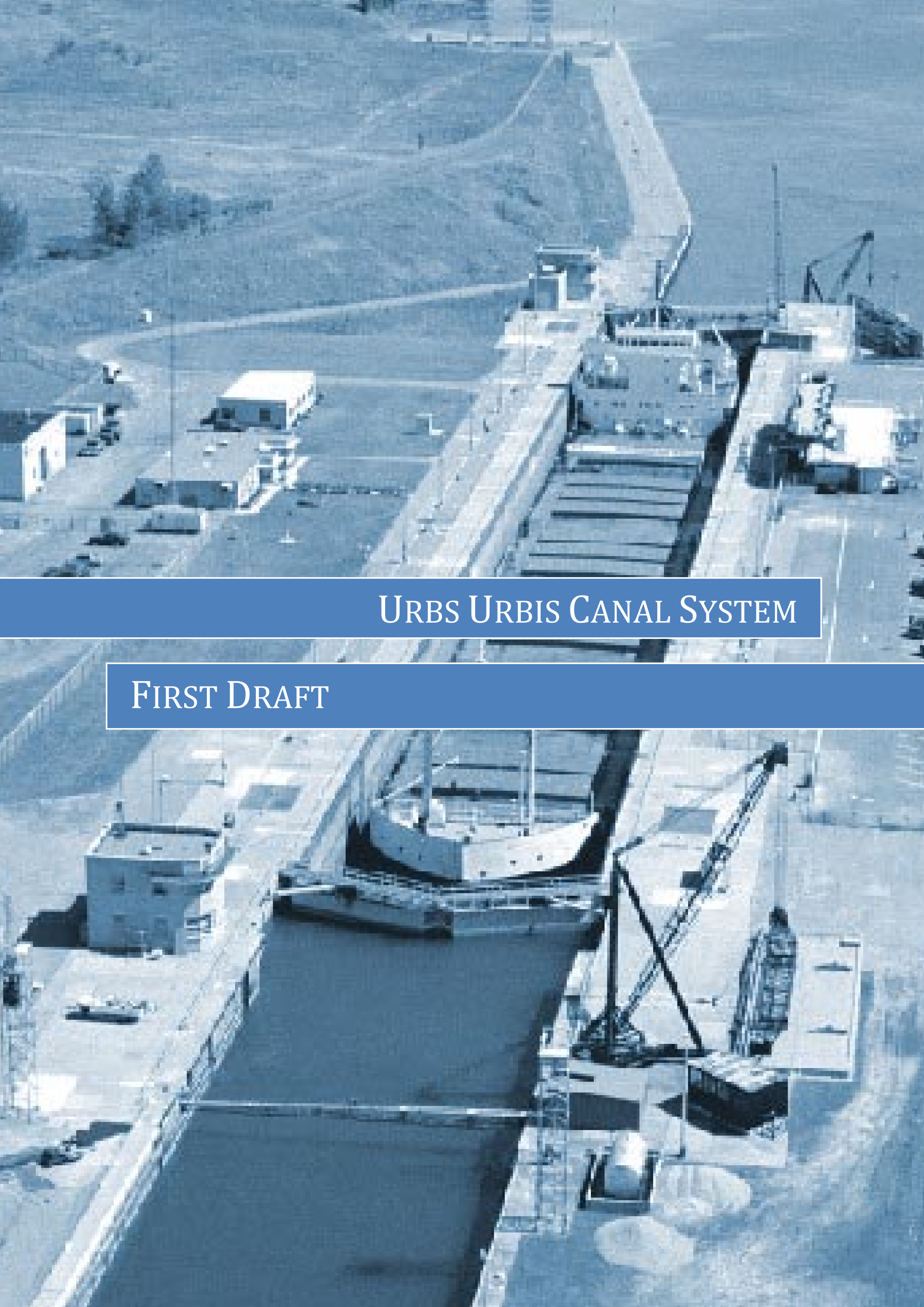


Urbs Urbis Canal System

First Draft

Index

PRESENTATION

This is the first draft of the document about canals. Here are describe all the ideas about this water transit network.

