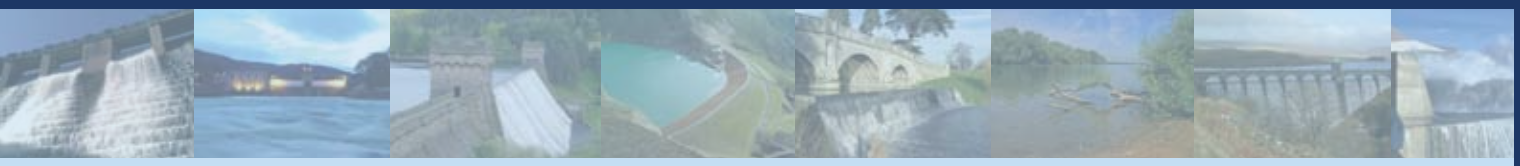


Fact Sheet 1

The British Dam Society
caring for dams, people and the environment

Dams and Reservoirs

Dams and reservoirs are essential structures that are critical for providing us with some of our basic needs. Dams are structures built to retain water by forming a reservoir behind the structure. These are usually built across, or near, naturally flowing water to manage the water for human use.

There are five main uses of dams:

- Hydro electric power
- Irrigation
- Water supply
- Flood protection
- Navigation.

There are four main types of dams:

- Embankment dams
- Arch dams
- Gravity dams
- Buttress dams

Katse Dam in Lesotho

Some facts about dams:

- Dams that store more than 3,000,000 m^3 of water are typically referred to as **large dams**. There are more than 50,000 large dams worldwide.
- There are more than 100,000 dams worldwide that hold over 100,000 m^3 of water.
- There are millions of dams that can hold less than 100,000 m^3 of water.
- All the dams in the world together hold nearly 7,000 km^3 of water which covers an area of 500,000 km^2 - which is equivalent to 1/3 of the area of the world's natural lakes.
- The 100 largest reservoirs of the world together hold half of all the water held by dams.
- The cost of all dams built since 1950 is estimated around one trillion pounds.

Hydro Electric Power (HEP)

Electricity generated in hydro electric power plants is one of the most useful opportunities offered by dams, especially in steep valleys and across continuously flowing rivers. Hydropower is a cheap and clean source of renewable energy. Twenty per cent of the world's electricity is created from hydropower and the majority of this (80%) comes from 2,000 large schemes. More than 80% of the world's reservoir storage is used for hydropower.

There are more than 50,000 small hydroelectricity plants in the world so dams are assured of a future, providing locally generated energy and helping reduce poverty.

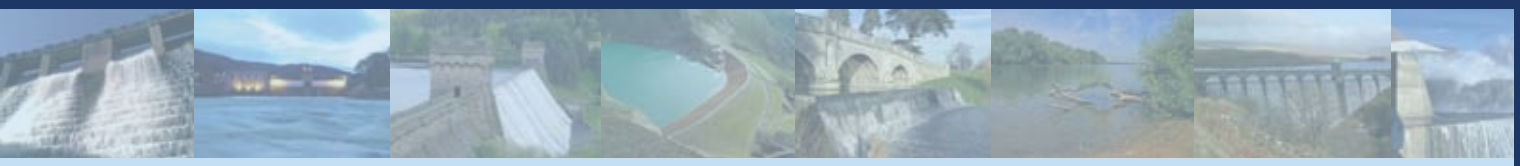
Irrigation

Dams and reservoirs provide water to irrigate land for around 15% of the world's population, supplying them with food that would otherwise be sparse and, in some situations, nearly impossible to grow. Small reservoirs will irrigate around 1 km^2 of farmland while large reservoirs can irrigate as much as 1,000 km^2.

With the demand for food set to double in the next 50 years making land available to grow crops will become increasingly important and irrigation reservoirs will be one of the most effective means of providing water for this purpose.

Hoover Dam, Colorado River, USA

If you would like more information on Dams please visit The British Dams Society Website at: **http://www.britishdams.org/student_zone**



Fact Sheet 2

The British Dam Society

caring for dams, people and the environment

Dams and Reservoirs

Flood Protection

Flood mitigation is another important role dams play in our world; they protect people and places from floods and allow the flood water they store to be put to good use. Flood protection dams are typically designed to reduce flood peaks by 30% to 50% and allow time for downstream areas to be evacuated.

