Architectural Technology

Architectural Technology represents a new and integrated approach to Construction Studies and will be extremely popular among students who opt to take this course for the Leaving Certificate.

This site contains five units related to 'Environmental Technologies and Services' taken from the syllabus. The units are ideally suited as an introduction to this aspect of Architectural Technology for Transition Year students.

Unit 1	**Unit 2**	**Unit 3**
Water supply, storage and distribution	Energy sources and environmental considerations	Principles of domestic heating and heat distribution
Unit 4	**Unit 5**	
Solar Energy	Gas Heating	

Glossary of terms

Each unit concludes with interactive crosswords and/or online multiple choice questions. All answers required for these activities are contained within the content of each unit.

Web links will lead you to related sites with additional information, and the glossary section will explain any words or terms that you do not understand.

For further information on SEAI Schools Programme contact:

Education Executive, Sustainable Energy Authority of Ireland, Wilton Park House, Wilton Place, Dublin 2

Phone: 01 808 2049, email: schools@seai.ie, web: www.seai.ie/schools

Water Supply, Storage and Distribution

Water supply

Precipitation
Precipitation is the main source of water for drinking purposes. A percentage of rainfall evaporates soon after it falls, a percentage runs off the ground to join streams and rivers and a percentage seeps through the ground to join underground supplies.

Sources of water supply consist of surface water and underground water.

Surface water
This includes water collected from roofs and paved areas as well as streams, rivers, lakes and reservoirs. This water is liable to contamination by vegetation and farm pollutants. Sewage and industrial waste are sometimes fed into rivers without any purification treatment. These same rivers are usually expected to supply fresh water for towns and villages. Rivers have the ability to purify themselves, especially if they are fast flowing and shallow. Despite this ability water taken from a river for public use should be treated before consumption.

Underground water
Rain that seeps through the ground may eventually reach an impervious layer, where it may be held as in a reservoir or it may flow like an underground stream on top of the impervious layer. Layers of 'water' are called aquifers.

Springs
There are two types of springs. A main spring which is usually deep and connects to the aquifer layer and a shallow or simple spring which connects to underground surface water. The latter is likely to be intermittent. Spring water is usually pure resulting from the natural purification that occurs as the water permeates through the ground.

Wells
Wells are different to springs as the ground has to be bored to reach the water. Springs occur naturally. The upper part of a well must be lined to exclude surface water entering it as it may be polluted.

Water treatment
Water to be used in a public water supply is required to be fit for drinking. This implies that it poses no danger to health, and it should be colourless, clear, odourless, sparkling and pleasant to taste. There are four main techniques used for the treatment of water. They are:

1. Storage
2. Filtration
3. Sterilisation
4. Softening

Storage
Water is stored in reservoirs where contaminants/impurities settle to the bottom (sedimentation). Pathogenic bacteria (disease producing) find it difficult to survive in storage due to the lack of food, low temperatures and the effect of sunlight. If water is stored for long periods, algae tend to grow. The growth of algae can be controlled using chemicals such as copper sulphate.

Filtration
Water is passed through sand or a fine wire mesh to remove particles. Rapid sand filters act as a physical filter, leaving the water in need of chemical treatment. Slow sand filters provide physical and chemical action. In a slow sand filter water slowly percolates down through the sand. Fine particles, micro-organisms, and microscopic plant life are retained in the sand bed. The bed must be emptied for cleaning after a number of weeks. The slow sand filter produces high quality water, which needs little further processing.

Sterilisation
Water must be sterilised before it can be consumed by humans. Chlorine is added to the water for public supply, but this isn't always feasible for small installations. Chlorine kills bacteria making the water safe to drink. After sterilisation ammonia is sometimes added to the water to reduce the offensive taste left by the chlorine. For smaller installations water is passed through a very fine filter capable of removing the bacteria.

Softening
Hard water is recommended for drinking but it has disadvantages. Scale may be deposited in hot water pipes and boilers, and soap does not make a lather.

There are a number of ways to soften water:

1. Base exchange methods change hardness compounds into compounds which do not cause hardness.
2. Demineralisation is a process to remove all chemicals dissolved in the water
3. .Lime-Soda treatment depends on chemical reactions to make the calcium and magnesium in the hard water insoluble and they are then removed.

