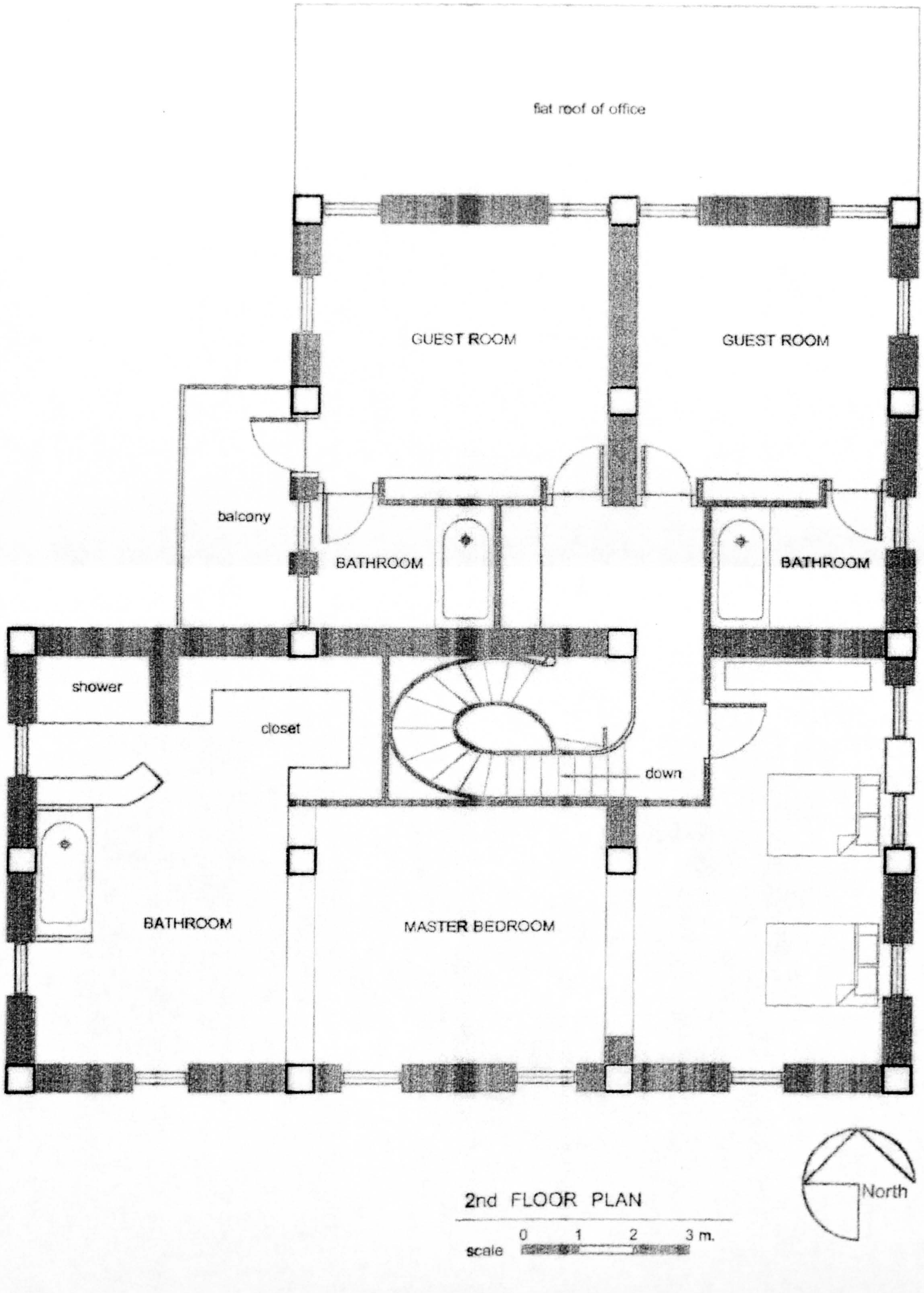


Belmont House
St. John
Barbados, West Indies
Owner Phillip Goddard
Year built: pre 1808

First Floor Plan

Date: 2001
Drawn By: Amnat Ratanbanyat

Charlotte D. Bonini
PH.D. Candidate 2005
Advisors; Dr. James Macaulay &
Dr. Raid Hanna
Mackintosh School of Architecture
University of Glasgow



Belmont House
St. John
Barbados, West Indies
Owner Phillip Goddard
Year built: pre 1808

