Case studies

• sustainable materials and technology

Argyll Bute COUNCIL

Introduction

New development in Argyll and Bute will play an important part in its future success as a sustainable, economically viable and high quality place to live and work. The aim of this design guidance is to ensure that any proposed development is appropriate for its context and is sustainable into the future; that it does not simply meet the applicants immediate needs.

Planning Advice Note (PAN) 68 published by the Scottish Executive in August 2003 sets out the role that Design Statements can play in ensuring appropriate, sustainable developments. It outlines their value as a tool for applicants and planning officers to examine design decisions made in development proposals. It also stresses their importance as a basis for constructive discussion between applicants, designers and planning officers. It recommends that Local Authorities should provide design guidance for specific topics and areas, as well as encouraging the wider provision of design statements in the development application process. All of this is to ensure that in the future the community benefits from better, more sustainable buildings and successful public places.

Following the PAN 68 recommendations this guidance intends to provide insight into the specific issues applicants and designers should consider in preparing development proposals. It outlines some potentially appropriate solutions and illustrates good practice elsewhere. Whilst the guidance does illustrate why certain proposals are inappropriate, it is not intended to restrict applicants' options for developing innovative and specific design solutions for sites in Argyll and Bute. This guidance aims to encourage individual, high quality design solutions for the very special sites and places within the Planning Authority's area.

This guidance aims to improve the dialogues between applicants and planning officers to reach a better understanding of the key issues a development must address. It is hoped that it will provide applicants with a context within which to develop their proposals, and outline those elements they should demonstrate their approach in applications and supporting design statements.

The design guidance is the start of an ongoing reference document that will be added to as appropriate case studies become available. It is intended that applicants demonstrating best practice in design statements and completed developments will contribute to them.

This first stage of the Design Guidance covers several topics which are considered important in contributing to the quality of the environment in Argyll and Bute. Each topic is published as standalone guidance in order to best meet the needs of applicants and the authority in considering specific developments.

Topic 1 **Small scale Housing Development** individual new houses and developments up to 5 homes in the countryside.

Topic 2 **Larger Housing Developments** that extend existing settlements or as standalone developments.

Topic 3 **Working with Argyll and Bute's built heritage** urban infill developments; extending and re-using existing buildings.

Topic 4 **Illustrating Opportunities** case studies sourced from throughout Scotland, as well as the Argyll and Bute area.

Whilst this guidance aims to illustrate why certain designs will not work well in particular situations, it is not intended to restrict applicants' options for developing innovative and individual design solutions for sites in Argyll and Bute. Instead, this guidance aims to encourage individual, high quality design solutions for the very special sites and places within the Planning Authority's area.

Sustainable Development

"development that meets the needs of the present, without compromising the ability of future generations to meet their own needs".
[Meeting the Needs - Scottish Executive Environment Group]

Both the new Local Plan and this Design Guidance are intended to encourage high quality sustainable development that reflects the technology and aesthetics of the 21st century.

More than half the resources consumed globally are used in construction, and 45 per cent of energy generated across the world is used to heat, light and ventilate buildings, with a further 5 per cent arising from constructing them. A sustainable approach to development aims to minimise any adverse impact on the environment by reducing the resources that buildings use both in terms of energy and materials. The Scottish Executive's Climate Change Programme seeks to highlight the important contribution that energy efficiency can make to good design through the correct siting and orientation of buildings and the right choice of materials.

The overall aim of the Design Guidance is therefore to include advice about sustainable choices for materials and renewable technologies.

Argyll and Bute has such a diverse range of landscape and settlements that sustainable solutions suitable for one location may not be appropriate for another. The aim of this Guidance therefore, is to explain the broad principles which underlie sustainable design, rather than to recommend specific products suppliers manufacturers or systems. This Guidance therefore highlights:-

- **Making the best use of available resources - by reducing energy loss using less energy in construction and using renewable energy sources**
- **Minimising environmental damage - by minimising pollution and designing healthy spaces and places**
- **Minimising the effect of climate change - by considering the impact of higher rainfall, stronger winds and the increased risk of flooding**

More information about sustainability and sustainable development is available

"illustrating opportunities"

This section of the Guidance **illustrates the technology available in the form of case studies**

Contents

Making the best use of available resources

Minimising environmental damage

Bibliography and Acknowledgements

Making the best use of available resources

Maximising energy efficiency within the building

Reduce energy loss

Reducing the amount of energy that is used within buildings on a day-to-day basis will not only impact on global warming, but will lead to increasing energy efficiency.

Maximise insulation to make the most of energy retained through solar gain

Orientating buildings for shelter and solar gain will increase the amount of heat which they can collect and lose, but the effects of correct siting will quickly be negated unless the building is well insulated. The more insulation in the external fabric of a building, the less heat will be lost - well insulated buildings have heating systems which are significantly smaller than usual.

• **Environmentally friendly insulation** Where possible avoid foam insulation materials which contain hydrofluorocarbons (HCFCs) as blowing agents. These gases contribute to global warming. Where material strength is required specify rigid foam products that use less damaging blowing agents. For best overall environmental performance consider using cork, cellulose rock-wool, low density glass wool , wool or recycled newspaper.

Use the right size of heating system

A heating system should be correctly sized to match the heat loss from a building; if it is oversized and produces too much heat, energy will be wasted. Heating controls must be easy to use so that a building's occupants do not waste energy - time and temperature controls which are easy to understand and adjust by the user will be most effective.

• **Smaller developments;** consider the use of renewable energy, if this is not possible then refer to SEDBUK for a measure of boiler efficiency. (See website www.boilers.org.uk) Condensing boilers (larger heat exchangers extract more heat from flue gases) are more efficient than ordinary non-condensing boilers. Fit thermostatic radiator valves and insulate pipework.

• **Larger developments**; consider the involvement of an engineer or environmental consultant at an early stage who will advise on the right kind of heating system, together with appropriate airhanding and ventilation advice.

Choose low energy lighting and appliances

Electrity consumption, particularly for lighting, can account for a large proportion of total energy costs. Reduce energy costs by maximising available daylight. Consider the use of appliances and fittings which use less energy, such as energy efficient light bulbs and low energy appliances with A energy rating. Use time switches to control the amount of time a fitting or appliance is used.

"A'Chrannag" (Crow's Nest), Rothesay

Sustainable social housing

- **need for central heating system eliminated**
- **community encouraged to become involved in the design and planning process.**
- **housing designed to reduce energy use during construction and occupation.**
- **triple glazing**
- **maximum levels of insulation in conjunction with an airtight construction**
- **heat recovery ventilation system.**

"A sustainable building doesn't have to have a grass roof and timber"

This seven storey building has fourteen flats incorporating a variety of one, two and three bedrooms. Flats have balconies with extensive views over Bute's countryside. The community chose between three initial design options; 80% of respondents went for the tower.