Mains Water Supply
Most dwellings and buildings, including those in rural areas are supplied with water from a public water supply, otherwise known as the mains supply. The design of a mains water supply needs to consider present demand and anticipated future demand, the size of the water mains, and the pressure of water in the mains (this is known as the 'head', the height to which the water would rise in a vertical pipe.

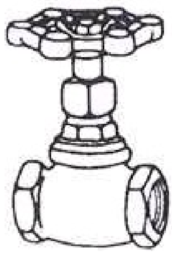
The standard size for a water main is 75 mm diameter if it is supplied from both ends and 100 mm if it is supplied from one end only. 30 m is the minimum head of water recommended for fire fighting purposes, while a head of 70 m is recommended to minimise waste and reduce noise in pipes. The head is achieved by locating reservoirs at appropriate heights above the buildings being served. Full pressure (head) from the reservoir is seldom available as flow in the mains will be taking place at most times. Pressure is further reduced by friction due to flow.

The water main is usually sited along the edge of a roadway. Permission must be obtained to connect to the mains and to cut the road if this is necessary. A domestic connection consists of a 12 mm diameter pipe with a minimum cover of 750 mm below ground as protection from frost.

Cold water storage and distribution

The connection to the mains water supply is usually taken to the boundary of the site and finished with a stop valve or stop cock, housed in a suitable box or purpose chamber. This chamber may be fitted with a hinged cast iron cover. The cold water supply for the dwelling is taken from the stop valve to the building, 750 mm below ground level. A second stop valve should be fitted on the service pipe where it enters the building. Where possible this should be at the kitchen sink, although the location is not critical. Inside the house a drain cock should be fitted above the stop valve to allow the cold water system to be drained down.

Drain cock



Stop valve

There are two main types of cold water supply systems within the house. These are known as 'direct' and 'indirect'.

Direct cold water supply system

In this system water from the cold water service pipe feeds all the cold water outlets including the sanitary appliances.

This system may be found in old houses, but otherwise it is not recommended for the following reasons:

1. In the event of mains failure there is no reserve
2. Mains supply exerts increased pressure on fittings
3. During peak demand the pressure may be reduced

Advantages of this system include:

1. Economical on pipework
2. Only a small cold water storage cistern is required to feed the hot water tank
3. Drinking water is available from all the cold water outlets

Indirect cold water supply system

Indirect cold water supply system In this system all cold water outlets with the exception of one drinking water outlet are supplied indirectly from a cold water storage cistern, usually located in the roof space. 'Indirect' means the water is not coming directly from the mains to the outlets, it is piped to and stored in the cistern in the attic.

Advantages of this system:

1. A reserve supply in case of mains failure
2. Less pressure on the taps and valves resulting in less wear

Disadvantages of this system:

1. More pipework required
2. Provision and installation of a storage cistern in the attic

This is the most common system used.

Energy Sources and Environmental Considerations

Energy sources

Energy for warmth and light is obtained from coal, oil, gas, wood, peat, wind, water, sun and nuclear power.

Many of these sources are used to produce electricity which in turn is used in the manufacture of all our physical needs, such as clothes, medicines, heat and light. Some fuel sources are used for transport. There are costs involved in producing energy sources, financial costs and also a cost to the environment. Environmental considerations should always be considered against the financial and comfort costs.

Coal, oil, natural gas and peat have taken many thousand of years to form in the earth. They are being used up very rapidly at present and cannot be replaced. They are non-renewable and are referred to as fossil fuels. Wood is renewable but takes many years to replace. Nuclear power can be used for many years using fissile plutonium but if nuclear fusion can be developed this source could be everlasting.

The sun, wind and water can also be used as sources of energy and these can be used indefinitely. They, along with nuclear fusion, are said to be renewable sources of energy. At the moment fossil fuels are the most used sources of energy and they are exploited mainly by the western world.

Environmental considerations:

Environmental damage is inevitable from all fuels and has to be accepted to some degree if we are to maintain energy use at present levels. The economic cost of having to meet environmental needs is being met by the introduction of techniques such as flue gas desulphurisation in the case of coal, in an attempt to reduce the amount of gases emitted to the air. Unleaded petrol is now widely used in cars. Ways of reducing carbon dioxide in the environment are being actively investigated.