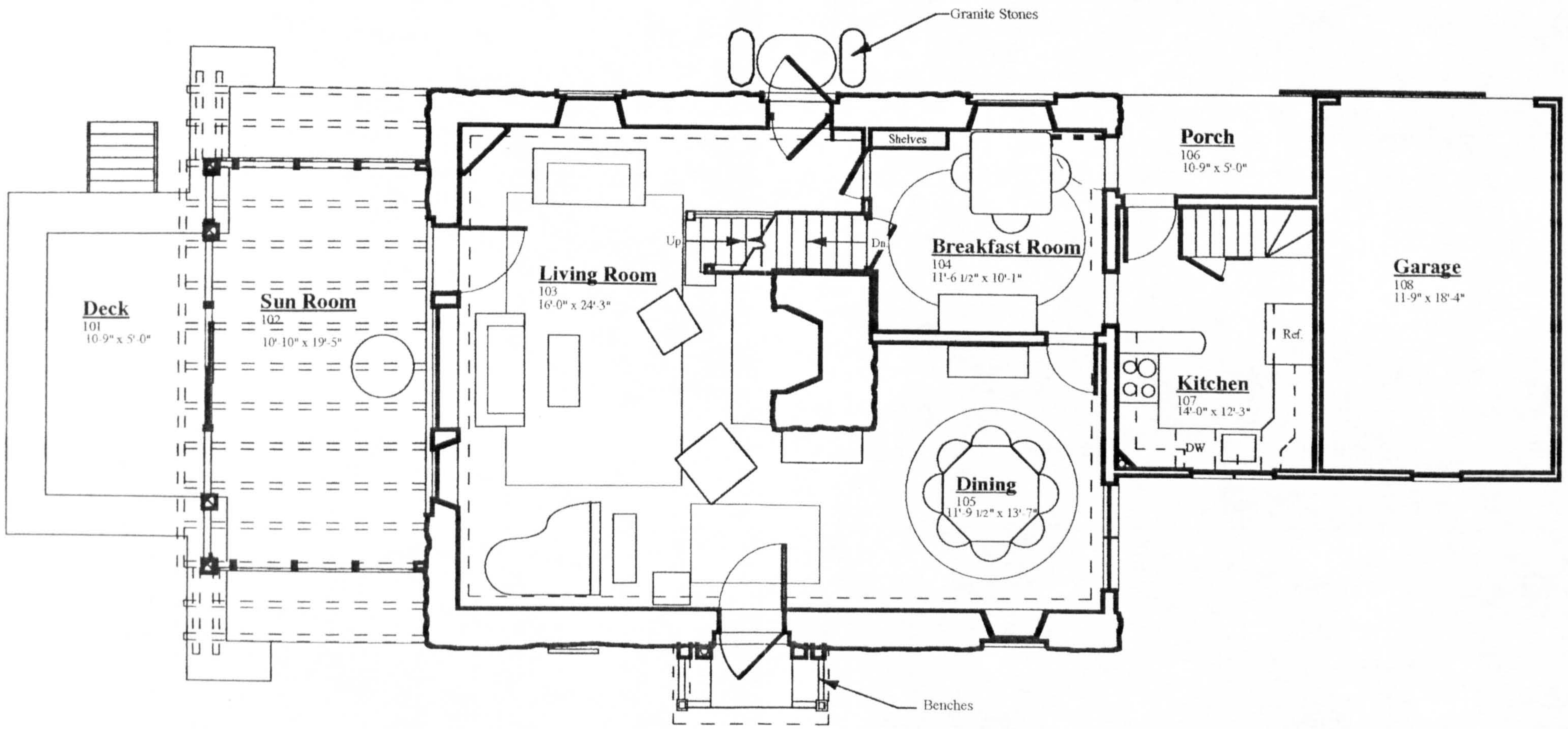
Second Floor Plan

Date: 2001
Drawn By: Amnat Ratanbanyat

Charlotte D. Bonini
PH.D. Candidate 2005
Advisors; Dr. James Macaulay &
Dr. Raid Hanna
Mackintosh School of Architecture
University of Glasgow

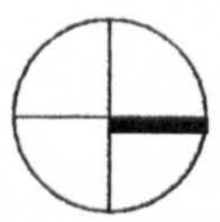
Appendix C

The Stone Cottage Floor Plans



1st Floor Plan

Scale: 1/8 = 1'-0"



