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## Roman Aqueduct Manual

By Dennis Gaffney

Aqueducts are one of the wonders of the Roman Empire. These graceful structures are not only majestic, but are engineering marvels that survive to this day. In “Construct an Aqueduct,” you are hired as Chief Water Engineer by the Roman Emperor.

**Your job:** to build an aqueduct that will supply the Roman city of Aqueductis with clean water to private homes, public baths and glorious fountains. Succeed, and citizens of Aqueductis will drink clean water and bathe happily. Fail, and there’s no telling what your countrymen will do.

### **Mapping the Flow**

A water engineer should use a surveying instrument called a chorobates to project a gently sloping line that connects the water source to the city. This way, engineers can figure out where the water needs to flow below ground in tunnels, on the surface in covered trenches or in pressurized pipes, or above ground on walls or arcades.

Every stage of the aqueduct has to be carefully planned to ensure that the water, pulled by gravity, makes its way gradually downhill to the city.

### **Parts of an Aqueduct**

Here are the different elements a Chief Water Engineer can choose to build at any point along an aqueduct:

- [Covered Trench](#)
- [Tunnel](#)
- [Pressurized Pipe](#)
- [Wall](#)
- [Arcade](#)

### **Covered Trench**

Roughly four of every five miles of Rome's aqueducts run underground, many in covered trenches. Trenches are used when the aqueduct follows the contours of the land. They are quick and easy to build for they require neither the construction of arches nor the burrowing of tunnels.

Romans built underground to hide and protect water from enemies. Even after the Empire expanded, they created a safe buffer around aqueducts, and built underground trenches and tunnels because they protected from the stresses of wind and erosion while underground. Covered trenches and tunnels are also less disruptive to life on the surface than are walls and arcades, which divide neighborhoods and farmers' fields.

## **Tunnel**

Sometimes, aqueduct engineers should carve a tunnel through a mountain rather than build a trench around one. When not too deep, shafts are dug down vertically from above to intersect with the proposed path of the tunnel.

By using shafts, more than one crew can work on a tunnel at a time. The shaft also serves another purpose: Once the tunnel is finished, slaves can crawl down stone steps to clean the tunnel. They can fill buckets with silt or chipped-out calcium deposits left behind from hard water and then haul the buckets out.

## **Pressurized pipe** (inverted siphon)

When faced with a deep valley, Roman engineers should use pressurized pipes that are inverted siphons. Roman water engineers build these rather than arcades because tall arcades are too unstable when built too tall.

With siphons, water travels down one side of the valley in watertight pipes. Water pressure forces water up the other side. Water exits the pipes at nearly the same height as it entered. The pipes are usually built of lead, which is costly, but the material can handle strong water pressure.

## **Wall**

When aqueduct engineers have to cross shallow depressions in the landscape, they should build the aqueduct on a wall. Simple to construct, walls are easier to build than arcades, although walls can impede the natural flow of water and people.

When engineers need to raise the aqueduct's channel more than approximately five feet above the ground, they should resort to arcades, which allow people and water to move freely beneath them.

## **Arcade**

In a valley, water engineers should use arcades rather than aqueduct trenches. Arcades, of course, are the bridges built with a series of arches, and one of the grandest monuments of the Empire.

When the aqueduct must flow higher than about five feet, Roman engineers should use an arcade rather than a wall. The arched arcades require less material than walls and don't interfere with the passage of water or people through the environment.