There are two main forms of pollution from energy processes: the physical and the chemical

Physical pollution:

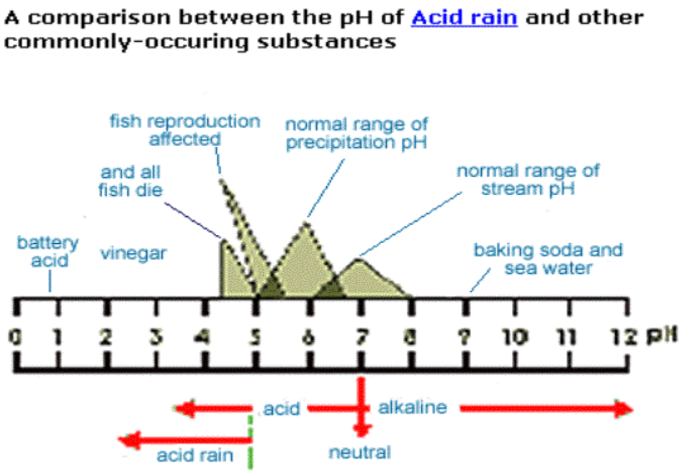
The physical sources of pollution impact on the natural landscape, e.g.:

- A windmill farm comprising many windmills rotating and producing noise and lack of visual appeal.
- The covering of mudflats causing changes in wildlife ecology.
- The damage to the landscape caused by open-cast mining, and electricity pylons blitzed across the countryside.

Electricity Pylon

Chemical pollution:
The chemical sources of pollution can be injurious to health either directly or indirectly through the food chain. The resulting damage may be physical in nature, for example, acid rain will cause serious damage to buildings over time, to forestry and also to fish in rivers.

Acid rain



Acid rain

Trees damaged by acid rain

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Environmental considerations

The effects of pollution on the environment include:

- Acid rain as mentioned above.
- Global warming which is as a result of the greenhouse effect, and is also due to fossil fuel use.
- Global warming is being blamed for many of the present climatic excesses, such as flooding, rising temperatures and droughts

Accidental or deliberate leakage of oil can cause serious environmental problems. The oil slick and the burning of oil wells in the Persian Gulf in 1991 are regarded as the worst environmental disaster in history.
Nuclear accidents can and do happen as was proved by Chernobyl.

Nuclear reactor

Fuels of all kinds carry with their use environmental consequences. The burning of fuels in buildings or for transport releases some quantity of toxic emissions in the form of smoke, hydrocarbons, sulphur dioxide, nitrogen oxides, lead, benzene and other compounds into the atmosphere.

Energy conservation and efficiency:

The finite nature of fossil fuels has led to campaigns to conserve energy but without loss of comfort. To achieve this, ways must be found of using our energy more efficiently.

Some examples include reducing wastage by improving the fabric of houses through insulation and other means. Insulating your home can reduce heating bills and increase comfort. Turning off appliances, heating and lights when not required are other means which are inexpensive and are worthwhile in economic terms.

To date alternative sources of energy have not been used to their full potential in Ireland. Hydro-electricity resources have been developed and what exists is relatively small but significant. Wind farms are becoming more prominent.

At a personal level energy can be conserved by wearing clothes which retain heat (insulation).

At the industrial and commercial level recovery of energy is becoming more common. Waste heat recovery is now widely used for example. The heat generated in one process is used for another.

Many homes and schools are poorly insulated and lose heat. This loss can be reduced by proper insulation and the inclusion of efficient control systems.

Transport systems can be improved either by sharing, using a better public transport system, or by people cycling and walking.

Energy conservation and efficiency

Energy conservation is not the same as energy efficiency.

Homes which have been made more energy efficient through improved insulation have not always led to energy conservation. It is important to determine how energy is used in the home in order to find ways of improving efficiency. 'Energy Audits' is one way of achieving this.

They are carried out in two stages:

1. Determine how much energy was used in the previous twelve months and how much it cost.
2. Set up a programme to show how energy can be conserved and to determine where, how and by how much energy savings can be made.

