Section 1.4

Key Insulation Design Considerations

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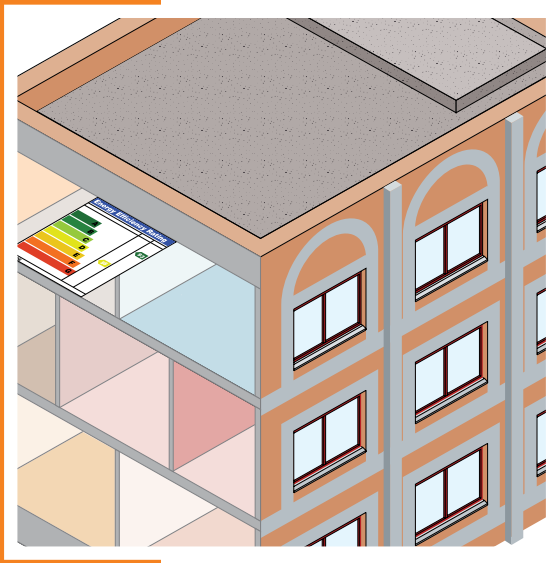
Considerations

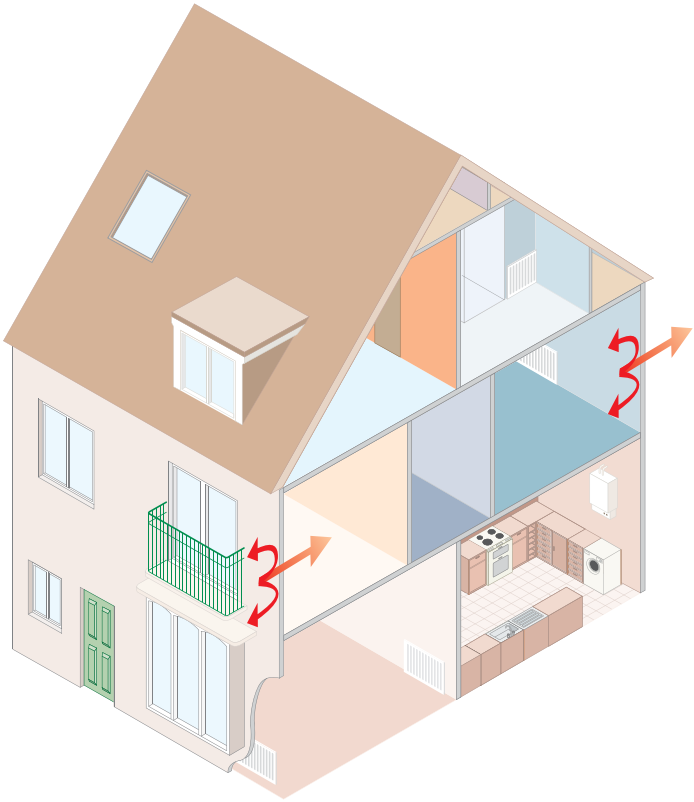


Key insulation design considerations

The following pages give an overview of the critical factors influencing the design of today's buildings.

Many are dealt with in greater depth in later sections of this book and page numbers are shown where relevant.

Key design considerations



Thermal fabric

The primary purpose of insulation is to limit either heat loss or heat gain though the external structure and fabric of a building.

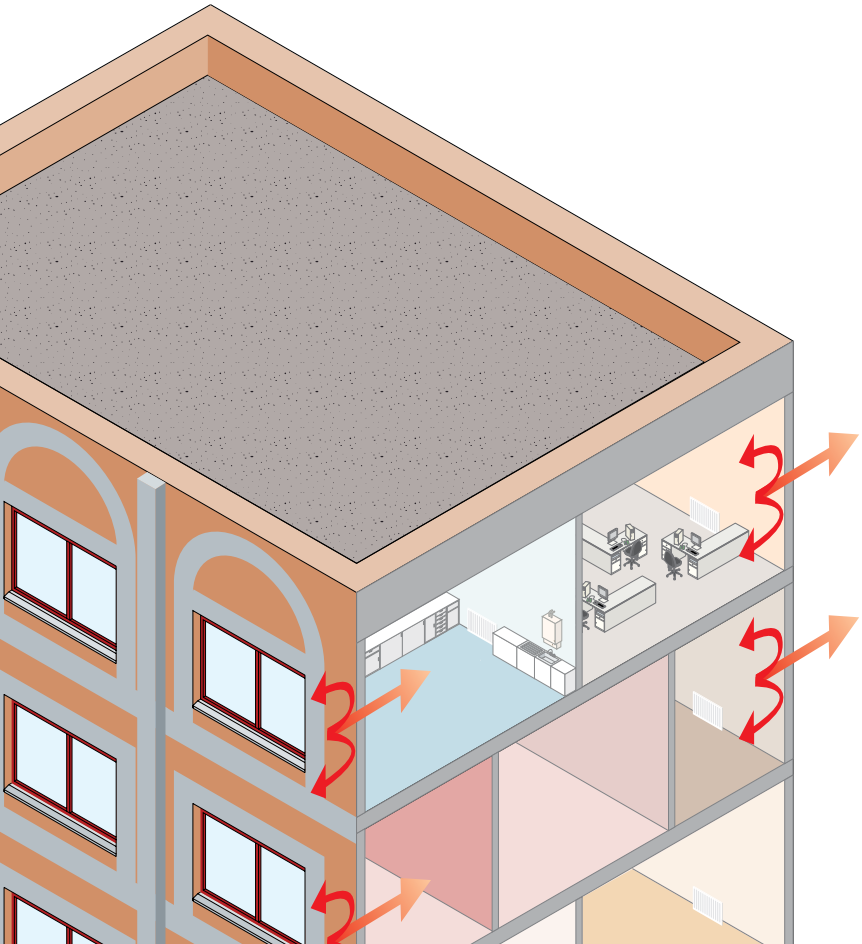
All building materials used in a wall, roof or floor, increase the thermal resistance to some degree, however insulation materials are the most efficient at adding thermal resistance because of their low thermal conductivity. Heat loss through a building element can occur through conduction, convection or radiation or a combination of them.