Lake Clementine Dam, Northern California

There are 2,500 dams dedicated to flood storage in the world, half of which are in the U.S.A.

Navigation/Recreation

Dams can also be used for navigation; more than 1,000 large dams worldwide are dedicated to navigation. Water used for navigation can be managed to keep canals filled during dry seasons and lowered during wet seasons.

The water stored behind dams is also commonly used for recreational purposes such as fishing and boating. There are many examples of this in the United Kingdom.

Multipurpose

Dams built these days usually have more than one use and are referred to as multipurpose dams. For example a water supply dam can be used for irrigation and HEP purposes. The storage capacity of multipurpose dams worldwide is five times greater than those devoted to just flood storage.

Challenges

There are environmental and social challenges associated with building a dam such as the unavoidable flooding of lands which can require relocation of people and can displace habitats. The impacts of a dam project have to be understood by carrying out an Environmental and Social Impact Assessment. These studies take into account the environmental, social, and economic implications of building the dam. Despite its many advantages, building a dam and the creation of a reservoir sometimes requires the relocation of people. About 25 million people have had to be relocated in the past 50 years to make way for new dams.

Design of Dams

Dams are designed to strict standards by experienced engineers to ensure that failure and a collapse of the dam does not occur.

The main cause of dam failure is from overtopping – where the structure fills and overflows causing erosion of the dam. To protect against overtopping dams should have structures such as spillways which are capable of safely passing floods and reduce the risk of overtopping failure.

Another cause of damage to dams is internal erosion – where weak material in the dam core or in its foundation allows water to seep through the dam.

Dams can also deteriorate due to age and/or lack of adequate maintenance. There are hundreds of Victorian dams in the UK that require periodic monitoring, and in the region of 5,000 dams worldwide that were constructed before 1950.

HEP reservoir at Zarnowiec in Poland

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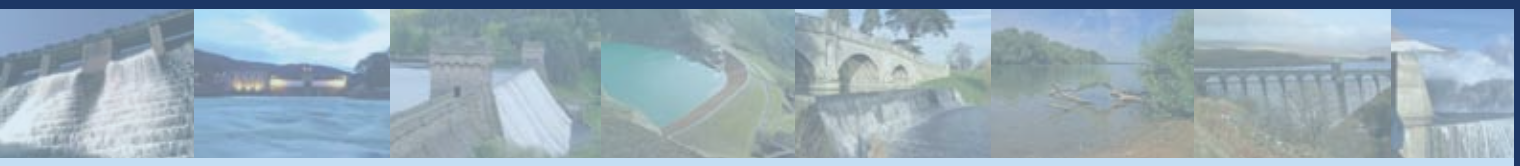

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Dams and Reservoirs

Reservoirs in the United Kingdom

There are 168 **large dams** (greater than 15 m high and holding more than 3,000,000 m^3 or more) in the United Kingdom and the three largest reservoirs in England are

- Kielder Reservoir
- Rutland Water
- Haweswater

Reservoirs which can hold 25,000 m^3 or more of water above surrounding ground level, known as **large raised reservoirs**, are subject to the Reservoirs Act, 1975.

In England and Wales, the Environment Agency (EA) is responsible for enforcing the Reservoirs Act, 1975, and there are currently 2,120 dams under the Act. The EA ensures that each site is monitored and inspected by a **Panel Engineer** who is a qualified engineer, appointed by the Secretary of State to carry out technical functions under the Reservoir Act 1975 and, where necessary, that safety works are undertaken within stipulated timescales.

The Reservoirs Act 1975 also applies to reservoirs in Scotland but it is enforced by Local Authorities. A new Act called The Reservoirs (Scotland) Act 2011 is being introduced which will replace the current capacity-based regime to one which is based on a reservoirs' risk of failure. The Act will also be changed in England and Wales in the foreseeable future.