The efficient use of energy in one area when it is not overcompensated by waste in another will lead to conservation.

Activities:

- Complete the crossword on Energy Sources.
- Test your knowledge with the multiple choice quiz.

Principles of Domestic Heating and Heat Distribution

Hot water supply

Hot water for domestic purposes is usually taken from a hot water tank or cylinder. The heat source is usually in the form of a solid fuel, oil or gas boiler. Other water heating alternatives include a back boiler to an open fire or an electric immersion heater fitted to the hot water cylinder. A hot water supply system must be capable of producing sufficient hot water to meet all demands by the household, it should be economical to run and easy to install and maintain.

There are two main systems of hot water supply called the direct and the indirect systems.

Direct hot water system

In this system cold water is heated in the water jacket in the boiler. The heated water rises through convection currents and is replaced by cold water coming from the bottom of the hot water cylinder. A circulation is thereby set-up.

Hot water is drawn off as required for domestic use and is in turn replaced by cold water from the cold water storage tank in the attic. The hot water drawn-off is taken from the top of the hot water cylinder where the hottest water is stored. An expansion pipe connects to a horizontal pipe at the top of the hot water cylinder and runs vertically from the hot water distribution pipe to the cold water storage tank.

In the direct hot water system the water that is heated in the boiler and subsequently stored in the cylinder is the same water that is drawn-off for domestic use. This makes this system unsuitable for supplying a central heating circuit. The direct hot water system is also not suitable for hard water areas due to lime scale deposits which may eventually block the pipework. Lime scale deposits occur when water is heated to temperatures ranging from 50 to 70, and this is the typical temperature range for domestic hot water. This system is seldom used due to the disadvantages stated.

Indirect hot water system

In this system hot water circulates between the boiler and the hot water cylinder. However, the cylinder is an indirect cylinder, which contains a coil. This means that the water that is circulating between the boiler and the indirect cylinder is travelling in a closed circuit and it does not mix with the stored water in the cylinder. Its sole purpose of travelling through the cylinder, in the coil, is to raise the temperature of the stored water. The water that is heated in the boiler and which travels through the cylinder is referred to as the 'primary' circuit. The 'secondary' circuit refers to the stored water in the hot water indirect cylinder which is used for domestic draw-off and replaced with water from the cold water storage tank in the attic. The 'secondary' circuit refers to the stored water in the hot water indirect cylinder which is used for domestic draw-off and replaced with water from the cold water storage tank in the attic. In the primary circuit it is the same water that is circulating continuously, apart from any water that needs to be replaced due to expansion. The advantages of the primary circuit are:

1. No lime scale build-up (furring) as fresh cold water is not constantly being introduced.

2. A central heating loop can be connected to the primary circuit, which isn't possible for the direct hot water system.

A disadvantage of this system is that extra piping is required and a second (smaller) feed cistern is required for the primary circuit.

Cisterns

Cold water storage cisterns are usually made of plastic, although galvanised mild steel cisterns were common in the past. The standard size for cold water cisterns is 228 litres. This is deemed adequate to serve both the cold and hot water supplies and provide a reserve in the event of mains failure. The standard size for the hot water storage cylinder is 114 litres.

The standard size for the hot water storage cylinder is 114 litres. This is normally situated in the 'hot-press' (airing cupboard) and is made from copper. It should be lagged to conserve energy. Pipework is usually copper, although plastic pipes are gaining in popularity. The service pipe from the mains is usually polythene.

Ball valves are fitted on all cold water storage cisterns to prevent overflow. A ball valve floats in the cistern and automatically closes when the water reaches a certain level.

Heating Systems and Layout

The pipework supplying water to radiators may be small-bore (12, 15 or 22 mm diameter) or microbore (6, 8 or 10 mm diameter). It is important that the correct size of pipe is used to supply given sized radiators with the correct amount of heat. In determining the correct size of radiator to use consideration should be given to the amount of heat/energy required to combat heat losses in a specific room and the temperature at which the radiator will be required to operate at.
The two main methods of supplying hot water to radiators are:

1. The one-pipe or single-pipe system and
2. The two-pipe system.

The one-pipe system

Hot water from the boiler is fed to each radiator in turn with the cooler water from each radiator being fed back to the same pipe. As a result the temperature of the water is gradually getting lower as it enters each successive radiator. This makes the control of the distribution of heat difficult. The one pipe system is the easiest and cheapest to install, but control of individual radiators is virtually ineffective.

