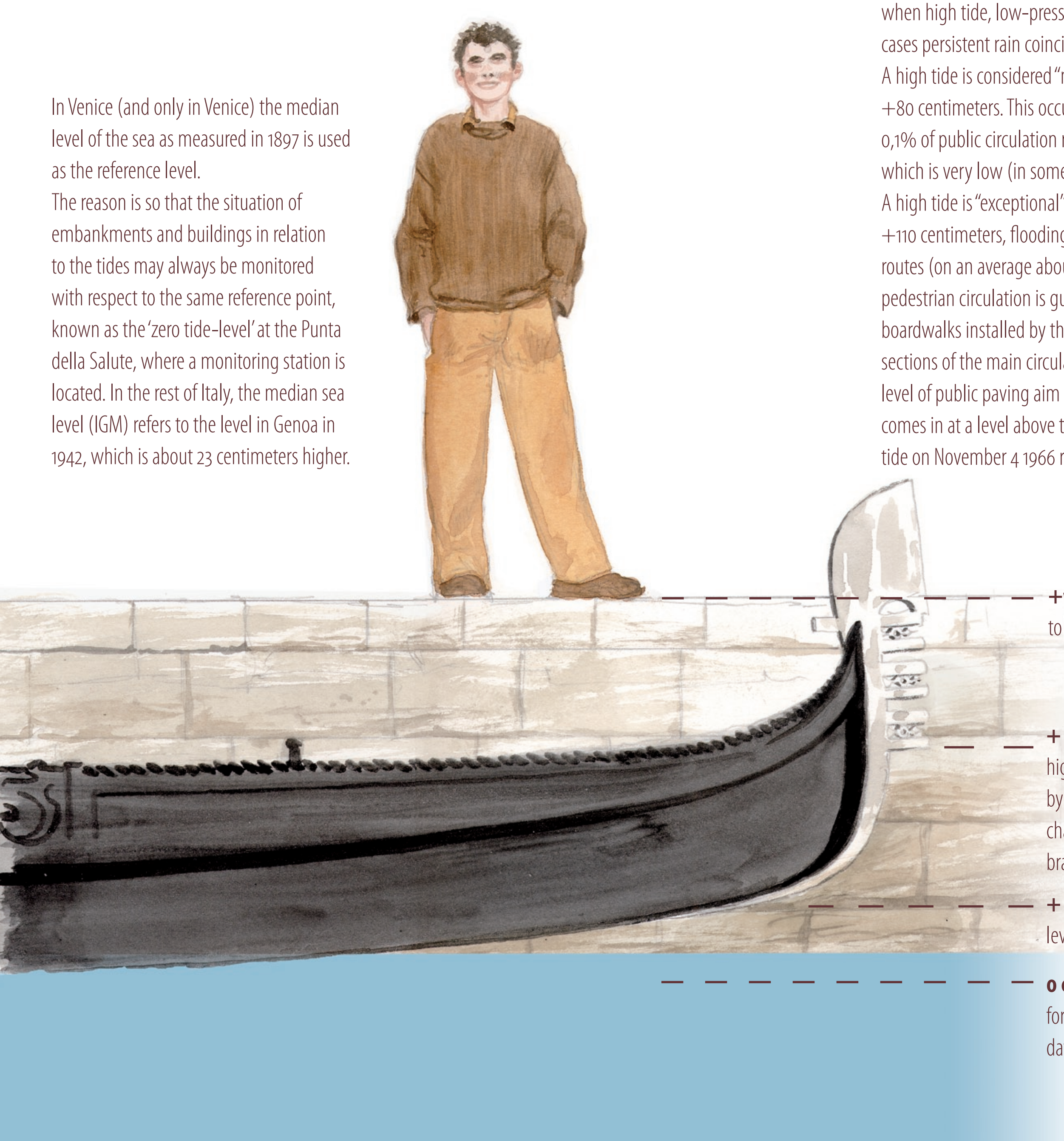
The Venetians built their city in a very special environment, a lagoon with land emerging from the shallow waters. Since its very origins, they made every effort to make this difficult terrain inhabitable: they "built" the ground itself on which their palaces were erected, consolidating the soft earth and defending it from the tides; since they did not have groundwater, they designed an efficient system to collect fresh water; they created a functional sewer system.

A symbiotic relationship with water is, today, an essential element of the personality and beauty of Venice. But at the same time, the water that perpetually immerses the city puts its future at risk. That is why it is vital to ensure its constant and thorough maintenance: to periodically dredge the sludge that accumulates in the canals, restore the banks damaged by the water, keep deterioration under control as much as possible. Knowing full well that the existence of the city itself depends on this maintenance.

The phenomenon of *acqua alta* is determined by exceptional conditions when high tide, low-pressure atmospheric systems, wind and in some cases persistent rain coincide.
A high tide is considered "normal" when it reaches a level of +80 centimeters. This occurs around 50 times a year and floods only 0,1% of public circulation routes. The flooding includes Piazza San Marco which is very low (in some points it barely reaches +70 cm).
A high tide is "exceptional" when it reaches or exceeds the level of +110 centimeters, flooding approximately 12% of public circulation routes (on an average about 3-4 times a year). In this case pedestrian circulation is guaranteed by 4 kilometers of raised boardwalks installed by the city administration in the lowest sections of the main circulation routes. The projects to raise the level of public paving aim for a level of +120 centimeters; the tide comes in at a level above this marker 1-2 times a year. The dramatic tide on November 4 1966 reached a level of +194 centimeters.