The Tower is one of Europe's most energy efficient social housing projects. Maximum energy efficiency was achieved by using super insulation levels and a heat recovery ventilation system. All windows are triple glazed with Super Low E glass and Argon Gas infills.

As very little heat is lost, the need for a dedicated heating system for each home is eliminated. The bedrooms do not require heating and the CO2 emission is reduced by 70%.

The one kilowatt or so per unit to maximum heat load can be achieved by putting in one simple backup electric panel heater when and if it is necessary. Most heat should be retained in the house - through the massive insulation system and additional insulation on the hot water tanks.

Family housing, Manse Gardens Duns

Sunspaces; design for passive solar gain

- **"whole house" energy strategy**

These houses for rent have Two-storey conservatories where heat is stored in the masonry walls & then drawn through the house by extracting air in the bathroom & kitchen.

The perforated metal floor in the sun space allows air to percolate to the upper section & from here it is drawn through the upper hall towards the bathroom. Air is extracted slowly using a large attic mounted fan to produce one air change per hour.

A timber porch (unheated) on the north side provides Two door protection to heated areas with the sun space acting as a lobby on the ground floor.

This development confirms that sunspaces can work in Scotland and also provide amenity spaces. The sunspaces, however, must be designed as part of an integrated whole house strategy for energy efficiency.

Making the best use of available resources

Maximising energy efficiency within the building

Minimise air loss

Even if a building is very well insulated, heat will be lost if there are gaps in the building fabric where air can escape, so this needs to be controlled. Typical situations where this occurs include;-

- **around windows & external doors**
- **air leakage paths where different materials meet**
- **gaps around services**

If air loss has been minimised it is important to maintain an adequate level of ventilation to minimise the risk of condensation and to ensure that occupants are comfortable (if not, they will open the windows, resulting in substantial heat loss!)

Use low energy glazing systems

Most traditional single-glazed windows offer little resistance to the passage of heat. Although larger windows allowed more daylight to enter buildings, any benefits from solar gain were lost very quickly. The latest Scottish Building Standards now ask for a good standard of thermal performance for glazing systems.

In general, double or triple glazed units, with argon used to fill the space between the panes and a **low-e coating*** will give a good level of thermal performance. In addition, double glazing provides improved security, sound insulation and minimises condensation.

(Low-e Glazing Low E glass has a special invisible coating that reflects heat back into the room).*

Provide an integrated package of energy efficiency measures

Insulation, heating and ventilation all need to be considered together. For example, improving the standard of insulation can mean that a less expensive heating system is needed. There are various methods by which alternative energy efficiency measures can be measured and compared.

- **Smaller developments** Using energy ratings means that various energy efficiency packages can be measured and compared in terms of their energy use. For example the BRE Domestic Energy Model (BREDEM) can be used to calculate energy requirements for housing by considering issues such as heat loss through each element of the building fabric and through ventilation. The Standard Assessment Proceedure (SAP) is an energy rating for housing which takes into account space and water heating. It is expressed on a scale of 1 for a very inefficient home to 120 for one which is very energy efficient.

- **Larger developments** The Building Research Establishment has produced "A sustainability checklist for developments" (see www.bre.co.uk). This guide enables developers, planning authorities and their advisors to specify/assess the sustainability attributes of a particular development. It contains a series of straightforward steps that can be followed to incorporate sustainability into new developments. It also reflects the latest guidance on sustainability and utilises the BRE's Environmental Assessment Method (BREEAM) and EcoHomes (BREEAM for houses) to assess performance. Performance is rated 'pass', 'good', 'very good' and 'excellent'.

Review Building Performance

Post Occupancy Evaluation is an opportunity to fine tune building management, improve working or living conditions and review the financial performance of heating and ventilation systems. Fuel bill estimates can be compared to occupants ability to pay and it is possible to set targets for improving energy efficiency.

Caolas, Colintraive

Energy efficient house

- **makes use of passive solar gain**
- **uses renewable energy**

This house features a verandah which provides large areas of south facing glazing. Combined with the solid walls of the main block (which absorb the heat collected), it results in an energy efficient home with minimal heat loss, good solar gain and a good level of natural daylighting.

The house is heated with a woodburing stove, and ground floor underground heating which is powered by a ground source heat pump.

Tiree, shutters

- **reduced heat loss**

This building has an exposed location; new windows are located in a larger opening which can be closed off with shutters at night, minimising energy loss.

House at Dalguise, Perthshire

Thermal mass controls internal temperature

- **designed to give good thermal performance and air quality while being cheap and easy to build.**

External walls are constructed from an outer leaf of timber frame construction with an inner leaf of unfired clay bricks from local manufacturer; clay bricks are also used for internal partitions.

The inner leaf of nonstructural clay bricks provides thermal mass acoustic insulation and moisture regulation - moisture can be absorbed into the walls from the interior of the house thus helping to maintain constant humidity.

The unfired clay bricks come from Tayside and as they are not fired like conventional bricks have a low embodied energy. By absorbing heat during warm weather and releasing it during colder months the thermal mass moderates temperatures and allows the house to use a slow response underfloor heating system

Making the best use of available resources

Using less energy in construction

Use materials with low embodied energy

"Embodied Energy" is a way of describing the total amount of energy used in a material's manufacture transport, assembly subsequent use and final disassembly. This embodied energy includes the energy it takes to extract minerals and raw materials from the Earth, the fuel it takes to transport the material to the manufacturing site, and the energy used at the plant to make the product. Also included is the energy it takes to use and later, dispose of the product.

The shorter and simpler the this process is, the less harm done to the environment, and the lower the embodied energy a material is considered to have. For example, unfired earth blocks have significantly lower embodied energy than fired bricks.

Materials and construction methods which minimise energy use and their impact on the environment are included on the following pages.

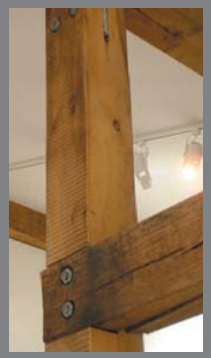
Dun Beag, Tighnabruaich
Round house & roundpole technology

- **uses local materials and skills**
- **sustainable timber treatment**

Dun Beag is a project concerned with the revitalisation of 30 acres of ancient oak woodland. It has developed innovative ways of using the extracted timber for building. The trees are felled and milled in-situ; the cut timber is then treated with Tim-Bor. (a natural boron salt preservative)

Building projects have included a workshop built on tree stumps and most recently, a round wooden dwelling made from 'home' grown timber -mostly sourced from within just 200m of the site. A larger prototypical affordable house is being built at present. It is hoped that this building will use many of the building techniques developed at Dun Beag to build affordable homes.