The Law

In England and Wales, Part L of the Building Regulations sets out the statutory requirements for the thermal design of new and refurbished buildings, for which the thermal performance of the building fabric is a fundamental component. The standards outlined in Part L of the Building Regulations will become more demanding in terms of thermal performance and are scheduled to be upgraded again in 2013. In Scotland, Technical Handbook, section 6 and in Northern Ireland Technical Booklet F cover the thermal regulations and requirements.

Key guidance

For domestic new build, the Code for Sustainable Homes is now a critical influencing factor. The Code sets out criteria for creating ever-more carbon, sustainable and environmentally efficient housing with the objective of all new-build housing being zero carbon by 2016.



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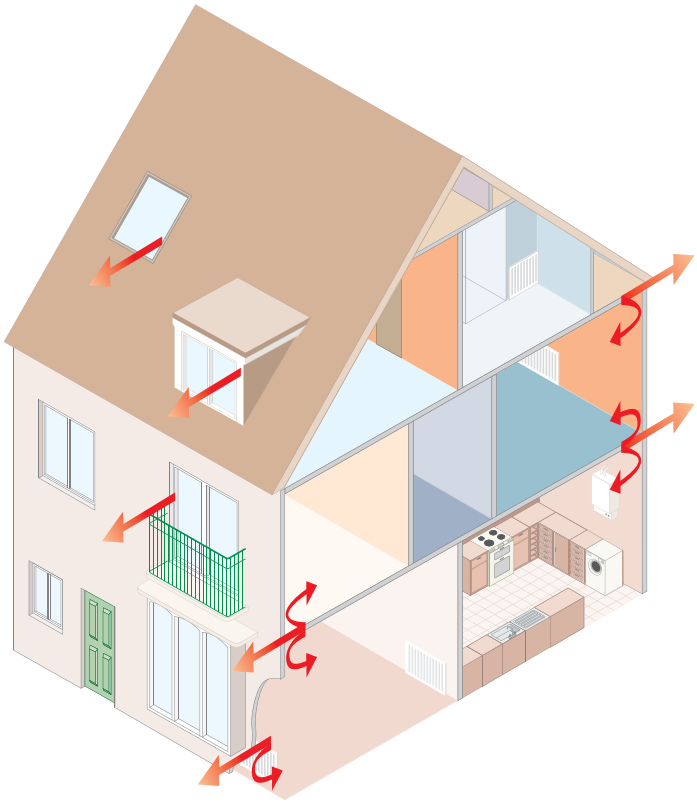


Thermal airtightness and ventilation

Airtightness and thermal bridging at junctions of building elements are key design considerations for all buildings.

Uncontrolled air exchange with the external environment is a major cause of heat loss within a building. However, there is a difference between air leakage and ventilation. Nearly half of all heat lost from the average home is a result of uncontrolled air leakage through gaps in the structure. This is distinct from controlled ventilation resulting from intentionally designed vents – such as windows and fans.

With air leakage, heat energy in the air is lost. The way to eliminate uncontrolled air leakage is to form a sealed external envelope, through which moisture vapour can escape, but wind and water cannot penetrate.

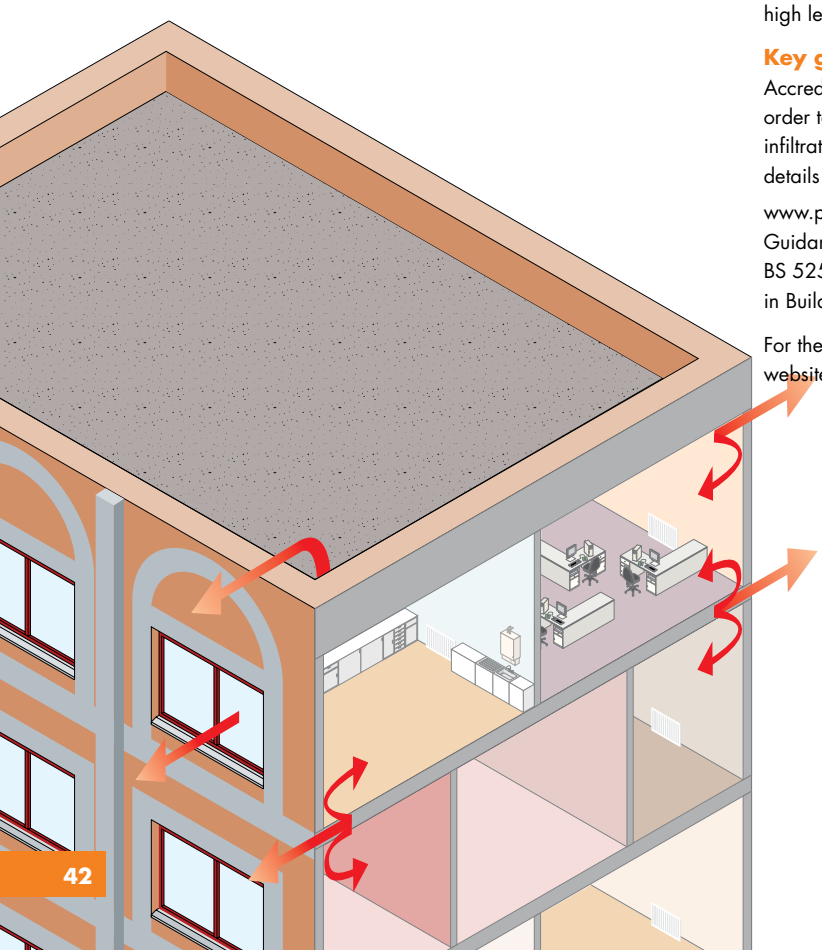
Constructions with high levels of air leakage have been exposed as wasteful of energy and are major contributors to CO_2 emissions. Ventilation systems with heat recovery capability require buildings with high levels of airtightness in order to operate at maximum efficiency.