2005

EXISTING CONDITIONS

A-1
1 of 3

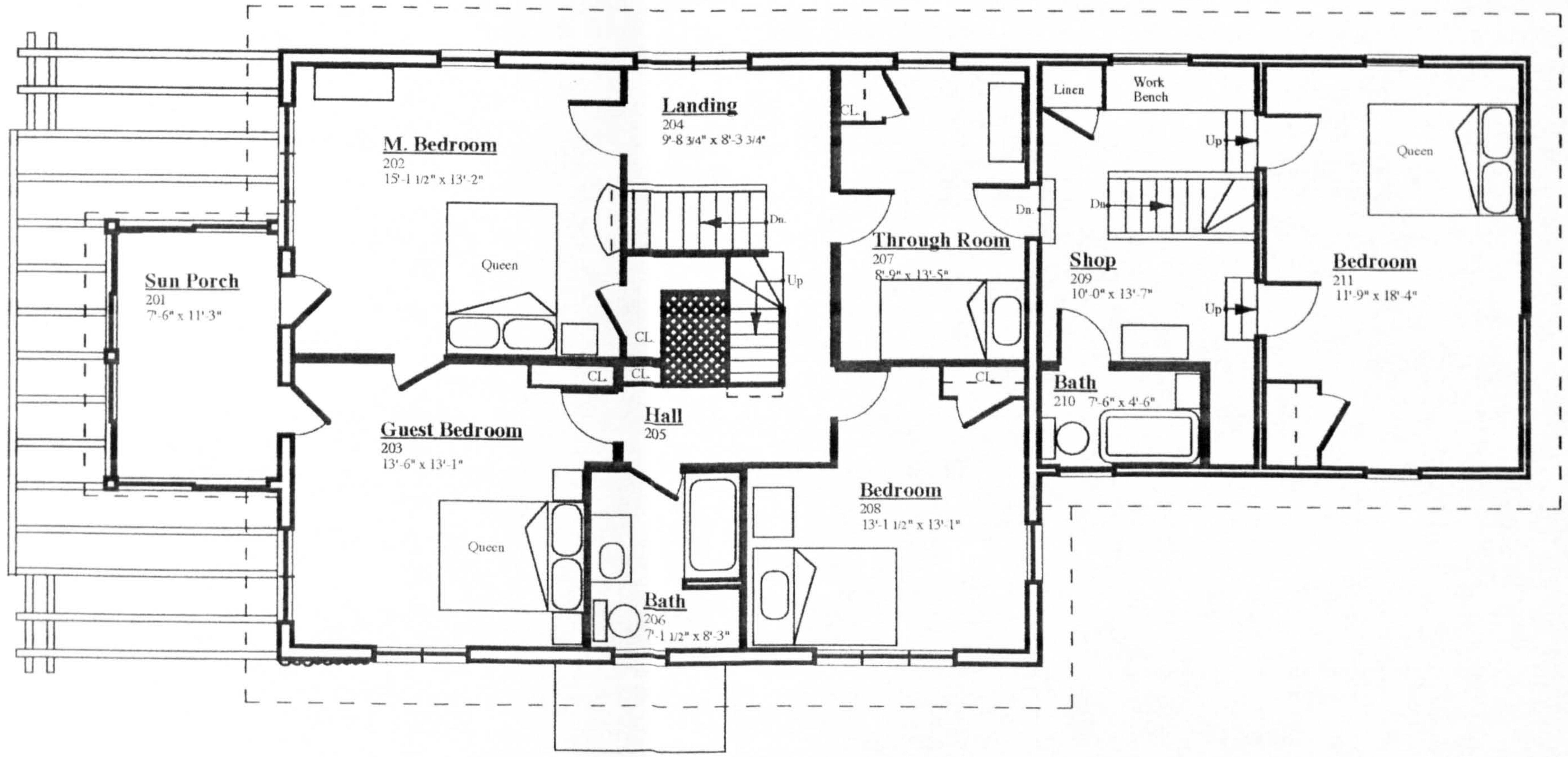
Charlotte D. Bonini
PH.D. Candidate 2005
Advisors: Dr. James Macaulay &
Dr. Raid Hanna
Macintoch School of Architecture
University of Glascow

FIRST FLOOR PLAN

Scale: 1/8" = 1'-0"
Date: 2005
Drawn By: EHL

Stone Cottage
Perkins Street, Castine Maine
Owner's Betty & Roger Gilmore
Year Built : Original Stone House 1757
Renovation 1887
Renovation 1922

CDB
2005



2nd Floor Plan

Scale: 1/8 = 1'-0"

North

2005

EXISTING CONDITIONS

SECOND FLOOR PLAN

Scale: 1/8" = 1'-0"
Date: 2005
Drawn By: EHL

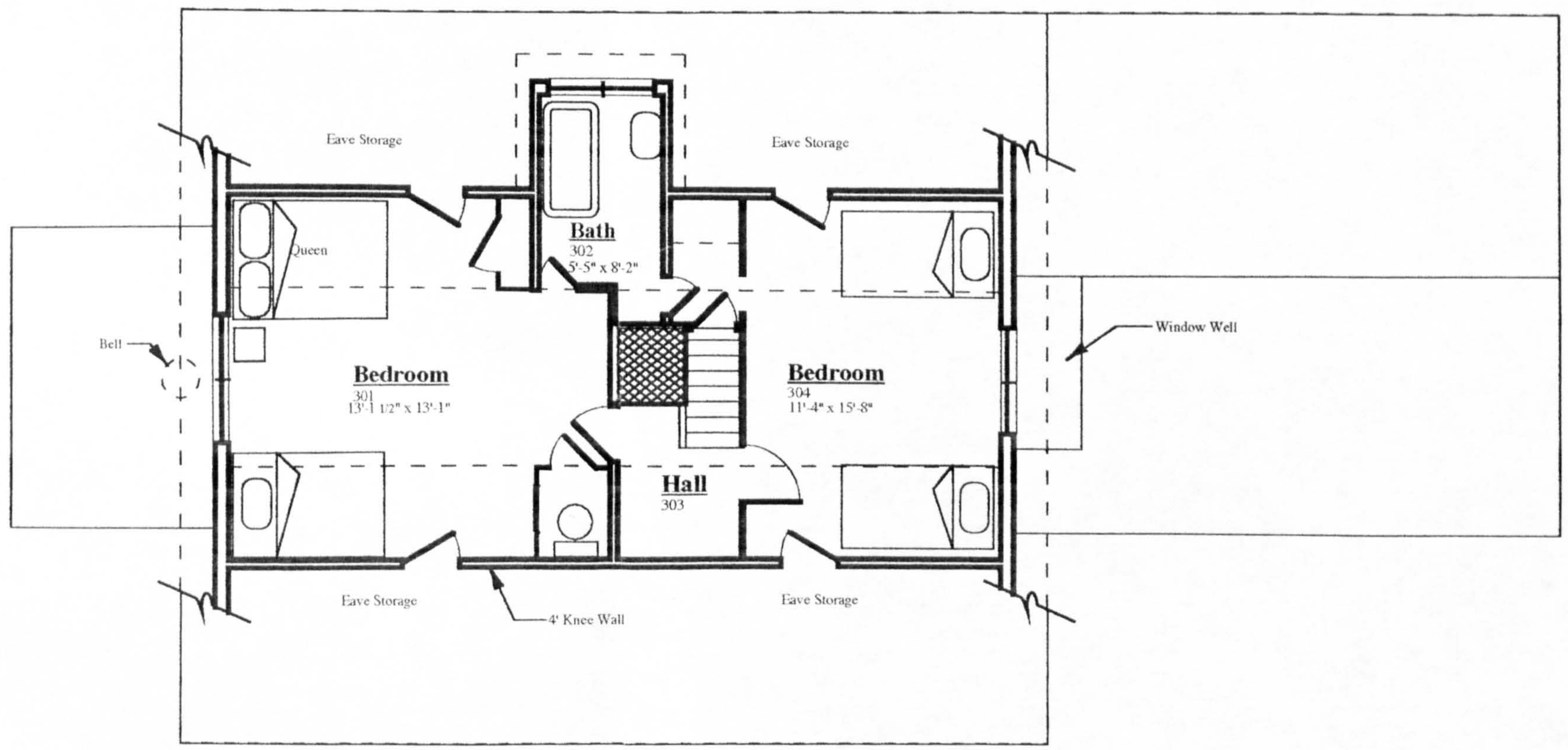
Charlotte D. Bonini
PH.D. Candidate 2005
Advisors: Dr. James Macaulay &
Dr. Raid Hanna
Macintosh School of Architecture
University of Glascow