The two-pipe system

Hot water from the boiler is fed to each radiator by one pipe and the cooler water coming from each radiator is fed to a second pipe and returned to the boiler for re-heating. This is the more common heating system used. Depending on the length of the circuit, each radiator receives water at approximately the same temperature. This allows greater control of individual radiators, and also provides for a faster warm-up time.
The majority of small-bore heating systems used in dwellings are operated in association with an indirect hot water supply system. Connections can be made to the primary flow and return circuits or separate connections can be made to the boiler unit.

Controls
Controls are fitted to heating systems in buildings in order to:

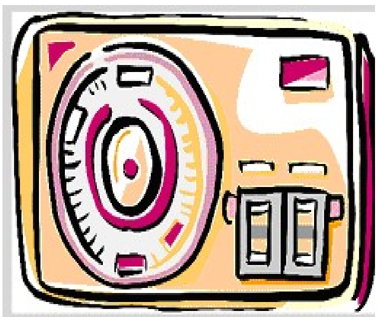
- provide a comfortable environment
- provide it at specified times and do both economically by avoiding unnecessary use of energy.

This is a matter of making sure that the building is never warmer than necessary, and that it is not kept warm when not required. The main types of control are concerned with adjusting the flow of water through the radiator as the temperature of the radiator is directly linked to the flow.

Typical controls in use are:

- **The circulating pump**. This is positioned on the return pipe beside the boiler. It pumps the hot water in the circuit to all radiators.
- **Radiator valves.** Each radiator has two valves: a wheel valve, which can be adjusted by hand to open or close the supply of hot water.
- Water to the radiator, and a **lock shield valve,** which is fitted on the return side of the radiator to balance the amount of heat in each radiator.
- **Thermostatic valves**. These allow control of individual room temperature
- **Air vent/cock**. This is located at the top of the radiator to allow trapped air to be vented.
- The trapped air prevents water from entering the radiator, meaning that it doesn't heat
- **Gate valves.** These allow a section of the system to be shut off, without the need to drain the complete system. For example, one should be placed at each side of the pump to allow the pump to be removed without draining the system.
- **Room thermostat.** This is set to the desired room temperature and it electrically controls the circulating pump
- **Boiler thermostat**. This controls the temperature of the water in the boiler.
- **Time switch**. Usually located near the boiler, it controls when the whole system comes on and for how long.

Thermostatic valves



Room thermostat.

Boiler thermostat.

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SEAI SUSTAINABLE ENERGY AUTHORITY OF IRELAND

Architectural Technology - Solar Energy

The sun is just one of billions of stars, yet it is the powerhouse of every living thing and of the earth itself. Fossil fuels are being used at such a rate that resources will be exhausted some time in the second half of this century. Nuclear power stations, once considered to be a good alternative, have proved hazardous. Of all the alternatives to fossil fuels, solar energy is one of the cleanest and safest.

About 30% of the solar radiation reaching the earth is reflected by the atmosphere, and another 20% is absorbed. This leaves 50% that passes through to the earth's surface. But this is still equivalent to the output of about 170 million of the world's largest power stations.

Solar energy is evident in heat and light from the sun. Even in Ireland solar energy has more potential than most people realise.

Harnessing Solar Energy

Three technologies have evolved to harness solar energy.

- Passive solar design
- Active solar heating
- Photovoltaics
-

Solar energy can be exploited directly in various ways. For heating, passive solar design and active solar systems are the main methods.

Passive Solar Design

Passive solar architecture is a design approach rather than the active use of a specific technology or device. The fabric, orientation and layout of the building are manipulated to achieve maximum solar gains and minimise the need for artificial lighting, heating and ventilation.

Passive solar design principles can be incorporated into new homes at no extra cost while bringing substantial benefits in energy savings and comfort. Passive solar design involves designing buildings so that they make the best use of the energy freely available from the sun in the form of heat, daylight or wind. By using simple passive solar design measures, the heating needs of an individual house can be reduced by up to 30 percent at no extra cost.