A solar array and hydro-generator have been installed



Here We Are Centre,Clachan, Cairndow
Local materials and skills

- **uses locally sourced timber**

An innovative community based project for a prototype Community Centre combining Visitor Information and a Local Resource Centre.

Oak sourced from Argyll's woodlands has been used for structural timbers such as beams and columns. It is also used for the external claddings and internal facings. The selection, milling, drying and certifying of the oak all formed part of the process of designing and con-

Isle Of Gigha, local quarry
Local materials and skills

- **uses locally sourced gravel**

The Isle of Gigha Trust have put in place a number of improvements to the island's homes and infrastructure necessitating the improvement and extension of the island's roads.
A previously redundant gravel quarry was opened up to provide materials for a new road leading to Three new community wind turbines

Making the best use of available resources

Using less energy in construction

• Minimising assembly and construction time. Many parts of Argyll and Bute are remote and travel time is lengthy. Not only are transportation costs high for materials, but there can also be costs associated with accommodating site personnel. It therefore makes sense to;-

- Avoid building materials and techniques which are time consuming and labour intensive
- Minimise the use of very specialist materials and details if cost and rapidity of construction are important
- Tailor construction methods and materials to those which are locally available
- Consider the use of more prefabrication

Prefabricated components can range from the use of timber kit to the prefabrication of entire houses

• Minimise maintenance. By carefully selecting and detailing the right materials it is possible to conserve resources which would otherwise be used for new construction and new products.

- use long lasting and durable materials which are easy to maintain.
- consider carefully the use of technology and components which need specialist maintenance.

• Design for deconstruction and reuse. Buildings should be designed to facilitate the easy and economical re-use and recycling of components and materials.

David Douglas Pavilion; Pitlochry
Local materials and skills

- **local timber mill used for roofing shingles**

This pavilion, for Pitlochry's Scottish Plant Collectors Garden, was built to commemorate the significant contribution to Scottish Forestry made by 19th century explorer David Douglas. The entire superstructure is constructed in Scottish timber.

The main structural posts & beams roof decking, wall framing, cladding & viewing deck are all in untreated Douglas Fir. The roof finish is sawn larch shingles from untreated selected heartwood. The windows & doors have been made in laminated Scottish oak. Ash and elm boards have been laid on the floor.

The shingles were sourced from a sawmill in Argyll and Bute.

Maud House; Struy
Local materials and skills

- **based on traditional Scottish timber buildings**

Many recent timber buildings have been inspired by designs from outwith the UK. In contrast, this house uses the traditions of traditional Scottish timber buildings that existed in Scotland prior to World War 1. Traditional buildings, such as servants houses and railway stations have simple proportions and conventional detailing well suited to a Scottish Maritime climate.

This house is one of a range of designs for rural houses based on a conventional timber frame with timber cladding from local suppliers.

Enhanced insulation and carefully located windows and openings mean that best use is made of solar gain.

Making the best use of available resources

Using less energy in construction

Using Renewable Materials - a renewable material comes from a source which is capable of naturally regenerating and which is therefore considered to be sustainable. Renewable materials include, for example timber, flax, cork and wool.

Within Argyll and Bute, a good example of a locally available material resource is timber. Timber is plentiful locally, has the potential to be part of a low energy and healthy building, a supply chain is readily identifiable, and it is a versatile material which can be used for a number of building components.

There are many different types of Scottish timber available and it needs to be carefully specified. Much Scottish timber grows very quickly in Scotland's warm, wet climate and is not suitable for either structural use or for cladding. However, some timber types are suitable for construction including oak, elm, and sycamore as well as durable softwoods such as Douglas fir and estate sourced European larch.

Most timber used in Scotland comes from abroad. Despite the cost of transportation from countries like Canada and Siberia, timber is still relatively low in embodied energy.

The main source of concern when using timber from outside of the UK is whether it comes from a sustainable source or not. FSC certification* confirms that timber is being produced in a sustainable manner

*The Forest Stewardship Council (FSC) is an international network to promote responsible management of the world's forests. It accredits independent third party organizations who can certify forest managers and forest product producers to FSC standards.Its product label allows consumers worldwide to recognize products that support the growth of responsible forest management worldwide.

Housing for Dunbritton HA; Garelochhead

prefabricated structural insulated panel system

- **prefabricated factory system minimises site wastage**
- **heating demands reduced**

This development of cottage flats for rent has been sited to benefit from passive solar gain, with larger south facing windows and smaller openings to the north. It is also designed to be accessible to those with disabilities and to easily accommodate future needs - such as stairlifts, or the needs of a wheelchair owner.
Local contractors recieved training to become registered installers of a prefabricated structural insulated panel system, which was used to minimise construction time. Space heating demands were reduced because the panel system provides high insulation levels; prefabrication and assembly by specially trained personnel means that gaps and voids in the building structure (a significant cause of heat loss) are minimised.

Taransay Pods

timber frame construction

- **prefabrication and design for deconstruction**

The design of these original "Pods" from the TV show 'Castaway 2000', was determined by the short development time permitted by TV programmers schedule, the highly changeable and sometimes severe weather, and the lack of available materials. As a result, the "Pods" had to be designed and prefabricated elsewhere and taken to the island for assembly. Their mainframes are made from solid sections of curved oak, with studs and purlins of Douglas Fir. Pods were dismantled and removed at the end of the Twelve month period; Two of the pods have been re-erected as an artists retreat near Kilcreggan.

Housing for Fyne Homes; Dunoon

timber frame construction

- **local timber kit**
- **local materials and recycled materials**

This development of Twelve houses for rent is located on a brownfield site in the centre of Dunoon. Houses are constructed from a prefabricated locally made timber-kit which offers faster construction time than standard masonry construction, and levels of insulation which are significantly higher than those required by the building regulations. Locally sourced larch is used as cladding and crushed material from demolitions was used as infill for solums. All major rooms generally face south to make use of passive solar gain and have larger openings than elsewhere in order to maximise passive solar gain.
The houses are designed to be accessible to those with disabilities and to easily accommodate future needs - such as stairlifts, or the needs of a wheelchair owner.