Stone Cottage

Perkins Street, Castine Maine
Owner's Betty & Roger Gilmore
Year Built: Original Stone House 1757
Renovation 1887
Renovation 1922

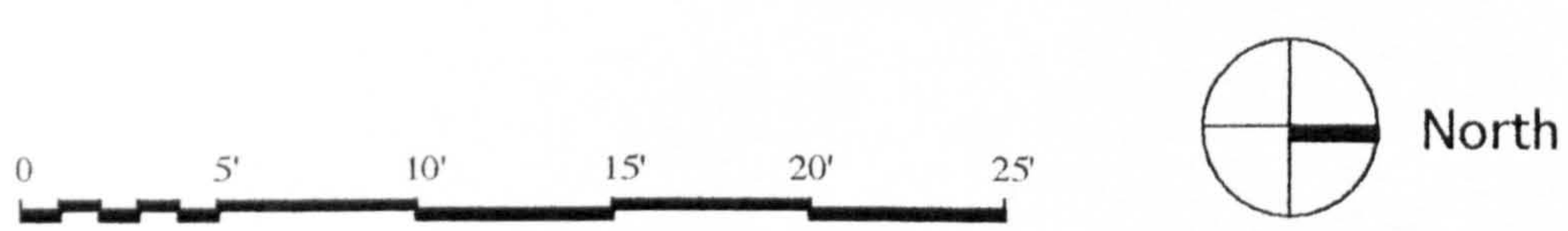
A-2
2 of 3

CDB
2005



3rd Floor Plan

Scale: 1/8 = 1'-0"



2005

EXISTING CONDITIONS

A-3

3 of 3

Third Floor Plan

Scale: 1/8" = 1'-0"
Date: 2005
Drawn By: EHL

Charlotte D. Bonini
PH.D. Candidate 2005
Advisors: Dr. James Macaulay &
Dr. Raid Hanna
Macintoch School of Architecture
University of Glasgow

Stone Cottage

Perkins Street, Castine Maine
Owner's Betty & Roger Gilmore
Year Built : Original Stone House 1757
Renovation 1887
Renovation 1922

CDB
2005

Appendix D

The Burra Charter: The Australia ICOMOS Charter for Places of Cultural Significance 1999.

The Burra Charter

(The Australia ICOMOS Charter for Places of Cultural Significance)

Preamble

Considering the International Charter for the Conservation and Restoration of Monuments and Sites (Venice 1964), and the Resolutions of the 5th General Assembly of the International Council on Monuments and Sites (ICOMOS) (Moscow 1978), the Burra Charter was adopted by Australia ICOMOS (the Australian National Committee of ICOMOS) on 19 August 1979 at Burra, South Australia. Revisions were adopted on 23 February 1981, 23 April 1988 and 26 November 1999.

The Burra Charter provides guidance for the conservation and management of places of cultural significance (cultural heritage places), and is based on the knowledge and experience of Australia ICOMOS members.

Conservation is an integral part of the management of places of cultural significance and is an ongoing responsibility.

Who is the Charter for?

The Charter sets a standard of practice for those who provide advice, make decisions about, or undertake works to places of cultural significance, including owners, managers and custodians.