Key guidance

Accredited Construction Details have been specifically designed in order to minimise heat loss from dwellings due to air leakage and infiltration. They can be considered to be the industry best practice details and can be downloaded free of charge from:

www.planningportal.gov.uk
Guidance on the ventilation of buildings can be found in BS 5250: 2011, Code of Practice for Control of Condensation in Buildings.

For the impending Constructive Details scheme please refer to our website at knaufinsulation.co.uk



Acoustic

Protection from noise contributes towards the 'quality of life' afforded by dwellings, and a healthy, productive and attractive environment in offices, hospitals, schools and other non-domestic buildings.

Many aspects of modern life contribute towards increasing levels of potential nuisance noise including the construction of housing at high densities, increasing use of home entertainment equipment throughout the home, and the 24 hour society.

In dwellings, legislation is concerned with protecting residents from nuisance noise in attached dwellings and within the dwelling, and requires that separating walls and floors are built to provide specific levels of protection. There is no requirement to protect from noise sources external to the dwellings such as road or air traffic.

Schools (in particular rain noise), hospitals, libraries and many other types of buildings have very specific acoustic requirements and specifications will often determine the acceptable noise levels within rooms by their activity and purpose.

Glass and rock mineral wool insulation has excellent acoustic absorption performance. Its use in carefully specified constructions with good detailing contributes significantly towards the requirements stipulated in the regulations set out below.

The Law

Approved Document E (England and Wales only) – Resistance to the passage of sound. The document sets minimum standards for the protection that separating walls and floors offer between dwellings and internal walls and floors within dwellings. It sets similar standards for other types of residential rooms including hotels and student accommodation. It also states minimum standards for reducing reverberation in communal areas of flats and apartment buildings and creating the appropriate acoustic conditions in schools.

In Scotland, **Technical Handbook, Section 5** and in Northern Ireland **Technical Booklet G** covers acoustic regulations in dwellings and non dwellings.

Key guidance

General

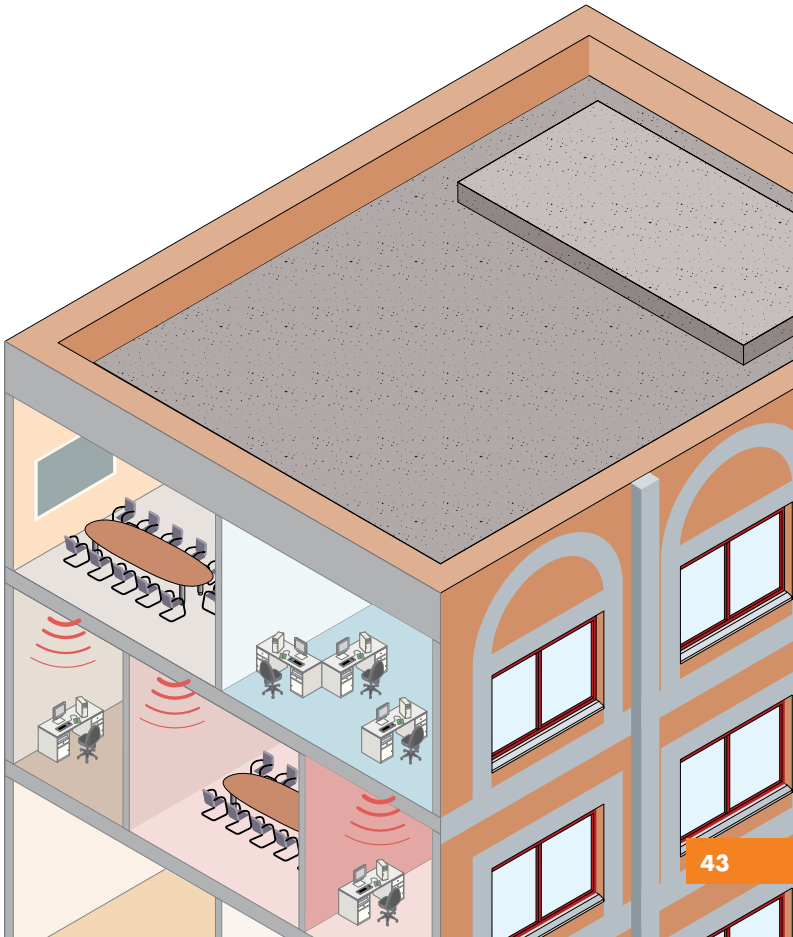
BS 2750-2:1995 – Measurement of sound insulation in buildings and of building elements.

Hospitals

HTM 08-01 and HTM 60 – These documents set out sound insulation requirements and guidance for various areas in hospitals.