My intentions

1) Describe the features of real life canals. With few historical information and illustration.
2) Sketching some of the parameters that in game canals.
4) Integrate canals with the overall proposal of Hjanfield.

Thanks

Real Life Canals

Some canals are part of an existing waterway. This is usually where a river has been canalized : making it navigable by widening and deepening some parts (by dredging and/or weirs), and providing locks with "cuts" around the weirs or other difficult sections. In France, these are called lateral canals and in the UK they are generally called navigations and the length of the artificial waterway often exceeds the natural. Smaller transportation canals can carry barges or narrow boats, while ship canals allow sea-going ships to travel from one sea or ocean to another, or to an inland port (eg Manchester Ship Canal, Caledonian Canal, Kiel Canal).

The oldest-known canals were built in Mesopotamia circa 4000 BC, in what is now modern-day Iraq and Syria. The Indus Valley Civilization in Pakistan and North India (from circa 2600 BC) had a sophisticated canal irrigation system. Agriculture was practiced on a large scale and an extensive network of canals was used for the purpose of irrigation. Sophisticated irrigation and storage systems were developed, including the reservoirs built at Girnar in 3000 BC. In Egypt, canals date back at least to the time of Pepi I Meryre (reigned 2332 – 2283 BC), who ordered a canal built to bypass the cataract on the Nile near Aswan. In ancient China, large canals for river transport were established as far back as the Warring States (481-221 BC), the longest one of that period being the Hong Gou (Canal of the Wild Geese), which according to the ancient historian Sima Qian connected the old states of Song, Zhang, Chen, Cai, Cao, and Wei. By far the longest canal of early medieval times was the Grand Canal of China, still the longest canal in the world today. It is 1794 kilometers (1115 miles) long and was built to carry the Emperor Yang Guang between Beijing and Hangzhou. The project began in 605, although the oldest sections of the canal may have existed since circa 486 BC. Even in its narrowest urban sections it is rarely less than 30 m (100 ft) wide.

In Europe, particularly Britain, and then in the young United States and the Canadian colonies, inland canals preceded the development of railroads during the earliest phase of the Industrial Revolution. The opening of the Bridgewater Canal in 1761 which halved the price of coal in Manchester triggered a period of "canal mania" in Britain so that between 1760 and 1820 over one hundred canals were built across the country.

Competition from the railway network from the 1830s and later the roads made the smaller canals obsolete for commercial transportation, and most of the British canals fell into decay.

At their simplest canals consists of a trench filled with water. Depending on the stratum the canal passes through it may be necessary to line the cut with some form of watertight material such as clay or concrete. When this is done with clay this is known as puddling.

Canals **need to be flat** and while small irregularities in the lie of the land can be dealt with through cuttings and embankments for larger deviations other approaches have been adopted.

Currently the most common is the **pound lock** which consists of a chamber within which the water level can be raised or lowered connecting either two bits of canal at a different level or the canal with a river or the sea. When there is a hill to be climbed flights of many locks in short succession may be used.

For smaller drops in the land where an embankment would be impractical (such as when passing over a river) **aqueducts** are sometimes used.

Another option when dealing with hills was to tunnel through them. An example of this approach is the Harecastle Tunnels on the Trent and Mersey Canal. Tunnels are only really practical for smaller canals.

Canals are so deeply identified with Venice that many canal cities have been nicknamed "the Venice of..." The city is built on marshy islands, with wooden piles supporting the buildings, so that there is not so much the waterways which are man-made, as the land.

Locks

On waterways (navigable rivers and canals) a lock is a particular type of device for raising or lowering boats between stretches of water at different levels. The distinguishing feature of a lock is a fixed chamber whose water level can be varied; whereas in a boat lift or canal inclined plane, it is the chamber itself which moves.