Making the best use of available resources

Using less energy in construction

• Use recycled and reclaimed materials

Using recycled products or products with recycled content helps the environment and the economy in several ways. Material that would have ended in landfill sites after its useful life can be reprocessed for use in other products. Newspapers can be reprocessed into cellulose insulation, for instance. Reclaimed materials can include the reuse of building materials such as slate and local stone and the reuse of individual components such as doors fireplaces etc.

Recyling Centre; Rothesay
Fyne Homes

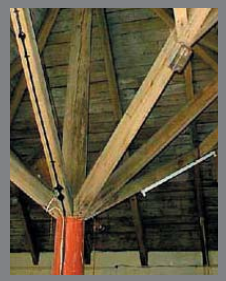
- **recycled and reclaimed materials**

This building was built to house recycling facilities for Fyne Homes. The Centre collects and processes plastic aluminium and steel waste from around the island

It is built almost entirely from a range of locally sourced sustainable recycled and reclaimed materials.

Timber is sourced from the island's own trees and recycled bottles are incorporated into glazed screens. The roof is constructed out of recycled aluminium, the walls out of mult-coloured surplus brick. Kitchen units sanitary fitments and internal doors are also reclaimed from local sources.

An article was published in the local press to facilitate location of any relevant materials which could be reclaimed.



Eilean Eisdeal Hall

- **reclaimed materials**
- **refurbishment of an existing building**

The original Eilean Eisdeal Hall was built in 1871 as a drill hall for the island's volunteer force with a Seven metre high central column supporting a pyramidal roof. The column is formed from a ship's mast, from the sailing ship Norval which was carrying wood from Montreal to Glasgow and sank nearby in 1870. Timber from the ships cargo was used to form the Hall's rafters.

The Hall was renovated and reopened in May 2003. Throughout the project the community were very involved in design development; at construction stage local contractors worked in partnership with the design team and client.

The original slate walls and roof structure have been retained; the roof has been replaced with reclaimed west highland slate; a new glass-fronted bar and reception areas at the front and side of the hall use FSC accredited timber with care taken over detailing to ensure the maximum lifespan for components.

A solar panel provides hot water; during the summer months it produces in excess of requirements and the community is keen to extend its use to provide hot water for the adjacent tea room.

Making the best use of available resources

Water Conservation

Water supply in rural areas is limited. Even if it is currently adequate for an existing number of properties in an area, a mains supply may not be able to cope with even a small development of new housing. Where developments are located in areas that are remote from the water main, they will need their own water supply. In these circumstances, it is prudent to consider recycling water and minimising water use.

Reduce demand for water

Reduce demand for water at point of use before recycling is considered.

- **WCs** - Flushing accounts for about 38%, more than a third of the water used each day. Replacing an old model toilet with a new low-consumption toilet could automatically and permanently water consumption by 25% or more.
- **Composting toilets** Compost toilets avoid the use of water entirely and convert human waste into compost. Compost chambers need space, so may not be always be suitable for conventional private homes.
- **Taps** - The most effective methods of reducing water use from taps are to fit spray inserts, flow restrictors or aerators to new or existing taps. There are also taps where the user has to consciously increase water use and switch to hot water (saving energy).
- **Appliances** Ratings for water efficiency as well as energy and wash efficiency are now given for all new appliances.
- **Showers** Generally, showers use less water than baths (except in the case of power showers) Flow restrictors for shower heads are available for certain types of shower.

Rainwater harvesting

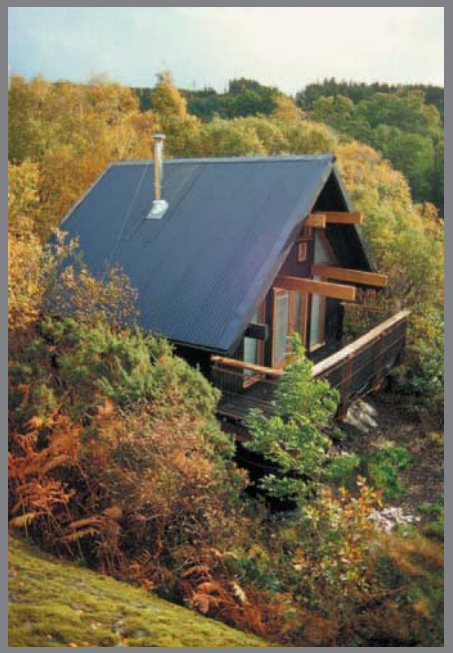
Rainwater "harvesting" (from the roof) usually supplements a mains or private supply and is used for washing machines, garden taps and for flushing WCs. The economics of rainwater harvesting in industrial and commercial situations can often be significantly greater than in household installations due to the generally higher demand for non-potable water and the larger roof catchment area. There are several factors which are crucial to the success of the design and installation of any rainwater harvesting system;-

- **Most rainwater harvesting systems need a mains electricity supply** however, it is possible to source those which are designed to run off solar or wind power
- **The type of roof should be taken into account.** Planted 'green' roofs discolour the water. Lead is poisonous!
- **It is important to consider the likely capacity of a rainwater collection system**, for example, a roof for a garage or outbuildings may only collect enough water to wash a car or water a garden, where a water butt would suffice as a collector.
- **It is advisable to assess both supply and demand for rainwater before considering water treatment.** Rainwater needs to be treated before it is drinkable - for example by Ultra-Violet (UV) sterilisation. This is only worthwhile if there is sufficient capacity to collect enough water. There is little point in water sterilisation if a building only receives enough rainfall to flush WCs.
- **In offices, factories and public buildings a risk assessment should be carried out at the design stage of any proposed rainwater harvesting system**

Greywater recycling

Greywater recycling schemes collect bath water and water from washing machines and reuse this for flushing WCs, gardens and washing machines. For smaller residential developments its use needs careful consideration as more onerous standards can apply to greywater treatment than those for rainwater. A small greywater recycling system may for example, have a larger environmental impact (materials, energy use for pumps, filters and maintenance) than the water use it is saving. On the other hand greywater recycling will reduce the loading on a septic tank or sustainable sewerage system.

On a larger scale, a greywater/rainwater harvesting system can be used to reduce the demand on the local sewerage system. Water from roofs washing machines and other greywater is treated and stored. The system can cater for a single block of dwellings, or a number of blocks, depending on its capacity and design.



Rudha Riabhach, Oban

- **Saving water and sustainable drainage**

This holiday home has a very remote location, on the rocky shores of Loch Melfort, in an area of outstanding natural beauty. The aim, therefore was to minimise any impact on the environment. Instead of standard masonry construction with strip foundations timber frame construction was used; the house was built off a platform supported by timber posts, minimising the extent of the foundations.