Using the Charter

The Charter should be read as a whole. Many articles are interdependent. Articles in the Conservation Principles section are often further developed in the Conservation Processes and Conservation Practice sections. Headings have been included for ease of reading but do not form part of the Charter.

The Charter is self-contained, but aspects of its use and application are further explained in the following Australia ICOMOS documents:

- Guidelines to the Burra Charter: Cultural Significance;
- Guidelines to the Burra Charter: Conservation Policy;
- Guidelines to the Burra Charter: Procedures for Undertaking Studies and Reports;
- Code on the Ethics of Coexistence in Conserving Significant Places.

What places does the Charter apply to?

The Charter can be applied to all types of places of cultural significance including natural, indigenous and historic places with cultural values.

The standards of other organisations may also be relevant. These include the Australian Natural Heritage Charter and the Draft Guidelines for the Protection, Management and Use of Aboriginal and Torres Strait Islander Cultural Heritage Places.

Why conserve?

Places of cultural significance enrich people's lives, often providing a deep and inspirational sense of connection to community and landscape, to the past and to lived experiences. They are historical records, that are important as tangible expressions of Australian identity and experience. Places of cultural significance reflect the diversity of our communities, telling us about who we are and the past that has formed us and the Australian landscape. They are irreplaceable and precious.

These places of cultural significance must be conserved for present and future generations.

The Burra Charter advocates a cautious approach to change: do as much as necessary to care for the place and to make it useable, but otherwise change it as little as possible so that its cultural significance is retained.

Articles

Article 1. Definitions

For the purposes of this Charter:

1.1 *Place* means site, area, land, landscape, building or other work, group of buildings or other works, and may include components, contents, spaces and views.

1.2 *Cultural significance* means aesthetic, historic, scientific, social or spiritual value for past, present or future generations.

Cultural significance is embodied in the *place* itself, its *fabric, setting, use, associations, meanings*, records, *related places* and *related objects.*

Places may have a range of values for different individuals or groups.

1.3 *Fabric* means all the physical material of the *place* including components, fixtures, contents, and objects.

1.4 *Conservation* means all the processes of looking after a *place* so as to retain its *cultural significance.*

1.5 *Maintenance* means the continuous protective care of the *fabric* and *setting* of a *place*, and is to be distinguished from repair. Repair involves restoration or reconstruction.

1.6 *Preservation* means maintaining the *fabric* of a *place* in its existing state and retarding deterioration.

1.7 *Restoration* means returning the existing *fabric* of a *place* to a known earlier state by removing accretions or by reassembling existing components without the introduction of new material.

1.8 *Reconstruction* means returning a *place* to a known earlier state and is distinguished from *restoration* by the introduction of new material into the *fabric.*

1.9 *Adaptation* means modifying a *place* to suit the existing use or a proposed use.

1.10 *Use* means the functions of a place, as well as the activities and practices that may occur at the place.

1.11 *Compatible* use means a use which respects the *cultural significance* of a *place.* Such a use involves no, or minimal, impact on cultural significance.

1.12 *Setting* means the area around a *place*, which may include the visual catchment.

1.13 *Related place* means a place that contributes to the *cultural significance* of another place.

Explanatory Notes

The concept of place should be broadly interpreted. The elements described in Article 1.1 may include memorials, trees, gardens, parks, places of historical events, urban areas, towns, industrial places, archaeological sites and spiritual and religious places.

The term cultural significance is synonymous with heritage significance and cultural heritage value.

Cultural significance may change as a result of the continuing history of the place.

Understanding of cultural significance may change as a result of new information.

Fabric includes building interiors and sub-surface remains, as well as excavated material.

Fabric may define spaces and these may be important elements of the significance of the place.

The distinctions referred to, for example in relation to roof gutters, are:

- maintenance — regular inspection and cleaning of gutters;
- repair involving restoration — returning of dislodged gutters;
- repair involving reconstruction — replacing decayed gutters.

It is recognised that all places and their components change over time at varying rates.

New material may include recycled material salvaged from other places. This should not be to the detriment of any place of cultural significance.

Articles

1.14 *Related object* means an object that contributes to the *cultural significance* of a *place* but is not at the place.

1.15 *Associations* mean the special connections that exist between people and a *place*.

Associations may include social or spiritual values and cultural responsibilities for a place.

1.16 *Meanings* denote what a *place* signifies, indicates, evokes or expresses.

Meanings generally relate to intangible aspects such as symbolic qualities and memories.

1.17 *Interpretation* means all the ways of presenting the *cultural significance* of a *place*.

Interpretation may be a combination of the treatment of the fabric (e.g. maintenance, restoration, reconstruction); the use of and activities at the place; and the use of introduced explanatory material.

Conservation Principles

Article 2. Conservation and management

2.1 *Places* of *cultural significance* should be conserved.

2.2 The aim of *conservation* is to retain the *cultural significance* of a *place*.

2.3 *Conservation* is an integral part of good management of *places* of *cultural significance*.

2.4 *Places* of *cultural significance* should be safeguarded and not put at risk or left in a vulnerable state.

Article 3. Cautious approach

3.1 *Conservation* is based on a respect for the existing *fabric, use, associations* and *meanings*. It requires a cautious approach of changing as much as necessary but as little as possible.