KIELDER

RUTLAND

HAWESWATER

If you would like more information on Dams please visit The British Dams Society Website at: **http://www.britishdams.org/student_zone**

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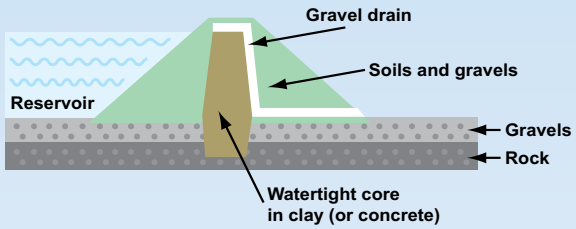
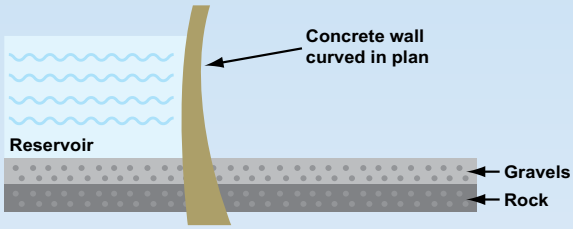
Types of Dams





Embankment Dam

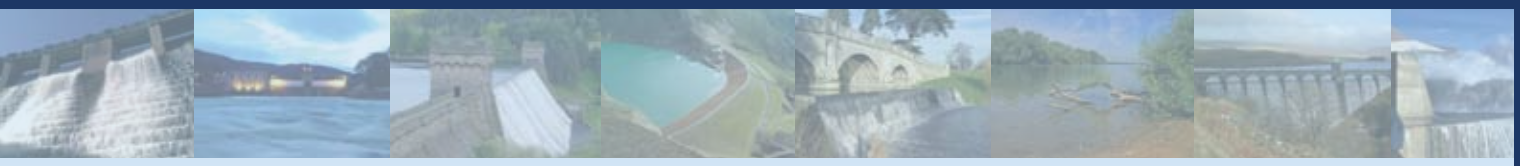
Embankment dams are mainly made from natural materials. The two main types are earthfill dams and rockfill dams. Earthfill dams are made up mostly from compacted earth, while rockfill dams are made up mainly from dumped and compacted rockfill. The materials are usually excavated or quarried from nearby sites, preferably within the reservoir basin.

A cross-section (or slice) through an embankment dam shows that it is shaped like a bank, or hill. Most embankment dams have a central section, called the core, made from impermeable material to stop water passing through the dam. Clayey soils, concrete or asphaltic concrete can be used for the core.

Arch Dam

Arch dams are made from concrete. They are curved in the shape of an arch, with the top of the arch pointing back into the water. An arch is a strong shape for resisting the force of the water behind the dam. Arch dams are usually constructed in narrow, steep sided valleys. They need good rock for their foundations, and for the sides of the valleys, to resist the forces on the dam.

There are only a few arch dams in the UK, including Monar Dam in Scotland.



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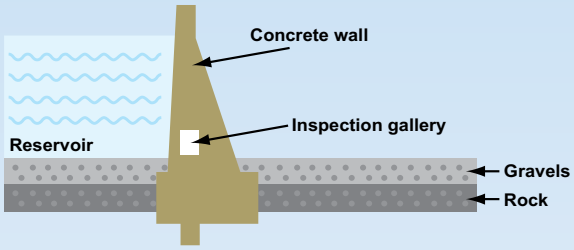
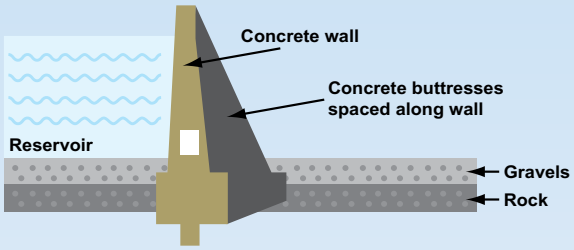
Types of Dams





Gravity Dam

A gravity dam is made from concrete or masonry, or sometimes both. It is called a gravity dam because gravity holds it down to the ground stopping the water reservoir pushing it over.

A cross-section (or slice) through a gravity dam will usually look roughly triangular.

Gravity dams are suited to sites with either wide or narrow valleys, but they do need to be built on sound rock.

There are more than 250 gravity dams in Britain. Masonry was used in many early dams, as far back as the 17th century. However, concrete became more common from about 1900.

Buttress Dam

Buttress Dams are made from concrete or masonry. They have a watertight upstream side supported by triangular shaped walls, called buttresses. The buttresses are spaced at intervals on the downstream side. They resist the force of the reservoir water trying to push the dam over.

The buttress dam was developed from the idea of the gravity dam, except that it uses a lot less material due to clear spaces between the buttresses. Like gravity dams, they are suited to both narrow and wide valleys, and they must be constructed on sound rock.

Since 1945, 14 buttress dams have been constructed in the UK, mainly for hydroelectric schemes in Scotland.