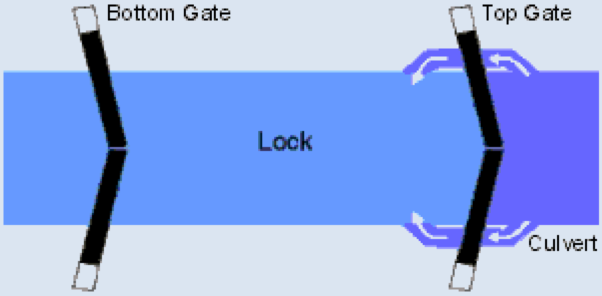
All locks have three elements:

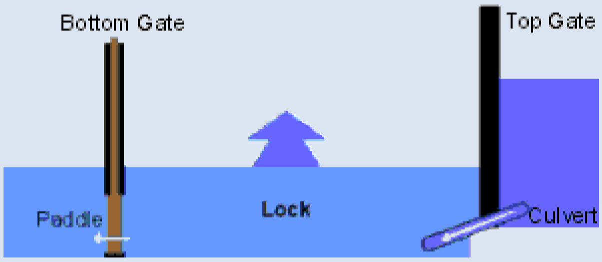
1. A watertight **chamber** connecting the upper and lower canals, and large enough to enclose one or more boats. The position of the chamber is fixed, but its water level can vary.
2. A **gate** (often a pair of "pointing" half-gates) at either end of the chamber. A gate is opened to allow a boat to enter or leave the chamber; when closed, the gate is watertight.

3. A set of **lock gear** to empty or fill the chamber as required. This is usually a simple valve (traditionally, a flat panel (paddle) lifted by manually winding a rack and pinion mechanism) which allows water to drain into or out of the chamber; larger locks may use pumps.

The principle of operating a lock is simple. For instance, if a boat travelling downstream finds the lock already full of water:

- The entrance gates are opened and the boat sails in.
- The entrance gates are closed.
- A valve is opened, this lowers the boat by draining water from the chamber.
- The exit gates are opened and the boat sails out.





If the lock was empty, the boat would have had to wait 5-10 minutes while the lock was filled.
For a boat travelling upstream, the process is reversed: for instance, the chamber is filled by opening a different valve which allows water to enter the chamber from the upper level.
The whole operation will usually take between 10 and 20 minutes, depending on the size of the lock, and whether it was originally set "for" the boat.
Boaters approaching a lock are usually pleased to meet another boat coming towards them, because this boat will have just exited the lock on their level and therefore set the lock in their favour — saving some work and some 5-10 minutes. (This is not true for staircase locks, where it is quicker for boats to go through in convoy.)
Locks can be built in parallel (ie side by side). This can be called *Doubling, Pairing, or Twinning*. There are several examples (in this case called "double locks") on one stretch of the Trent and Mersey Canal). Doubling gives advantages in speed: avoiding hold-ups at busy times; or increasing the chance of a boat finding a lock set in its favour. Also, there can be water savings: the locks may be of different sizes, so that a small boat does not need to empty a large lock; or each lock may be able to act as a side pond (water-saving basin) for the other. In this latter case, the word used is usually "twinned": here indicating the possibility of saving water by synchronising the operation of the chambers so that some water from the emptying chamber helps to fill the other.

Staircase Locks

When a very steep gradient has to be climbed, a lock staircase is used. A staircase can be thought of as a "compressed" flight, where the intermediate pounds have disappeared, and the upper gate of one lock is also the lower gate of the one above it. However, it is incorrect to use the terms *staircase* and *flight* interchangeably: because of the "loss" of the intermediate pounds, operating a staircase is very different from operating a flight. It can be more useful to think of a staircase as a single lock with intermediate levels (the top gate is a normal top gate, and the intermediate gates are all as tall as the bottom gate). Because there is no intermediate pound, a chamber can only be filled by emptying the one above, or emptied by filling the one below : thus the whole staircase has to be full of water before a boat starts to ascend, or empty before a boat starts to descend.

Flood Locks

A flood lock is to prevent a river from flooding a connected waterway. It is typically installed where a canal leaves a river. At normal river levels, the lock gates are left open, and the height of the canal is allowed to rise and fall with the height of the river.