Heating

South-facing surfaces absorb more solar radiation in winter and less in summer when compared to surfaces with east or west orientations Throughout the year, solar gains through west and south-west glazing are very similar to those through glazing facing east and south-east. When solar radiation strikes any material part, it is absorbed, transformed into heat and stored in the mass of the material. The material heats up progressively by conduction as the heat diffuses through it.

Materials with high heat storage capacity such as concrete, brick and water heat up and cool down relatively slowly. Thermal insulating materials such as glass fibre and foam, usually because of their open or cellular structure, form poor heat stores and diffuse heat very badly.

Lighting

Daylighting design involves the provision of natural daylight in the interiors of buildings to reduce or eliminate daytime use of artificial lights, thereby offering substantial savings in energy use and reducing environmental damage. Various devices are now available to capture daylight and direct it deep into buildings and to reduce excessive light levels near glazing, providing a more uniform spread of natural light. Some of these such as prismatic glazing reflective blinds or shading systems can be more easily applied in the case of existing buildings. A wide range of specially treated glazing materials which can control the intensity and optical properties of natural light and heat flows through windows is now available.

Active Solar Energy

Solar panels

A second type of solar system, sometimes known as active solar technology, involves the installation of a solar collector device, which is typically a metal box structure containing an absorber.

The solar collector absorbs the sun's heat to provide space or, more commonly, water heating. A correctly sized unit can provide around half of a household's hot water needs over a year.

Around 2,500 square meters of solar thermal collectors have been installed in Ireland. This represents just 0.2% of the estimated practical solar heating resource available now (ESBI Report).

Active solar heating systems are perhaps the most familiar methods of harnessing solar energy. These use solar panels to collect heat from the sun. Sunshine heats water flowing through flat collecting panels, which work like radiators in reverse - they absorb radiation to heat water. Such a system can provide hot water directly or for use in a central heating system. Solar panels provide clean, CO_2 free heat, which, can be used to provide domestic hot water, to heat swimming pools and to provide service hot water for commercial buildings such as hotels and hospitals.

In Ireland, a correctly sized unit can provide 60 percent of a household's hot water needs over a year. The panels are usually placed on the roof of the house and angled to catch as much direct sunshine as possible. Ideally solar collectors should face south however, an orientation up to 45° east or west of due south will not significantly decrease performance. It is estimated that current solar collector installations represent just 0.2% of the estimated practical solar heating resource available.

Measuring the resources

A visual inspection of a site will be needed to assess the best location for a solar panel and whether there will be an impact from shading from other buildings. As most solar heating applications only require collectors to be faced anywhere from south-east to south-west, a large proportion of existing buildings will have roof orientations suitable for solar energy systems. In order to collect as much solar radiation as possible, a surface must be tilted towards the sun. How much it should be tilted is dependent upon the latitude and at what time of year most solar collection is required.

Solar water systems

There are several types of solar collector used for water heating, the most popular of which is the flat plate water collector. This consists of a layer of glazing over a black absorber plate through which water is passed to be heated by the sun. A solar water heating system for an individual household will have an area of about 3-4m^2. Another device is the evacuated tube, able to heat water to much higher temperatures. These are tubes, similar in appearance to long fluorescent lamps, consisting of an evacuated glass tube with a heat absorbing plate and a heat pipe running up the centre. An array of 20 to 30 tubes is normally used for an individual house.

System installation

These types of system can be supplied and installed on a building relatively easily, either by professional contractors or indeed anyone with good plumbing skills. They are usually mounted on the roof of a building and need to be firmly secured in a leak-proof manner. Solar heating systems need to be able to withstand the impact of the elements. Water can cause corrosion to metal parts, and high winds can damage the structures and crack the modules. It is the expansion and contraction which may cause cracking. Most of these risks can be overcome with a well designed system. Because the panels are exposed to the elements an anti-freeze solution must be added to the water in the primary circuit.