Schools

BB93 sets out the acoustic performance standards for new schools.



Key design considerations

Fire

All buildings must be designed and constructed to minimise the risk of fire; to minimise its spread should it occur; to maximise the structure's stability; and to maximise the ability of the occupants to escape unharmed.

Insulation fire protection products

Knauf Insulation products achieve the highest Euroclass `Reaction to fire` ratings and have excellent resistance to the Surface Spread of Flame when tested to BS 476 Part 7:1997. Many products are classified as Class `0` to the Building Regulations and can be used in a wide range of partitions, separating walls, ceilings and structural beams and columns to achieve anything from 30 to 240 minutes fire resistance.

Reaction to fire

'Reaction to fire' tests are used to evaluate the contribution of a material to fire growth. Tests are carried out either to national classifications, i.e. BS 476 or to European classifications. The results of the latter are more transparent and allow easier comparison of the reaction to fire of different products. The Euroclass fire classification of a product is required to be declared on the CE mark.

All Knauf Insulation unfaced mineral wool products achieve a Euroclass rating of A1 – the highest performance possible. Put simply this means that the products are non-combustible. Most cellular plastic foams will achieve a Euroclass rating of C or D.

The Law

Approved Document B (England and Wales) sets out the requirements for provision of means of escape; inhibition of fire spread internally; optimisation of building stability; inhibition of spread of smoke; and limitation of fire spread from one building to another. Periods of fire resistance for specific buildings, building areas and types of construction are also set out in the Approved Document's appendices. In Scotland, **Technical Handbook, Section 2** and in Northern Ireland **Technical Booklet E** covers fire safety.

Key guidance

BS EN ISO 13501-1 - Fire classification of construction products and building elements

BS 476 range of standards - Fire tests on building materials and structures

BS 5950: 3.1 : 1990 - Structural use of steel in buildings

Fire Protection for Structural Steel in Buildings (The Yellow Book) produced by the Association of Specialist Fire Protection.

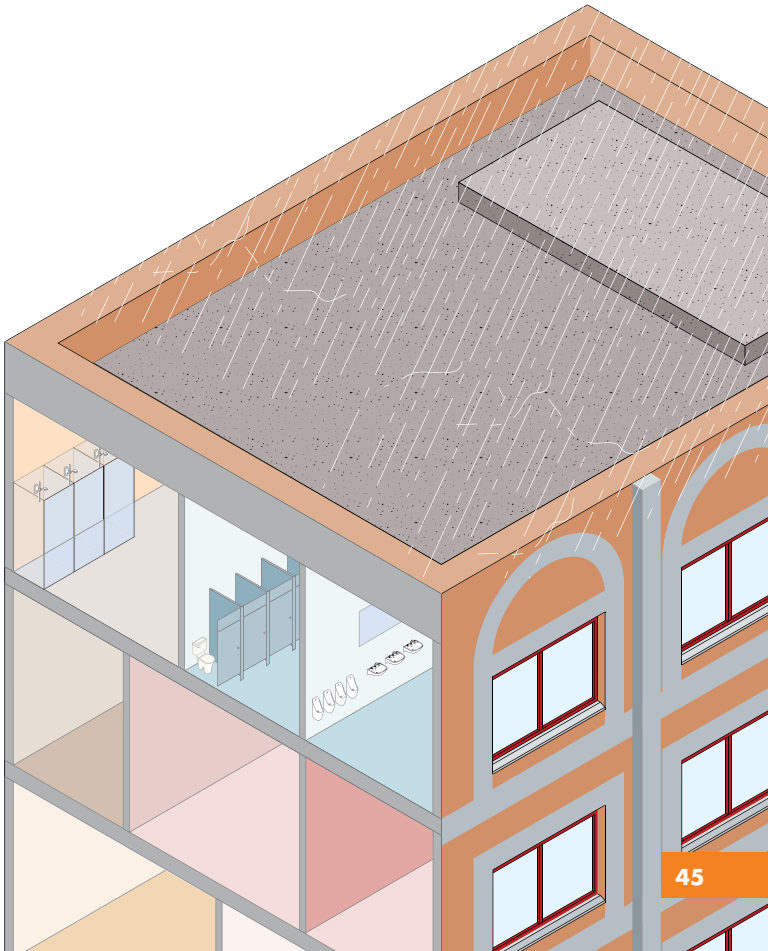
Moisture

The comfort that a building offers can be adversely affected by the presence of moisture on internal surfaces or within the construction elements. The fabric of a building can be a contributory factor in the accumulation or presence of moisture in two ways: either by not protecting from or contributing to the ingress of liquid water either from precipitation or the ground, or by allowing the formation of condensation.

The prevention of liquid water penetration from the outside through the building fabric is a critical task for both the design and construction team of any building. The designer must select appropriate materials and provide details that will enable their correct installation in line with the details provided and maintain a high standard of workmanship. The positioning of and integrity of membranes often next to insulation is critical as is the correct specification of materials next to layers which are intended as rainscreens rather than waterproofing layers.

Condensation

Condensation occurs most commonly where warm humid, moisture laden air meets a cold surface. Harmful condensation can occur both on inner surfaces and within construction elements. The former typically occurs where a specific area of the inner surface is significantly colder, either caused by poor detailing or workmanship that leads to the omission of insulation. Condensation occurs within the element of structure where water vapour is able to migrate through a structure by diffusion, or more seriously, transported by air movement through gaps, until it meets a barrier which prevents further diffusion/transport and causes the water vapour to condense. This can be overcome by installing effective vapour control layers on the warm side of the insulation. In all circumstances, air movement into the construction through gaps must be prevented.