Tidal Locks

Loosely, any lock connecting tidal with non-tidal water. This includes a lock between a tidal river and the non-tidal reaches; or between a tidal river and a canal; or a sea lock. However, the term usually refers specifically to a lock whose method of operation is affected by the *state* of the tide. Examples:

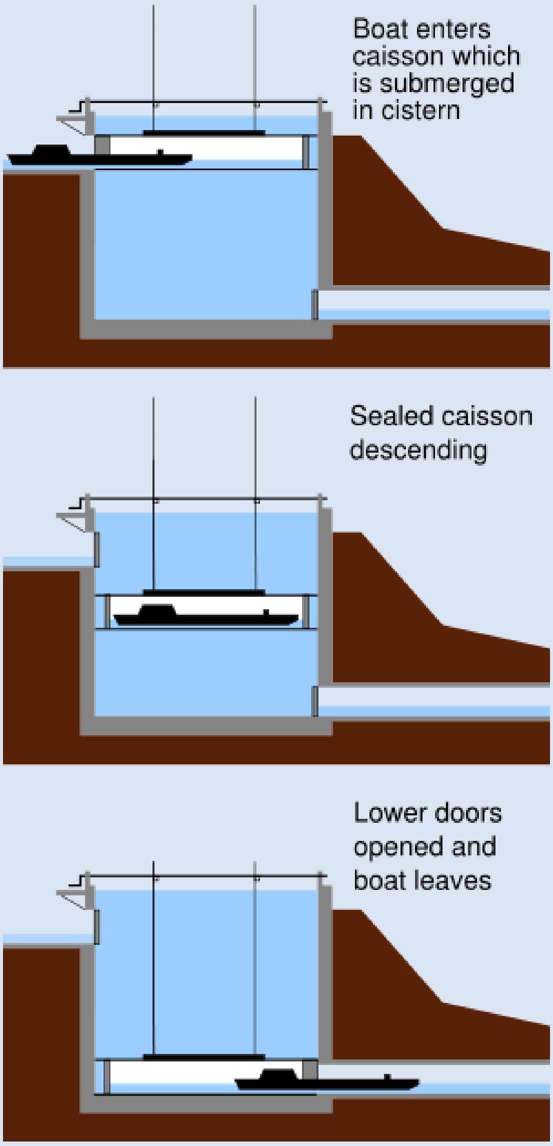
- *A canal joining a river whose levels are always lower than the canal.* All that is needed is an ordinary lock, with the gates pointing up the canal. The lock is used normally so long as the tide is high enough to float boats through the lower gates. If near low tide the lock becomes unusable, then the gates can be barred (and simply become a "reverse flood gate", holding water in the canal). This arrangement also applies to some sea locks (e.g. Bude Canal).
- *A canal joining a river which is normally below it, but which can rise above it (at very high tides, or after heavy rain).* One pair of gates can be made bidirectional, ie the inward-pointing gates would be supplemented by a pair pointing out to the river. When the river is higher than the canal, the normal gates would just drift open, but the additional pair of gates can be closed to protect the canal, and prevent navigation to the river. In effect, we have simply added a flood gate.
- *As above, but where it is safe to navigate even when the river is higher than the canal*. The lock will be fully bidirectional (two pairs of oppositely pointing gates at each end) to allow boats to pass at any normal river levels. At extreme low or high tides unsuitable for navigation, the appropriate sets of gates are barred to prevent passage.

SPECIAL FEATURES OF CANALS

Here we can see some very strange things about canals. One of the was only a prototype that never saw success, others are quite strange but successful and in use in today canals.

Caisson Locks

A caisson lock is a type of canal lock in which a narrow boat is enclosed in a sealed box and raised or lowered between two water levels.



It was first demonstrated at Oakengates on the now lost Shropshire Canal in 1792. In about 1817 the Regents Canal Company built one of these locks at the site of the present-day Camden Lock, north London. Here the motivation was, again, water supply problems, although the change in level is much lower than that at Combe Hay. They too soon substituted conventional locks. No commercially successful example has ever been built.