As far as possible, all materials were renewable and obtained locally, such as the larch for the timber cladding. The house is orientated to make the most of solar gain, with larger openings facing south. Smaller openings to the north, along with enhanced insulation levels, minimise heat loss.

There is a system for the recollection and use of rainwater and a reed bed filtration system is installed to treat sewerage without the need for a septic tank. Heat comes from a stove which burns wood from local suppliers

Making the best use of available resources

Refurbishing existing buildings

Buildings have a significant amount of embodied energy invested in them during their construction. Their rehabilitation and reuse will ensure that the return on this embodied energy is maximised through the building having as long a life as possible.

- **Maximise opportunities for daylighting and solar gain.** Many traditional buildings have very small window openings, sized to reduce the impact of Argyll and Bute's severe weather. Consider supplementing these with rooflights, adding a sunspace or increasing the size of south facing openings

- **Minimise energy loss.** In addition to increasing the insulation of the building envelope consider retrofitting draught lobbies draughtproofing and replacing doors and windows with high performance window and doorsets - preferably timber.

- **Reclaim materials** such as stone brick or paving slabs. Often older buildings and their sites can prove a useful source of "free" sustainable materials.

- **Review existing materials and details in the light of climate change.** Heavier rainfall and more flooding are likely in the future. It is worth reviewing the capacity of gutters downpipes and any soakaways, to carry water quickly away from the building, and ensuring that existing walls are properly pointed to withstand driving rain.

- **Review opportunities for renewable energy use.** Many buildings within Argyll and Bute have no connection to lower cost fuel such as oil or gas so it the use of renewable energy technology, such as solar water heating or photovoltaics should be considered in conjunction with increased insulation levels.

Isle of Gigha, refurbishment of existing cottages.

- **solar water heating and ventilation systems**

The Isle of Gigha was recently the subject of a community buy-out. After years of private ownership, properties on the island were in a state of poor repair and urgently needed refurbishment. In addition to the usual repairs, (such as re-roofing and re-wiring, and additional insulation), various other energy saving measures have been incorporated into the houses. These include installation of solar water heating and a solar ventilation system.

Throughout the Summer Spring and Autumn it is intended that the solar water heater will provide most of the hot water requirements without cost; at other times the water will be pre-heated by the solar collector before entering the hot water cylinder.

The solar ventilation draws air from between the roof slates by way of a small solar powered fan and introduces air into the house. Since slates warm quickly when the sun is out, the air drawn through them is pre-heated by the sun. By mildly ventilating the house, the system helps prevent condensation which might otherwise be a problem.

In all houses a solid fuel stove has been installed to complement the central heating system, and in some houses sun spaces (porches) have been installed to heat the air within the house.

Kilmartin House Museum

use of natural, renewable materials

- roofing, stairs and conservatory in dowel- nailed green oak

Making the best use of available resources

Renewable energy sources

Much of the energy we use comes from burning non-renewable fossil fuels – oil, gas and coal - to heat (or cool) our houses and workplaces. These fuels release 'greenhouse gases' (carbon dioxide, nitrous oxide and methane) which contribute to climate change. Recent Government Policy has, therefore set a target of generating 20% of the UK's electricity from renewable sources by 2020. In order to meet these aims the renewable energy sector is set to increase.

The Argyll and Bute area is well placed to make the most of this new technology because it will -

- **contribute to the areas economy** (through large scale power generation)
- **exploit the area's significant natural resources** (through wind generation, Biomass CHP (Combined Heat and Power) and tidal and wave power.)
- **allow occupation of very remote areas** it has the potential to allow communities to be self sufficient in energy production for both heat and electrical power; technologies such as ground source heat pumps and photovoltaic panels are being introduced to island communities.

Communities can benefit from this new technology through the Scottish Community and Household Renewables Initiative (SCHRI) which can provide grants and technical assistance . Within Argyll and Bute, SCHRI is implemented by the Argyll, Lomond and the Islands Energy Agency (ALIenergy).

The aim of this Design Guidance is not to duplicate the good quality advice already available for those already contemplating the use of Renewable Energy. Rather, it is intended as a brief overview of the technologies which are available which can be considered for future developments, along with advice about sources of further information, and an illustration of the use of renewable energy already being made throughout the area, by means of case studies.

Isle of Gigha, Community Wind Farm

community energy generation

The Gigha windmills comprise Three second-hand wind turbines. Each turbine stands on a three section, Thirty metre rolled steel tower, set on steel reinforced foundations. The windmills are medium sized by modern standards and whilst they are significant structures in their own right, they are well suited to the small island landscape.

Given the prevailing wind conditions on the Isle of Gigha, it is estimated that the three windmills combined will produce approximately 2.1 gigawatt hours of electricity a year, approximately Two-Thirds of the island's electricity requirements.

This is Scotland's first community owned grid connected, windfarm. Whilst there may be a small but vocal minority opposed to windfarms elsewhere all major decisions on the community owned Isle of Gigha are made by the community. A well-attended trip to a nearby windfarm was arranged by the Trust and a full discussion and debate held, culminating in a meeting at the Gigha Village Hall where the vote in favour of the windmills was 100%.

The financial model that has been developed to underpin the project is robust and capable of widespread replication by communities throughout Scotland. Over the first eight years of the project, the Isle of Gigha Heritage Trust will build up a capital reinvestment fund sufficient to replace all the second hand equipment.

Community District Heating System for Fyne Homes Lochgilphead

community district heating system

. use of wood fuel

Fyne Homes Whitegates housing development was the first example of a wood fuel district heating system in Argyll. Modelled on successful Austrian district heating systems viewed after a trip to Austria arranged by ALIenergy, the the system represented a major advance for wood fuel in the area. New houses are situated around a central boiler system which feeds each individual house on a metered basis.

Fyne Homes and West Highlands Housing Association (WHHA) have gone on to adopt renewable energy solutions in many new-build developments. These include the Fyne Homes Shore Road development in Campbeltown and the WHHA Glenshellach development in Oban. The Glenshellach system represents the largest wood fuelled district heating scheme to be built in Scotland - 92 houses will be supplied by one boiler system when both construction phases are completed.

Columba Centre Islay

An Talla, Tiree

sustainable community building

- **wind generator**
- **timber frame construction**

This new hall has its own small scale wind turbine which is grid connected and which minimises running costs for the new Community Hall.

Use of timber frame construction means that heavy masonry walls have been eliminated. Timber frame construction techniques and materials are suited to the skills of local contractors on the island and prefabrication has helped to ensure quality standards.