The Law

Approved Document C (England and Wales) sets out requirements for resistance to moisture via floors and walls (from the ground and outside), and roofs (from the inside and outside).

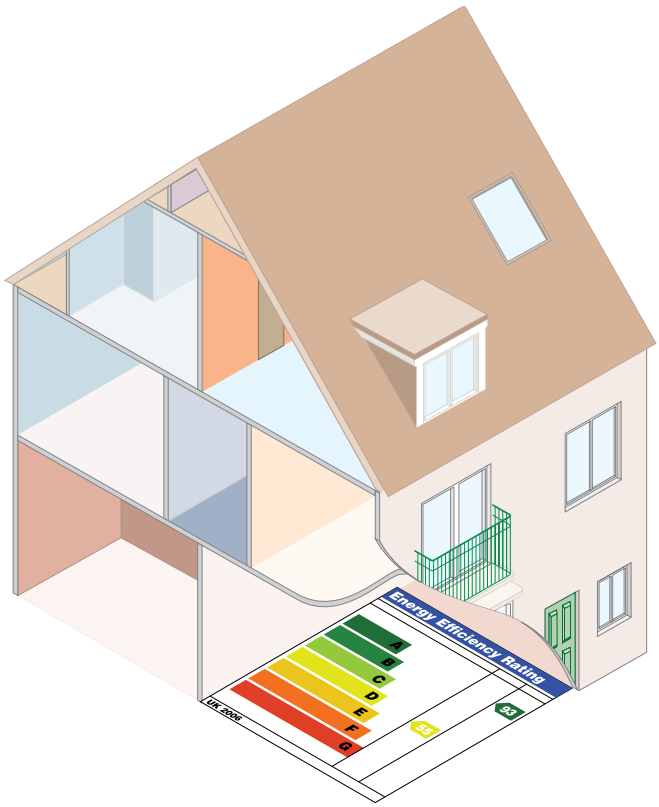
Approved Document F (England and Wales) sets out the natural and mechanical ventilation requirements of dwellings and non-dwellings.

In Scotland, **Technical Handbook, Section 3** and in Northern Ireland, **Technical Booklet C** covers site preparation and resistance to moisture.

Key guidance

BS 5250 : 2011 Code of practice for the control of condensation in buildings.

Key design considerations



Energy efficiency

Using energy more efficiently is the fastest and most cost effective way of cutting carbon dioxide emissions.

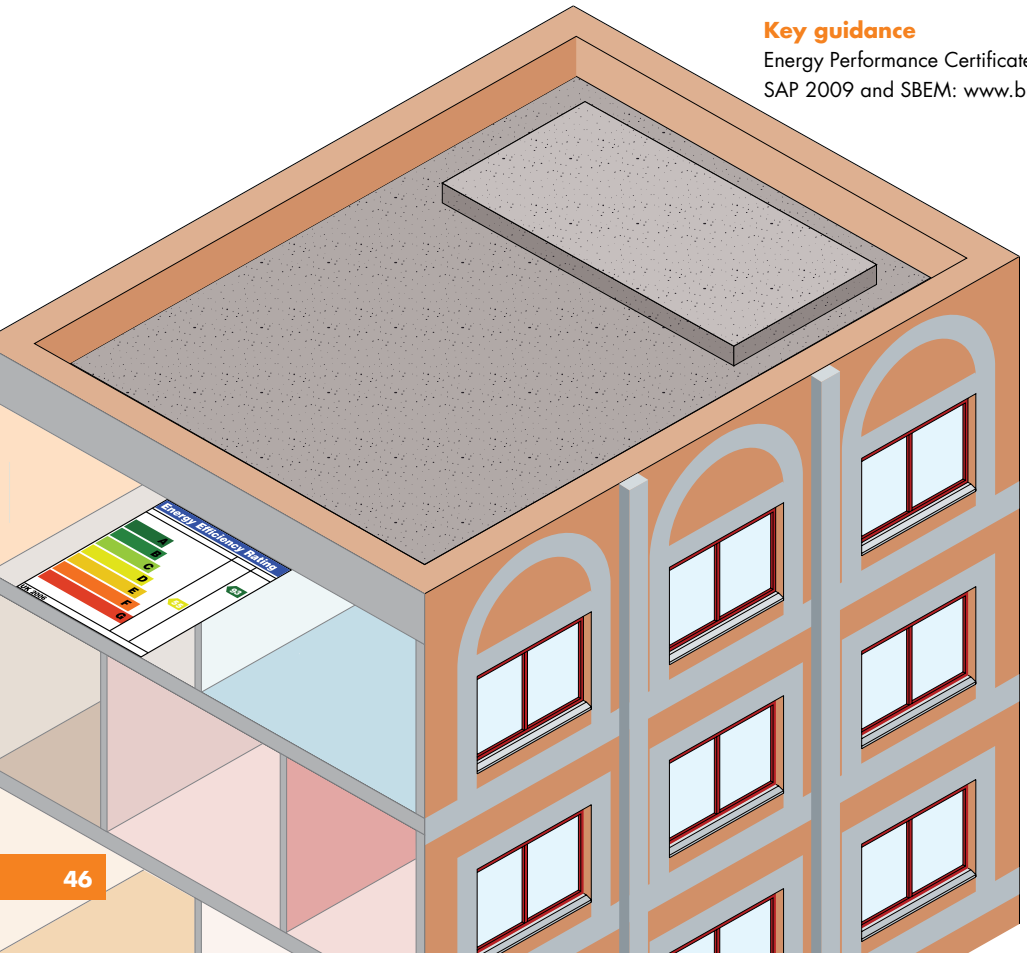
It can also improve productivity and contribute to the security of our energy supplies by reducing our reliance on imported energy and ensuring we make maximum use of our own and global energy resources. Improving the energy efficiency of homes can also reduce energy bills and help ensure that the most vulnerable members of society can afford to heat their homes.