The traces of additions, alterations and earlier treatments to the fabric of a place are evidence of its history and uses which may be part of its significance. Conservation action should assist and not impede their understanding.

3.2 Changes to a *place* should not distort the physical or other evidence it provides, nor be based on conjecture.

Article 4. Knowledge, skills and techniques

4.1 *Conservation* should make use of all the knowledge, skills and disciplines which can contribute to the study and care of the *place*.

4.2 Traditional techniques and materials are preferred for the *conservation* of significant *fabric*. In some circumstances modern techniques and materials which offer substantial conservation benefits may be appropriate.

The use of modern materials and techniques must be supported by firm scientific evidence or by a body of experience.

Articles

Article 5. Values

5.1 *Conservation* of a *place* should identify and take into consideration all aspects of cultural and natural significance without unwarranted emphasis on any one value at the expense of others.

Conservation of places with natural significance is explained in the Australian Natural Heritage Charter. This Charter defines natural significance to mean the importance of ecosystems, biological diversity and geodiversity for their existence value, or for present or future generations in terms of their scientific, social, aesthetic and life-support value.

5.2 Relative degrees of *cultural significance* may lead to different *conservation* actions at a place.

A cautious approach is needed, as understanding of cultural significance may change. This article should not be used to justify actions which do not retain cultural significance.

Article 6. Burra Charter process

6.1 The *cultural significance* of a *place* and other issues affecting its future are best understood by a sequence of collecting and analysing information before making decisions. Understanding cultural significance comes first, then development of policy and finally management of the place in accordance with the policy.

The Burra Charter process, or sequence of investigations, decisions and actions, is illustrated in the accompanying flowchart.

6.2 The policy for managing a place must be *based* on an understanding of its *cultural significance.*

6.3 Policy development should also include consideration of other factors affecting the future of a *place* such as the owner's needs, resources, external constraints and its physical condition.

Article 7. Use

7.1 Where the *use* of a place is of *cultural significance* it should be retained.

7.2 A *place* should have a *compatible* use.

The policy should identify a use or combination of uses or constraints on uses that retain the cultural significance of the place. New use of a place should involve minimal change, to significant fabric and use; should respect associations and meanings; and where appropriate should provide for continuation of practices which contribute to the cultural significance of the place.

Article 8. Setting

Conservation requires the retention of an appropriate visual *setting* and other relationships that contribute to the *cultural significance* of the *place.*

New construction, demolition, intrusions or other changes which would adversely affect the setting or relationships are not appropriate.

Aspects of the visual setting may include use, siting, bulk, form, scale, character, colour, texture and materials.

Other relationships, such as historical connections, may contribute to interpretation, appreciation, enjoyment or experience of the place.

Explanatory Notes

(Explanatory notes are placed above beside their articles.)

Articles

Explanatory Notes

Article 9. Location

9.1 The physical location of a *place* is part of its *cultural significance*. A building, work or other component of a place should remain in its historical location. Relocation is generally unacceptable unless this is the sole practical means of ensuring its survival.

9.2 Some buildings, works or other components of *places* were designed to be readily removable or already have a history of relocation. Provided such buildings, works or other components do not have significant links with their present location, removal may be appropriate.

9.3 If any building, work or other component is moved, it should be moved to an appropriate location and given an appropriate use. Such action should not be to the detriment of any *place* of *cultural significance*.

Article 10. Contents

Contents, fixtures and objects which contribute to the *cultural significance* of a *place* should be retained at that place. Their removal is unacceptable unless it is: the sole means of ensuring their security and *preservation;* on a temporary basis for treatment or exhibition; for cultural reasons; for health and safety; or to protect the place. Such contents, fixtures and objects should be returned where circumstances permit and it is culturally appropriate.

Article 11. Related places and objects

The contribution which *related places* and *related objects* make to the *cultural significance* of the *place* should be retained.

Article 12. Participation

Conservation, interpretation and management of a *place* should provide for the participation of people for whom the place has special *associations* and *meanings*, or who have social, spiritual or other cultural responsibilities for the place.

Article 13. Co-existence of cultural values

Co-existence of cultural values should be recognised, respected and encouraged, especially in cases where they conflict.

For some places, conflicting cultural values may affect policy development and management decisions. In this article, the term cultural values refers to those beliefs which are important to a cultural group, including but not limited to political, religious, spiritual and moral beliefs. This is broader than values associated with cultural significance.

Conservation Processes

Article 14. Conservation processes

Conservation may, according to circumstance, include the processes of: retention or reintroduction of a *use;* retention of *associations* and *meanings; maintenance, preservation, restoration, reconstruction, adaptation* and *interpretation;* and will commonly include a combination of more than one of these.

There may be circumstances where no action is required to achieve conservation.

Article 15. Change

15.1 Change may be necessary to retain *cultural significance,* but is undesirable where it reduces cultural significance. The amount of change to a *place* should be guided by the *cultural significance* of the place and its appropriate *interpretation.*

When change is being considered, a range of options should be explored to seek the option which minimises the reduction of cultural significance.

15.2 Changes which reduce *cultural significance* should be reversible, and be reversed when circumstances permit.

Reversible changes should be considered temporary. Non-reversible change should only be used as a last resort and should not prevent future conservation action.