Photovoltaics

A third way in which solar energy can be harnessed in buildings is through the use of photovoltaic technology. Photovoltaic systems use semiconductor materials to convert sunlight to electricity. They are used in consumer goods such as solar watches and calculators. In Dublin, parking metres are powered by PV panels. They can also be integrated in building structures or used in larger scale electricity generation.

Close up of solar panel

Solar power and the environment

Passive and active solar heating techniques have few environmental impacts other than from a visual perspective. The environmental impact is similar to those for any new building or alteration of an existing building.

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Architectural Technology - Gas heating

No heating system is 100% efficient. Levels of efficiency vary widely. A badly maintained oil burner, for example, may be only 50-60% efficient while gas heating efficiency can be as high as 80-95%. The difference in efficiency levels results from the amount of heat being exhausted into the atmosphere through the flue rather than being recycled through the system.

History of gas production

The ancient Chinese were the first to use gas for lighting. They piped natural gas from the ground through bamboo tubes. But it was many centuries before the use of gas became widespread. Modern gas production began in the late 1700s. The first successful coal-gas project was a system installed in 1765 in Britain, to light the offices of a coal mine. Once a gas supply was available for lighting, it was not long before it was put to other uses. The first gas cookers were introduced in 1840, and gas fires appeared in 1855. At present, most consumers are supplied with natural gas, but coal gas is used in some regions and gas is also obtained from oil.

Natural gas

Many countries have valuable deposits of natural gas. Gas from beneath the North Sea is now the main source of gas for Britain and other countries in northern Europe.
Natural gas consists mainly of methane, together with ethane and small amounts of propane, butane and nitrogen. It has a much higher calorific value than coal gas. This means that, when burnt, a given amount of it produces much more heat than the same amount of coal gas.

The demand for natural gas in Ireland is growing at an unprecedented rate. A survey conducted by Bord Gáis in 1999 highlighted that indigenous supplies are no longer adequate to supply the Irish market. It states that supplies from Kinsale Head are depleting and while the Corrib field is commercially viable it will not be available in time to avert a shortfall. The Irish market relies heavily on imported gas supplies and this is expected to continue until 2025.

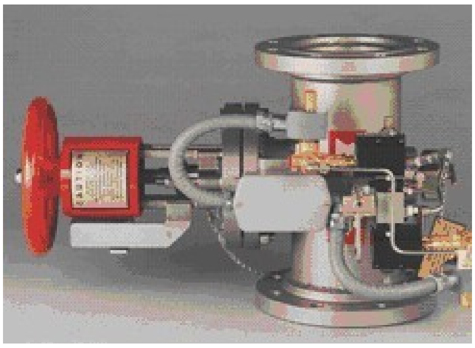
Installation guidelines

General

Gas pipework is installed in a dwelling in order to convey gas in a safe manner from the meter to the various appliances, which may be installed both inside and outside the dwelling. When installing gas pipework the following guidelines should be adhered to.

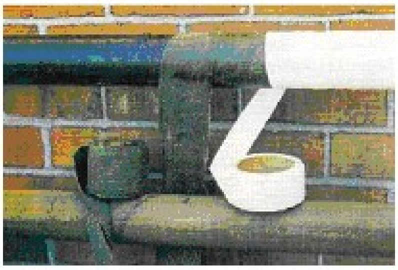
- All gas mains are to be installed by the gas company or their appointed contractor.
- All gas main trenches shall be excavated to a depth to allow a minimum cover for the gas main of at least 750 mm.
- All gas main trenches shall be excavated to the width of the outside diameter of the gas pipe plus 300 mm.
- Where it is necessary to cross or run close to any other service, a minimum clearance of 250 mm is recommended.
- Marker tape should be placed over all gas mains and services.

Meters
Meters are normally fitted in purpose designed cabinets external to the building. An isolation valve should be fitted to each meter. Where more than one meter is fitted in a cabinet each meter must be labelled clearly showing which dwelling is supplied by it.



Piping materials
Piping materials should be selected by considering mechanical strength, appearance, corrosion potential and cost. Copper tubing is normally used for residential gas service piping.