The Law

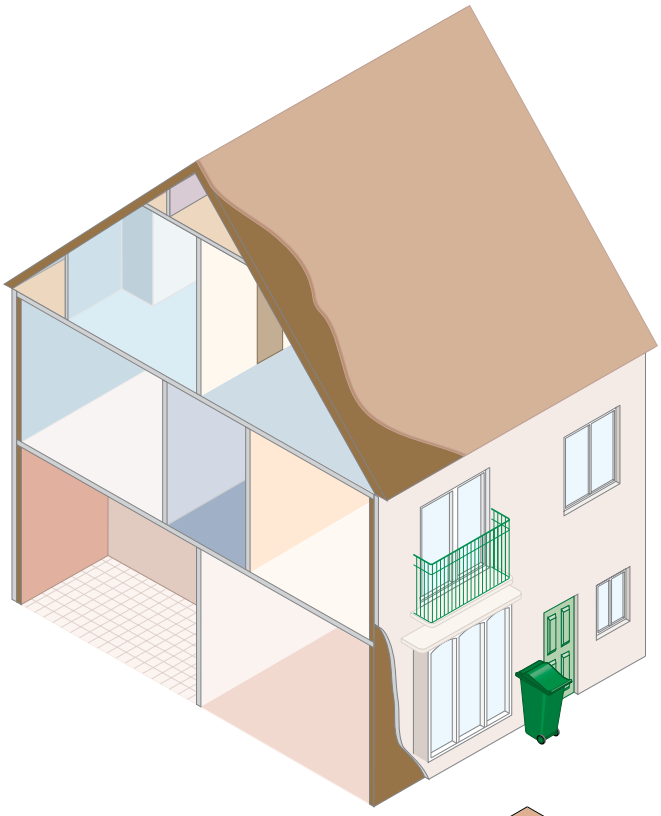
Anyone selling a property in Scotland, England and Wales must provide potential buyers with an Energy Performance Certificate (EPC). It is calculated using the UK Standard Assessment Procedure (SAP 2009) for dwellings which gives an energy efficiency rating based on fuel costs and an environmental impact rating based on carbon dioxide (CO_2) emissions. For non residential buildings the EPC is generated using the Simplified Building Energy Model (SBEM).

Key guidance

Energy Performance Certificates: www.communities.gov.uk
SAP 2009 and SBEM: www.bre.co.uk



Sustainability of materials

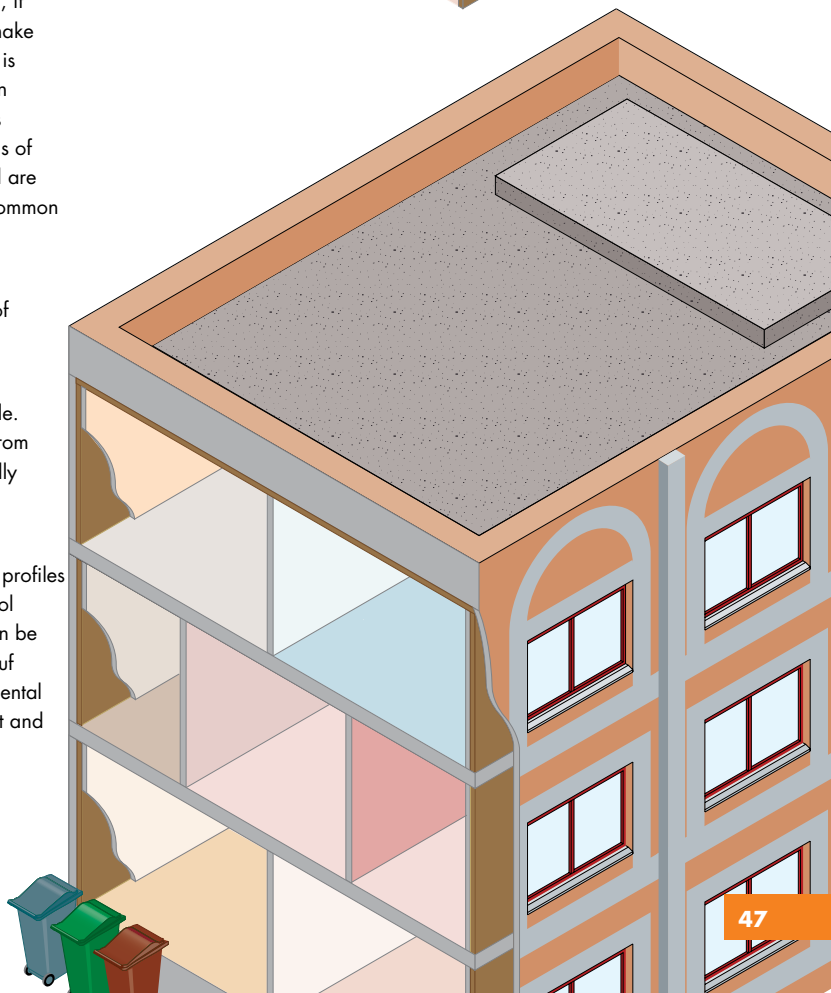


An increasingly important consideration (as new building techniques are developed to supply the buildings that meet the government requirements of low and zero carbon buildings) is the sustainability of building materials used in the construction from 'cradle to grave' or even cradle to cradle.