Sustainable houses Methil. Kingdom Housing Association

maximising active and passive solar gain

- **solar hot water systems**
- **sunspaces**
- **use of sustainable materials**

The site layout and orientation of houses is designed to maximise solar gain and to provide shelter. Houses incorporate sunspaces and solar panels to heat domestic water in order to reduce energy consumption and save on residents' fuel costs. Each house features a $3m^2$ or a $4m^2$ solar panel connected to unvented hot water cylinders.

Sustainable materials used in this development include thermal insulation derived from recycled newspaper organic paints wood from renewable sources and the use of local materials in order to reduce transportation distances.

High efficiency central heating systems were specified to complement both the active (solar hot water) and passive solar gain systems.

Bowmore Housing for West Highland Housing Association

- **Ground Source Heat pump**

West Highland Housing Association have built twelve houses in Bowmore Isle of Islay which are heated by GSHP systems. They have under floor heating at the groubd floor and radiators on the 1st floor.

Mid Argyll Swimming Pool

- **woodchip boiler**

This woodchip boiler was installed at the Mid Argyll Swimming Pool as part of ALIenergy's Woodwarm project which also included a similar 200kW installation at Kyle Swimming Pool and a smaller 80kW system at Duror Community Hall.
These are modern, clean, efficient energy systems fed by automated woodchip hoppers. Further woodfuel boilers are planned as part of the Campbeltown Community Facility (swimming pool) and the proposed Mull and Iona Community Pool at Craignure.

Lotte Glob House Sutherland

- **woodburning stove**
- **prefabricated building components**
- **high level of insulation**
- **minimal building footprint**

This house for an artist has a large multi-purpose double-height living/sleeping/eating space oriented towards to the South.
The construction is a timber post and beam structure with a curved roof clad with patinated copper sheets. The external walls are clad with untreated Scottish oak shiplap boarding.
The chosen construction method can accommodate super-insulation levels for maximum energy efficiency and yet has minimum impact on the landscape with an inherent ease of assembly and disassembly. The prefabricated post and beam structure provides a flexible adaptable and buildable form which allows the creation of large multi-purpose space and also accommodates the sloping ground with ease by incorporating an undercroft which also becomes an outdoor exhibition space
The structure is built to withstand Winter winds up to 120kmph which sweep across the loch and which "make the stones fly" according to local residents.

Minimising environmental damage
Healthy spaces and places

Ventilation

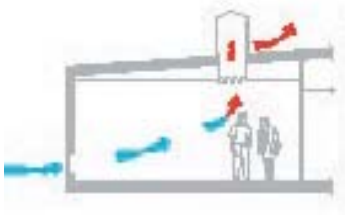
Although newer buildings can minimise energy use by insulating the building fabric maximising solar gain and using an efficient heating system, a significant proportion of heat is lost and energy used through ventilation. The costs involved can be a significant proportion of space heating costs - up to One half in a modern well-insulated dwelling (because of the lower overall heat loss), and typically One-Third in older properties.

At the same time newer, more energy efficient and sustainable buildings are designed to allow much less air to pass through the building fabric than was previously the case, in order to conserve heat and minimise energy use, so a serviceable ventilation system is essential.

A well designed sustainable ventilation system should provide a proper balance between energy efficiency and indoor air quality. Typically, this should include provision for the following features.

- **Background ventilation** - finely controlled low-level ventilation (such as trickle ventilation fitted into window frames) to provide fresh air to the room.
- **Rapid ventilation** provides short-term high rates of ventilation in individual rooms on demand. An example would be an openable window or external door.

- **Extract ventilation** another form of rapid ventilation provided in rooms such as kitchens and bathrooms which are likely to be a source of pollution or odour.



A more energy-efficient alternative to conventional extract ventilation is **passive stack ventilation** (PSV). This system allows exhaust air to rise up through a building naturally, using extract pipes that typically exit at the ridge of a roof. Its main advantage is that it requires no power and has no moving parts. PSV can be controlled by humidity sensors so that ventilation only occurs when needed, thus avoiding energy wastage. The disadvantage is that it needs adequate height to create a steady flow. It is therefore not suitable for all locations (for example, it is less suitable for ground floor WCs located in porches).

Mechanical heat recovery systems can recover heat lost through ventilation by extracting heat from exhaust air and using it to pre-heat incoming fresh air.

Auchterarder Primary School

minimising impact of larger scale development

- **natural ventilation**
- **SUDs drainage system**

Within this single storey primary school, high level clerestory glazing is combined with lower windows within classrooms to maximise natural ventilation. The school has a sustainable urban drainage system, with a swale which provides a wetland area for local flora and fauna.

Ardencraig Square; Glasgow

sustainable housing on brownfield site

- **passive ventilation sytems**
- **sunspaces and solar gain**
- **increased insulation**

A passive ventilation system uses ducting and humidity sensitive grilles in windows to control the free flow of fresh air within individual flats and houses. It also extracts damp air automatically from humid kitchen and bathroom environments. With no electrical extract fans required, there are no running costs once installed, and the system should require little or no maintenance.

Houses have draught lobbies to all front entrances and sunspaces - south facing glazed porches which can direct solar heat build up within the porch into the home. The southern orientation of many of the blocks maximises solar heat gain, as well as providing sunny bright, comfortable rooms; minimal openings to the north facades reduce heat losses.

Energy efficiency performance standards to which the homes are designed exceed Building Regulations minimum requirements. External walls and roofs have an increased depth of insulation and floors are insulated below slabs to allow the concrete mass to act as a heat store releasing heat back into the building passively and cutting the need for additional usage of the conventional heating system.

Minimising environmental damage
Healthy spaces and places

Materials

There is concern over the negative health effects of toxic chemicals used within buildings. Many modern building materials - including paint and wood preservatives contain solvents biocides and other volatile organic compounds which have the capacity to "off-gas" ie. to leach into the atmosphere contaminating the indoor environment. More effective air tightness and controlled ventilation means that these contaminants are less likely to be dissipated than was the case in older buildings; using healthy materials which are low in toxins becomes more of a priority.

Ecological buildings materials

Ecological building materials and products are non toxic and actively promote healthy and comfortable living conditions. Typically, they include insulation made out of flax, cellulose or sheep wool; boards made from a composite of clay, reed and hessian; fired clay blocks; clay and lime based plasters and woodfibre boards.

These basic technologies have been extensively tested by many years of weather and habitation. Many of them help with moisture control and regulation because of their vapour permeability and water absorbing properties leading to a reduced risk of condensation. Developers should seek to specify products and materials which minimise their negative impact on the environment.