15.3 Demolition of significant *fabric* of a *place* is generally not acceptable. However, in some cases minor demolition may be appropriate as part of *conservation.* Removed significant fabric should be reinstated when circumstances permit.

15.4 The contributions of all aspects of *cultural significance* of a *place* should be respected. If a place includes *fabric, uses, associations* or *meanings* of different periods, or different aspects of cultural significance, emphasising or interpreting one period or aspect at the expense of another can only be justified when what is left out, removed or diminished is of slight cultural significance and that which is emphasised or interpreted is of much greater cultural significance.

Article 16. Maintenance

Maintenance is fundamental to *conservation* and should be undertaken where *fabric* is of *cultural significance* and its maintenance is necessary to retain that *cultural significance.*

Articles

Explanatory Notes

Article 17. Preservation

Preservation is appropriate where the existing *fabric* or its condition constitutes evidence of *cultural significance*, or where insufficient evidence is available to allow other *conservation* processes to be carried out.

Preservation protects fabric without obscuring the evidence of its construction and use. The process should always be applied:

- where the evidence of the fabric is of such significance that it should not be altered;
- where insufficient investigation has been carried out to permit policy decisions to be taken in accord with Articles 26 to 28.

New work (e.g. stabilisation) may be carried out in association with preservation when its purpose is the physical protection of the fabric and when it is consistent with Article 22.

Article 18. Restoration and reconstruction

Restoration and *reconstruction* should reveal culturally significant aspects of the *place.*

Article 19. Restoration

Restoration is appropriate only if there is sufficient evidence of an earlier state of the *fabric.*

Article 20. Reconstruction

20.1 *Reconstruction* is appropriate only where a *place* is incomplete through damage or alteration, and only where there is sufficient evidence to reproduce an earlier state of the *fabric.* In rare cases, reconstruction may also be appropriate as part of a use or practice that retains the *cultural significance* of the place.

20.2 *Reconstruction* should be identifiable on close inspection or through additional *interpretation.*

Article 21. Adaptation

21.1 *Adaptation* is acceptable only where the adaptation has minimal impact on the *cultural significance* of the place.

21.2 *Adaptation* should involve minimal change to significant fabric, achieved only after considering alternatives.

Adaptation may involve the introduction of new services, or a new use, or changes to safeguard the place.

Article 22. New work

22.1 New work such as additions to the *place* may be acceptable where it does not distort or obscure the *cultural significance* of the place, or detract from its *interpretation* and appreciation.

22.2 New work should be readily identifiable as such.

New work may be sympathetic if its siting, bulk, form, scale, character, colour, texture and material are similar to the existing fabric, but imitation should be avoided.

Articles

Explanatory Notes

Article 23. Conserving use

Continuing, modifying or reinstating a significant *use* may be appropriate and preferred forms of *conservation.*

These may require changes to significant fabric but they should be minimised. In some cases, continuing a significant use or practice may involve substantial new work.

Article 24. Retaining associations and meanings

24.1 Significant *associations* between people and a *place* should be respected, retained and not obscured. Opportunities for the *interpretation,* commemoration and celebration of these associations should be investigated and implemented.

For many places associations will be linked to use.

24.2 Significant *meanings,* including spiritual values, of a *place* should be respected. Opportunities for the continuation or revival of these meanings should be investigated and implemented.

Article 25. Interpretation

The *cultural significance* of many places is not readily apparent, and should be explained by *interpretation.* Interpretation should enhance understanding and enjoyment, and be culturally appropriate.

Conservation Practice

Article 26. Applying the Burra Charter process

26.1 Work on a *place* should be preceded by studies to understand the place which should include analysis of physical, documentary, oral and other evidence, drawing on appropriate knowledge, skills and disciplines.

The results of studies should be up to date, regularly reviewed and revised as necessary.

26.2 Written statements of *cultural significance* and policy for the *place* should be prepared, justified and accompanied by supporting evidence. The statements of significance and policy should be incorporated into a management plan for the place.

Statements of significance and policy should be kept up to date by regular review and revision as necessary. The management plan may deal with other matters related to the management of the place.

26.3 Groups and individuals with *associations* with a place as well as those involved in its management should be provided with opportunities to contribute to and participate in understanding the *cultural significance* of the place. Where appropriate they should also have opportunities to participate in its *conservation* and management.

Article 27. Managing change

27.1 The impact of proposed changes on the *cultural significance* of a *place* should be analysed with reference to the statement of significance and the policy for managing the place. It may be necessary to modify proposed changes following analysis to better retain cultural significance.

27.2 Existing *fabric, use, associations* and *meanings* should be adequately recorded before any changes are made to the *place.*

Articles

Explanatory Notes

Article 28. Disturbance of fabric

28.1 Disturbance of significant *fabric* for study, or to obtain evidence, should be minimised. Study of a *place* by any disturbance of the fabric, including archaeological excavation, should only be undertaken to provide data essential for decisions on the *conservation* of the place, or to obtain important evidence about to be lost or made inaccessible.