Designers should consider the total environmental impact of production and use, including the extraction and supply of all raw materials, the manufacturing process, delivery to site as well as the expected service life of the material.

The first step in evaluating these impacts is to carry out a Life Cycle Analysis. International Standards (ISO 14040 series) exist for the collection and analysis of life cycle data. These standards allow for differing approaches and interpretations, and whilst this may be completely justifiable and understood by life cycle analysis experts, it can cause confusion for building professionals who are trying to make judgments on the sustainability of the materials they specify. What is needed is a common approach to life cycle analysis of construction materials and this is provided by the **BRE Green Guide**. The ratings from the BRE Green Guide are used to inform the materials sections of the Code for Sustainable Homes and all BREEAM assessments and are generated from data collection certified by the BRE and a single common interpretation methodology.

The BRE Green Guide is available at www.thegreenguide.org.uk. This carries ratings that classify insulation materials and elements of construction in to six bands: A+ to E.

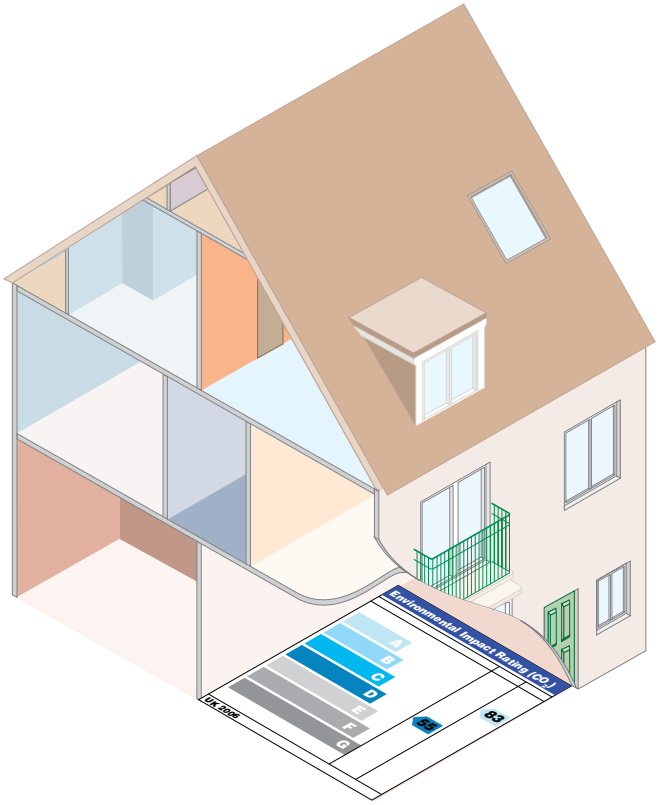


Mineral wool – complete sustainability

Mineral wool products achieve excellent ratings in the Green Guide. The raw materials used in the products' manufacture either come from recycled sources such as bottle glass, or are extracted from naturally abundant sources such as sand or dolomite stone.

Consumption of energy and other materials is minimised in the manufacturing process to allow the product to have environmental profiles similar to or better than many natural products such as sheep's wool and hemp. In fact, the energy and CO_2 saved by mineral wool can be hundreds of times that used in manufacture of the product. All Knauf Insulation's manufacturing plants operate under Certified Environmental Management Schemes which set out steps for continual assessment and improvement of environmental performance.

Key design considerations



The zero carbon principle

A 'zero carbon' building is a general term applied to a building with zero net energy consumption.

This can be measured in different ways (relating to energy, or carbon emissions) and different views are taken on the relative importance of energy generation and energy conservation to achieve energy balance. In general, the carbon emissions generated from on-site or off-site fossil fuel use are balanced by the amount of on-site renewable energy production.Designers should not only consider the carbon emissions generated by the building in use, but also those generated in the construction of the building and the embodied energy of the structure.

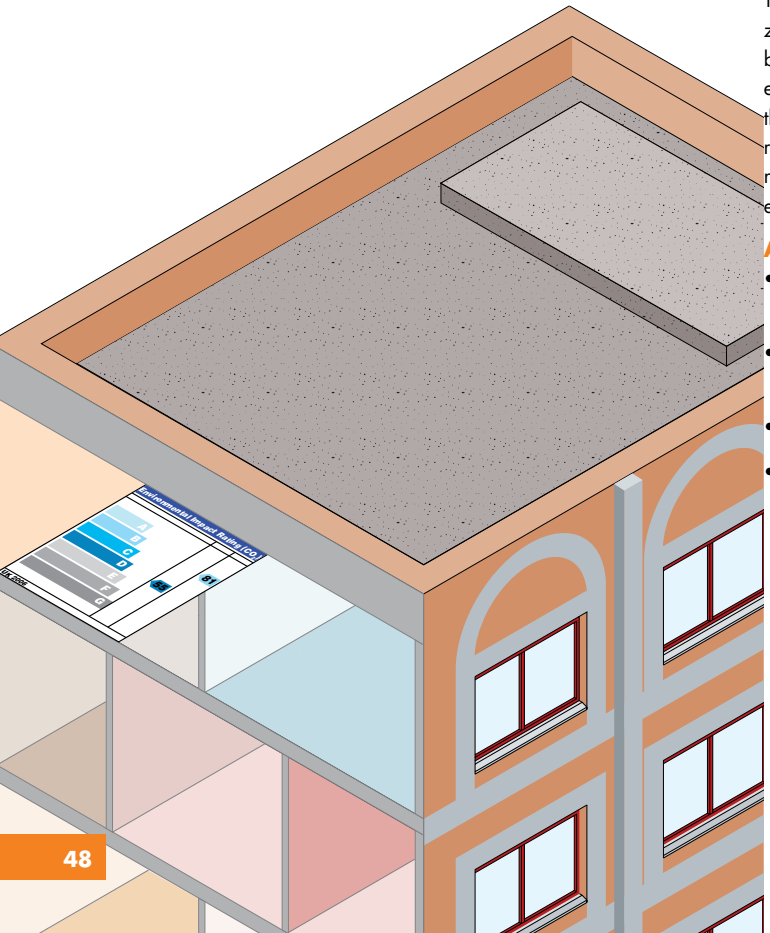
The 'zero carbon' or 'zero energy' approach is promoted as a potential solution to a range of social and environmental issues, including reducing carbon emissions, reducing dependence on energy imports and providing a measure of security against future energy crises.