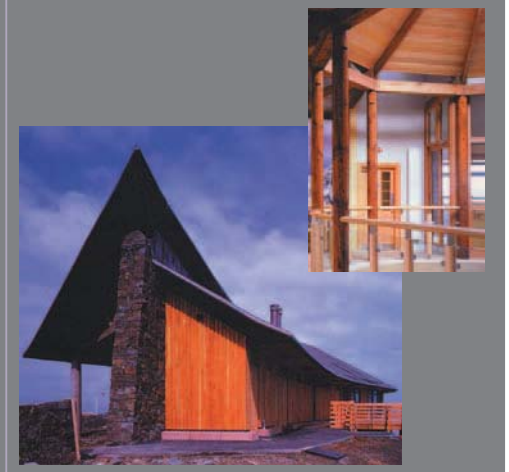
For example the manufacture of uPVC construction components is extremely energy intensive requiring the use of a range of petrochemicals (which are not a renewable resource). In contrast, the timber used in construction is renewable and sustainable, its growth is considered environmentally appropriate and it has a low embodied energy.

Some alternatives to uPVC are noted below

PVC product	Alternative
Rainwater guttering and drainpipes	steel, cast iron, hdpe
Water supply pipes	Polyethylene
Sewerage and drainage pipes	Vitrified clay pipes or High Density Polyethylene piping
Doors, windows and conservatory frames	Timber from a sustainable source; high quality timber window systems
PVC floor & PVC (vinyl) wall	Linoleum, cork, stone, ceramic

Steel gutters and downpipes
alternative to uPVC

Galvanised sheet steel rainwater systems combine a good performance with fast and easy assembly This type of system is installed in 90% of buildings in Sweden.



Seabird Centre East Lothian
high performance timber windows & doorsets

Conventional timber treatments contain insecticides and/or fungicides which can harm the environment and create health problems. The windows used in the centre are treated with boron, considered the safest and most environmentally-benign of all timber preservatives. In addition, the paints and finishes are all based on natural plant oils and contain no biocides.

The choice of high performance timber windows was also part of a conscious effort on the part of the Scottish Seabird Centre to avoid the use of uPVC. uPVC has been almost entirely avoided in the centre with copper being used instead for rainwater goods.

Ecological building products

- **renewable materials**
- **materials with low embodied energy**

Ecological building materials and products are non-toxic and actively promote healthy and comfortable living conditions.

Typically, they include insulation made out of flax, cellulose or sheeps wool; boards made from a composite of clay, reed and hessian; fired clay blocks; clay and lime based plasters and woodfibre boards.

These basic technologies have been extensively tested by centuries of weather and habitation. Many of them help with moisture control and regulation because of their vapour permeability and water absorbing properties, leading to a reduced risk of condensation.

Minimising environmental damage

Healthy spaces and places

Products containing formaldehyde

Wood based boards are ubiquitous in modern interiors and in some cases formaldehyde based resins are used to bond together the constituent parts. Even at a low level, exposure to formaldehyde though inhalation can cause irritation to the eyes, nose and throat; it is also a suspect carcinogen.

Low formaldehyde wood-based boards are available; alternatively timber can be specified.

Timber treatment

Over the last 50 years a number of toxic chemicals have been used to preservative-treat timber. DDT Dieldrin, Pentachloraphenol, Lindane, Tributyl tin oxide and Arsenic are some of the highly toxic and carcinogenic chemicals which have been used to eradicate or prevent fungal and insect attack. Recently a new generation of timber treatments has been introduced with much lower acute toxicity, but health and environmental concerns remain.

In order to avoid treating timber with toxic preservatives try to either;-

- **use durable timber which does not require treatment**

or

- **use very low toxicity preservatives without toxic solvents such as inorganic borates**

Paint treatments

Conventional synthetic paint consist of numerous ingredients to give it the properties required for its purpose, including resins pigments drying agents, and solvents. Many of these components may be toxic but the primary concern relates to the use of volatile organic compounds (VOC's) used as a solvent, as thinners and in cleaning materials. After the paint is applied, the toxic ingredients can be given off ('off gassing') for some time afterwards, and there is concern about the neurological effects of solvents. Mineral and plant based paints can be considered to be generally environmentally benign (although minerals are not renewable), but in some cases there can be disadvantages, such as durability, drying time ease of application and cost. Alternative paint treatments are available - see table below.

worst

better

Generic paint type	Example supplier or manufacturer
Petroleum origin, solvent based paints	Most conventional paints
Minimal VOC paints 0.00 to 0.29 % (water based paints)	Crown "breathe easy" range Low odour covermatt emulsion range Acrylic Eggshell http://www.crowntrade.co.uk B&Q minimal VOC emulsion paint
Low VOC 0.3 to 7.99% (water based paints)	Crown Indulgence and Easy Clean range http://www.crownpaints.co.uk/
Mineral based paints are low maintenance and environmentally friendly- they are waterborne odourless, non-toxic and provide a breathable semi-permeable membrane.	Keim Mineral Paints for external render stonework and masonry
Natural Paints and Finishes are made from natural raw ingredients such as plant oils and dyes; bees' wax, earth and mineral dyes. Natural paints have minimal embodied energy; some are 100% biodegradable and many ingredients are from renewable sources.	Biodur paint systems for timber and internal walls http://www.biodur.net/ Auro organic paints http://www.auro.co.uk/

Offices for Loch Fyne Oysters Ltd; Clachan
Timber cladding

Painted scots pine timber cladding to the external walls and corrugated steel roof.

Housing at Gremista; Shetland
Timber cladding

High wind speeds mean a high risk of wind-driven water penetration. Vertical board-on-board preservative treated softwood cladding is carefully detailed to allow ventilation and drainage and given an opaque water-repellant coating

Housing at Tarbert
Timber cladding

Opaque colour finish for timber cladding complements the use of bright colour for other buildings in Tarbet.

Housing at Gothenburg; Sweden
Timber cladding

Opaque colour finish for timber cladding, in a maritime area with a climate very similar to that of Argyll and Bute.