28.2 Investigation of a *place* which requires disturbance of the *fabric*, apart from that necessary to make decisions, may be appropriate provided that it is consistent with the policy for the place. Such investigation should be based on important research questions which have potential to substantially add to knowledge, which cannot be answered in other ways and which minimises disturbance of significant fabric.

Article 29. Responsibility for decisions

The organisations and individuals responsible for management decisions should be named and specific responsibility taken for each such decision.

Article 30. Direction, supervision and implementation

Competent direction and supervision should be maintained at all stages, and any changes should be implemented by people with appropriate knowledge and skills.

Article 31. Documenting evidence and decisions

A log of new evidence and additional decisions should be kept.

Article 32. Records

32.1 The records associated with the *conservation* of a *place* should be placed in a permanent archive and made publicly available, subject to requirements of security and privacy, and where this is culturally appropriate.

32.2 Records about the history of a *place* should be protected and made publicly available, subject to requirements of security and privacy, and where this is culturally appropriate.

Article 33. Removed fabric

Significant *fabric* which has been removed from a *place* including contents, fixtures and objects, should be catalogued, and protected in accordance with its *cultural significance*.

Where possible and culturally appropriate, removed significant fabric including contents, fixtures and objects, should be kept at the place.

Article 34. Resources

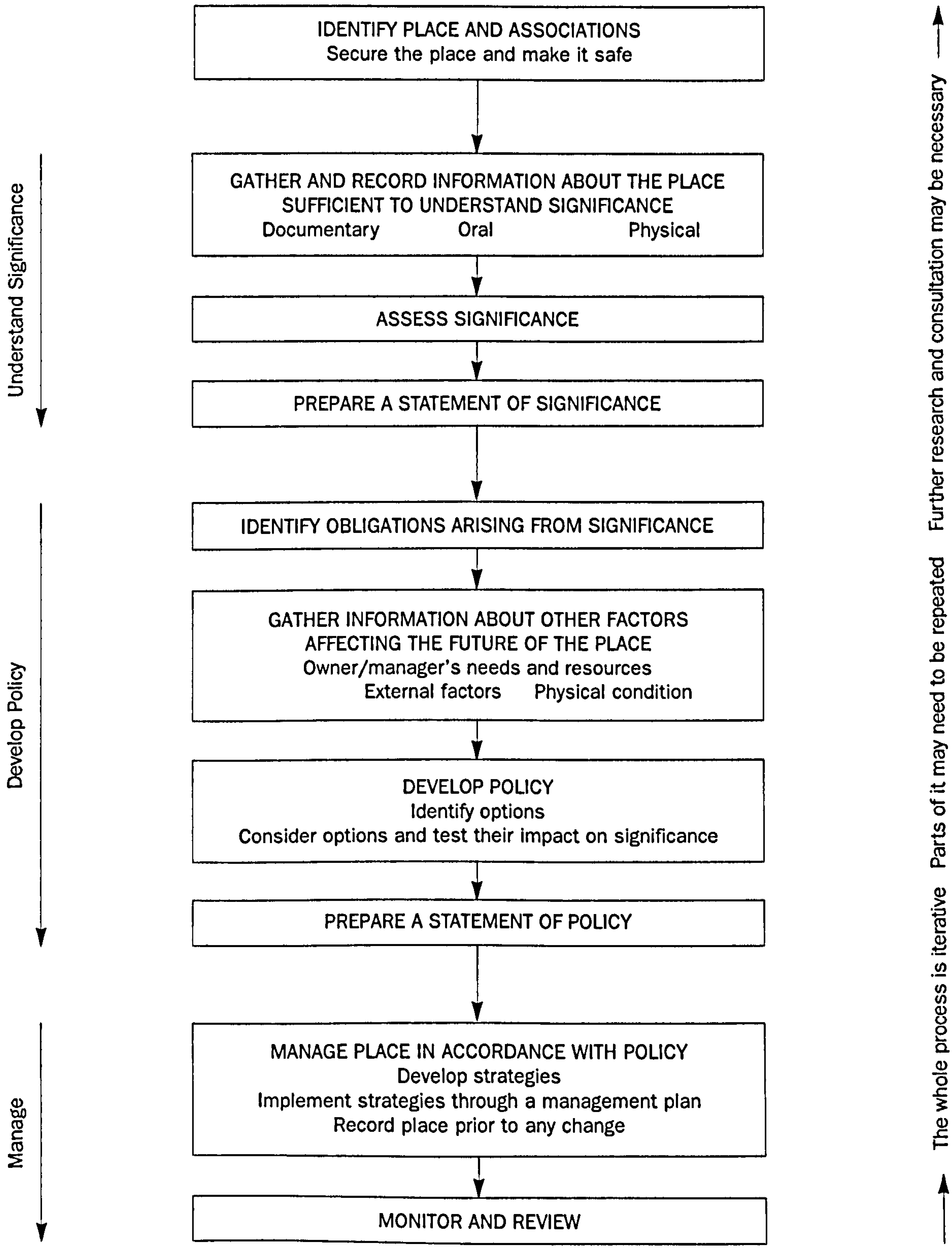
Adequate resources should be provided for conservation.

The best conservation often involves the least work and can be inexpensive.

Words in italics are defined in Article 1.

The Burra Charter Process

Sequence of investigations, decisions and actions



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