Achieving minimal energy use

To achieve minimal energy use, the design and construction of zero energy buildings departs significantly from conventional building practice. In addition to using renewable sources, zero energy buildings are also designed to make use of heat energy that conventional buildings typically let go to waste by use of heat recovery ventilation and hot water heat recycling units. They are normally optimised to use passive solar heat gain and thermal mass to even out temperature variations throughout the day.

Advantages of zero carbon buildings

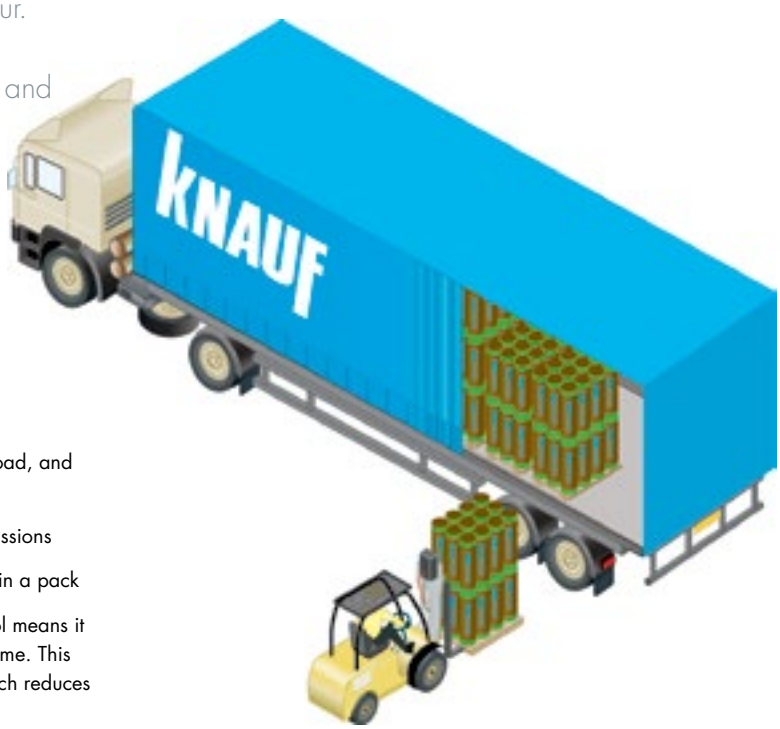
- potential isolation of buildings' occupants from energy price increases
- reduced cost to improve energy efficiency during initial design and construction rather than via a retrofit
- higher resale value
- the value of a zero carbon building relative to a similar conventional building increases as energy costs increase.



Key design considerations

Materials handling

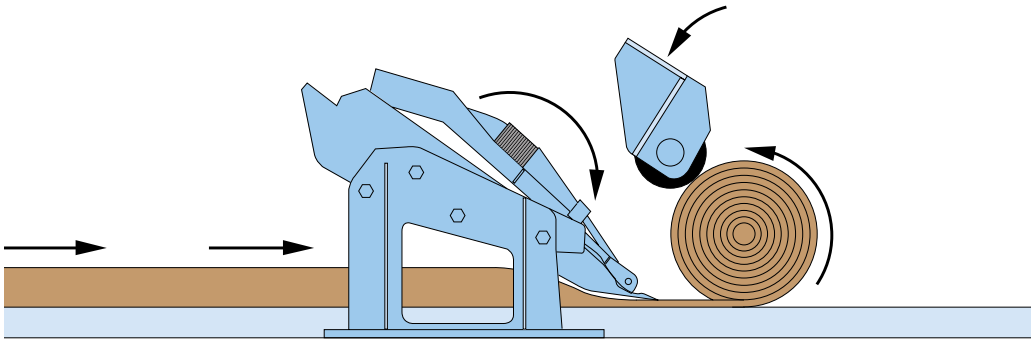
Consider products which reduce transport and material handling to save transport and labour. Earthwool® glass and rock mineral wool are compression packed to reduce site handling and have the
added benefit of reducing transport related CO_2 emissions.



The most technically advanced manufacturing and testing facilities in the world enable Knauf Insulation to supply superior quality glass and rock mineral wool products with a range of benefits:

- Weatherproof palletised packaging is easier to handle and store
- Compact, weatherproof packaging is easy to load and unload, and can be stored outside
- Compression packaging reduces transport related CO_2 emissions
- Compression packaging saves energy and gives you more in a pack

The high compression ratio and elasticity of glass mineral wool means it can be compressed down, to up to a nineth of its original volume. This means more glass mineral wool can be carried on a lorry which reduces the environmental impact of transportation.



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it's time to save energy