Ship Lift

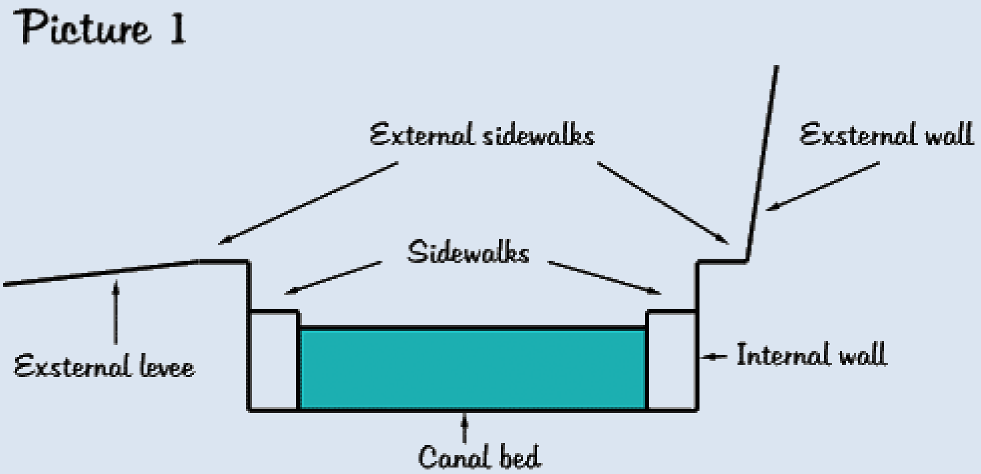
A boat lift, ship lift, or lift lock is a machine for transporting boats between water at two different elevations, and is an alternative to the canal lock and the canal inclined plane.

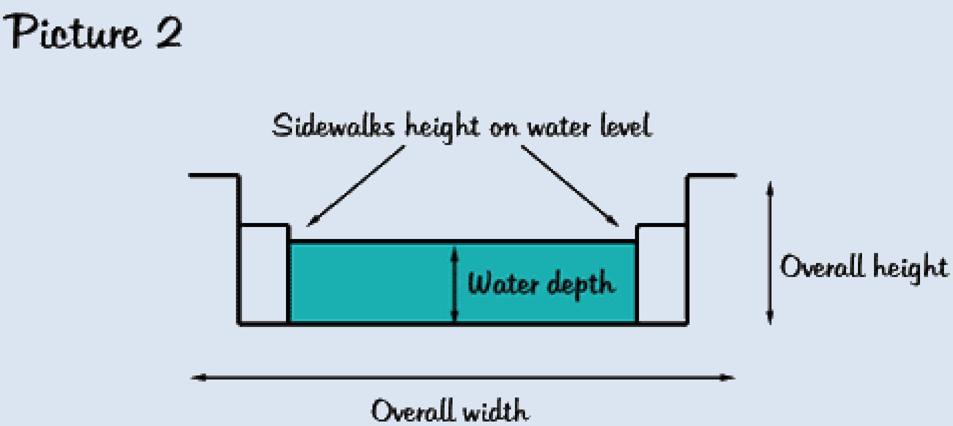
The first known boat lift was a 2.5 ton lift on the Churprinz canal near Dresden. It lifted boats 7 meters without the use of caissons. The lift operated between 1789 and 1868. For a period of time after the opening of the Churprinz lift boat lifts were of an experimental nature with the engineer James Green reporting that 5 had been built between 1796 and 1830. He credited the invention to Dr James Anderson of Edinburgh.

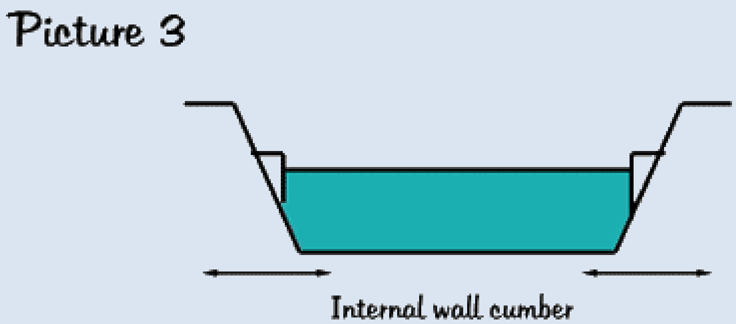
Water Bridges

PARAMETERS FOR THE SIMULATION

In order to build canals in our game we need to know few basic terms.







Overall Width

Overall Height

Water Depth

Internal Sidewalks

Internal Wall

External sidewalks

External Levee

External Wall

Canal Bed