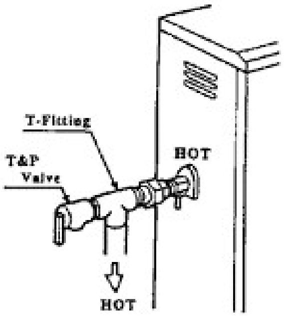
External pipe runs in vulnerable positions should be of corrosion protected steel to provide against physical damage.



Where the piping is to be laid on a solid floor slab, the finished floor screed level must allow 25mm (minimum) cover over the installed pipe.

Pipes may be chased into a wall surface and covered with a plaster screed, or surface mounted and concealed in a purpose made duct.
Pipes passing across cavities, including cavity walls, should take the shortest route and be sleeved through the cavity.
In timber framed construction and dry lined walls, purpose designed protective metal channels must be provided.

Safety Considerations
Any person installing natural gas must be competent to do so in accordance with I.S. 813 Domestic Gas Installations. It is necessary to provide an appliance valve as close as possible to each appliance supplied with gas.



Purging natural gas installations

Every installation must be purged of air or air/gas mixture whenever a gas supply is made available for the first time or when an existing system has been shutdown and is being re-commissioned.

This is necessary because a gas/air mixture in the meter or pipework is potentially explosive. The installation and appliances must only contain a 100% gas concentration. While an appliance may initially light and burn correctly, if there is a pocket of air in the internal installation, the appliance flame will extinguish as the air reaches the appliance burner

Electrical cross bonding

Electrical cross bonding is required to create a zone in which voltage differences and therefore hazards from electrical shocks or sparks are minimised. This is achieved by connecting separate conductive components together with earthing cable.

This is necessary in case an electrical problem occurs on wiring or an appliance. It is possible for stray electrical currents to be transmitted to and through the gas pipework.

Emergency procedures

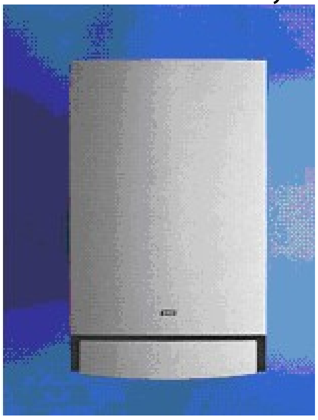
In the event of damage to a gas main stop work immediately and take the following precautionary measures:

- Report all damage even if there is no smell of gas.
- Shut down all working plant in the area of damage.
- Keep people away from the affected area.
- Prevent all sources of ignition (e.g. smoking, naked flames etc.).
- Do not use mobile phones near the gas leak.
- Do not try to repair the damage.
  Contact the gas company. Bord Gáis emergency service number is 1850 205050
- Provide assistance to the gas emergency crew as necessary.

Natural gas is a highly flammable gas, which is transported through a network of polythene and steel pipes at pressures ranging from 70 Bar to 20 mBar. Damage to a gas main can result in the escape of large volumes of gas into the atmosphere in an uncontrolled manner. Even if there is no smell of gas the damage should be reported regardless of how minor the damage may appear to the naked eye.

Gas heating systems

Gas-fired heating systems generate heat in either a furnace or a boiler. A furnace heats air that is blown through air ducts and delivered to rooms through grills. A boiler heats water or steam that circulates through pipes to radiators. Hot-water heating systems are more common than steam systems.



Inside the furnace or boiler, gas is released into a combustion chamber where it is mixed with air and burned. The combustion products are vented out of the home through a flue pipe. The flames heat a metal box called a heat exchanger. In a furnace, air is heated in the heat exchanger, while in a boiler, water is heated in the heat exchanger.

For hot- water systems, the water is heated to between 180 and 200 F; in steam systems, the water is boiled, creating steam. A commonly used method for improving the efficiency of conventional gas systems is adding heat exchangers to extract more heat from the exhaust before it leaves the home.

These combustion by-products must be fairly hot so they will rise out of the system, but the hotter they are, the more heat they waste to the environment that could have been used in the home. Stack temperatures as high as 400°F are not uncommon, which means there is a great opportunity to save energy and money.

Heating system controls regulate when the various components of the heating system turn on and off. The most familiar control is the room thermostat, which activates the system to keep you comfortable. But there are other controls in a heating system, including aquastats, valves, vents, fan thermostats, and dampers.

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