Bibliography
Acknowledgements

Acknowledgements

Guidance documents incorporate illustrations from the following sources;-

- RCAHMS
- Claudia Ferguson-Smyth
- Gokay Devici
- The Saltire Society
- Tighmore Developments
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- Fyne Homes
- Mike Davis
- Mike Hyatt
- Tiree Development Partnership
- Simpson and Brown
- Gaia Architects
- the Easdale Island Trust
- Gareth Roberts
- Arc Architects
- Richard Gibson Architects
- Richard Murphy Architects
- David Blair (dun beag)
- Blast Architects
- Malcolm Fraser Architects
- Dualchas
- Isle of Gigha Trust
- West Highland Housing Association
- Vernon Monaghan
- Sills Associates
- Jamie Troughton
- Page and Park
- Elder and Cannon
- Chris Stewart Architects
- Kingdom Housing Association

Bibliography

Information about Argyll and Bute

Argyll and Bute Council
The Local Plan is available digitally from the Argyll and Bute Council website at;- **http://www.argyll-bute.gov.uk/content/planning/developmentpolicy**

Argyll and Bute Council Library and Information Service's Local Collection
Highland Avenue Sandbank Dunoon PA23 8PB Tel: 01369 703214 Fax: 01369 705797 Contact Eleanor Harris, Local Studies Librarian, for more details (eleanor.harris@argyll-bute.gov.uk).

Each branch library holds a small Local Collection specific to its area, but the bulk of the material, including books, pamphlets, maps and postcards is held at Library Headquarters

Publications
The Buildings of Scotland, Argyll and Bute by Frank Arneil Walker
ISBN 0140 710 795
A guide to historic buildings in the Argyll and Bute Area

Argyll and the Islands: An Illustrated Architectural Guide byFrank Arneil Walker
ISBN: 1873190522
RIAS Series of Illustrated Architectural Guides to Scotland

The North Clyde Estuary: An Illustrated Architectural Guide by Frank Walker Fiona Sinclair
ISBN: 1873190077
RIAS Series of Illustrated Architectural Guides to Scotland

The Stenlake Publishing Series 'Old Islay' etc. -compilations of old photographs are available at **www.stenlake.co.uk**

The CANMORE database contains details of archaeological sites, ancient monuments and buildings in Scotland. It also provides an index to the catalogued collections of RCAHMS and images of some of the photographs or drawings in the collection and can be found at **www.rcahms.gov.uk**

Buildings at Risk Register for Scotland - redundant buildings of architectural interest which have the potential to be redeveloped
http://www.buildingsatrisk.org.uk

Information about Sustainability and Renewable Energy

Potential Adaptation Strategies for Climate Change in Scotland
Andy Kerr, Andy McLeod; University of Edinburgh Scottish Executive Central Research Unit 2001

Sustainable Housing Design Guide for Scotland
Fionn Stevenson and Nick Williams
HMSO

ALI Energy
ALI Energy is a local charitable organisation dedicated to increasing the use of renewable energy and increasing energy efficiency. The can give advice on both the technology and funding available.
Their website can be found at http://www.alienergy.org.uk. Alternatively email ***enquiries@alienergy.org.uk or tel 01631 565 183***

SEPA
SEPA is responsible for the protection of the environment in Scotland so it deals with issues related to pollution, sewerage and waste disposal. Their website is a good source of information and can be found **at http://www.sepa.org.uk**
SUDs information is available on their website at **http://www.sepa.org.uk/publications/leaflets/suds/index.htm**
SEPA is the Flood Warning Authority for Scotland. The section of their website dealing with flooding is located at **http://www.sepa.org.uk/flooding/floodline/index.htm** and details products and publications. SEPA are developing internet flood maps for Scotland

The Energy Saving Trust
The Energy Saving Trust is a public body which encourages energy efficiency and the use of renewable energy. It provides comprehensive advice and can provide funding.
It's web site is located at **http://www.est.org.uk/**

Scottish Ecological Design Association has links to a number of useful websites and is available at **http://www.seda2.org/**

WRap - information about recycling and reclaimed products is available at this website **http://www.wrap.org.uk/**

Bibliography

General Planning Guidance

Planning Guidance from the Scottish Executive
The Scottish Executive have compiled a range of Guidance on design within both rural and urban areas. Relevant Guidance can be accessed from their website at **http://www.scotland.gov.uk/Topics/Planning-Building/Planning** and includes

- PAN 78 Inclusive Design
- PAN 77 Designing Safer Places
- PAN 76 New Residential Streets
- PAN 75 Planning for Transport
- PAN 72 Housing In the Countryside
- PAN 69 Planning and Building Standards Advice on Flooding
- PAN 68 Design Statements
- PAN 67 Housing Quality
- PAN 65 Planning and Open Space
- PAN 61 Planning and sustainable urban drainage systems
- PAN 52 Planning in Small Towns
- PAN 44 Fitting New Housing Development into the landscape **(PAN 44 incorporates a detailed illustrated consultants manual of design and analysis techniques prepared by Gillespies.)**

Scottish Buildings and their care

Scottish House: A Review of Recent Experience in Building Individual and Small Groups of Houses in Rural Scotland with a View to Sustainability the Use of Tra ditional and New Materials, and Innovative Design
BY Sandy Halliday Gaia Research and Gill Pemberton, Scottish Ecological Design As sociation
Available from the Scottish Executive website at
http://www.scotland.gov.uk/cru/resfinds/cnh11-00.asp

The Conversion of Redundant Farm Steadings to Other Uses
by Andy Davey (with assistance from Lesley Kerr)
Simpson and Brown Architects
Available from the Scottish Executive website at
http://www.scotland.gov.uk/cru/kd01/orange/crfs-01.asp

Historic Scotland
Memorandum of Guidance on Listed Buildings and Conservation Areas Historic Scotland
This Comprehensive guidance for working within conservation areas and working with Listed Buildings can be downloaded from the Historic Scotland database

Other Information about Historic Scotland's policy and guidance available includes;-

- Maintaining Your Home: A Short Guide for Homeowners
- Scotland's Listed Buildings; a guide for owners and occupiers
- Passed to the Future; Historic Scotland's Policy for the Sustainable Management of the historic environment
- Looking after your sash and case windows; a short guide for homeowners

available on
http://www.historic-scotland.gov.uk/index/publications/pubsforowners.htm

Timber frame Housing in the Scottish Countryside
John and Margaret Richards
HMSO

General Design Guidance

Cork Rural Design Guidance; building a new house in the countryside
Cork County Council

Edinburgh Standards for Urban Design
Edinburgh City Council

Institute of Civil Engineers Knowledge Database - this internet site has many useful briefing documents such as "Briefing Document Places, streets and movement (Supplement to DB 32)" the site is located at **http://www.ice.org.uk/knowledge/**

Urban Design Compendium
LLewelyn-Davies for English Partnerships and the Housing Corporation

Safety and Security

"Secured By Design"
Improving home security - website address which lists contact names in the Argyll and Bute Area - **http://www.securedbydesign.com.** Alternatively, contact **ACPO Crime Prevention Initiatives**; 7th Floor, 25 Victoria Street, London SW1H 0EX; Tel: 020 7227 3423