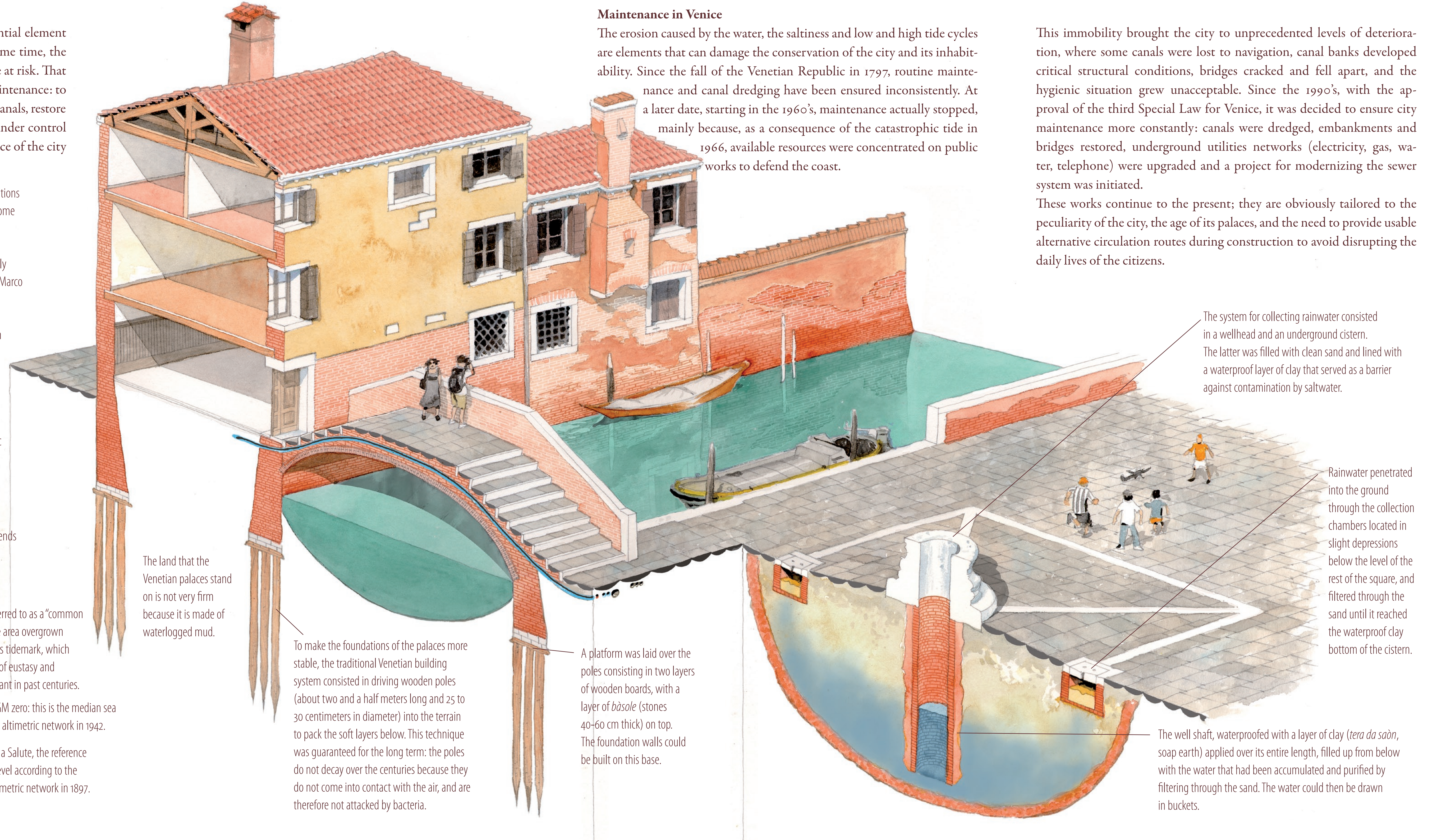
In Venice (and only in Venice) the median level of the sea as measured in 1897 is used as the reference level.
The reason is so that the situation of embankments and buildings in relation to the tides may always be monitored with respect to the same reference point, known as the 'zero tide-level' at the Punta della Salute, where a monitoring station is located. In the rest of Italy, the median sea level (IGM) refers to the level in Genoa in 1942, which is about 23 centimeters higher.



Maintenance in Venice

The erosion caused by the water, the saltiness and low and high tide cycles are elements that can damage the conservation of the city and its inhabitability. Since the fall of the Venetian Republic in 1797, routine maintenance and canal dredging have been ensured inconsistently. At a later date, starting in the 1960's, maintenance actually stopped, mainly because, as a consequence of the catastrophic tide in 1966, available resources were concentrated on public works to defend the coast.

This immobility brought the city to unprecedented levels of deterioration, where some canals were lost to navigation, canal banks developed critical structural conditions, bridges cracked and fell apart, and the hygienic situation grew unacceptable. Since the 1990's, with the approval of the third Special Law for Venice, it was decided to ensure city maintenance more constantly: canals were dredged, embankments and bridges restored, underground utilities networks (electricity, gas, water, telephone) were upgraded and a project for modernizing the sewer system was initiated.
These works continue to the present; they are obviously tailored to the peculiarity of the city, the age of its palaces, and the need to provide usable alternative circulation routes during construction to avoid disrupting the daily lives of the citizens.

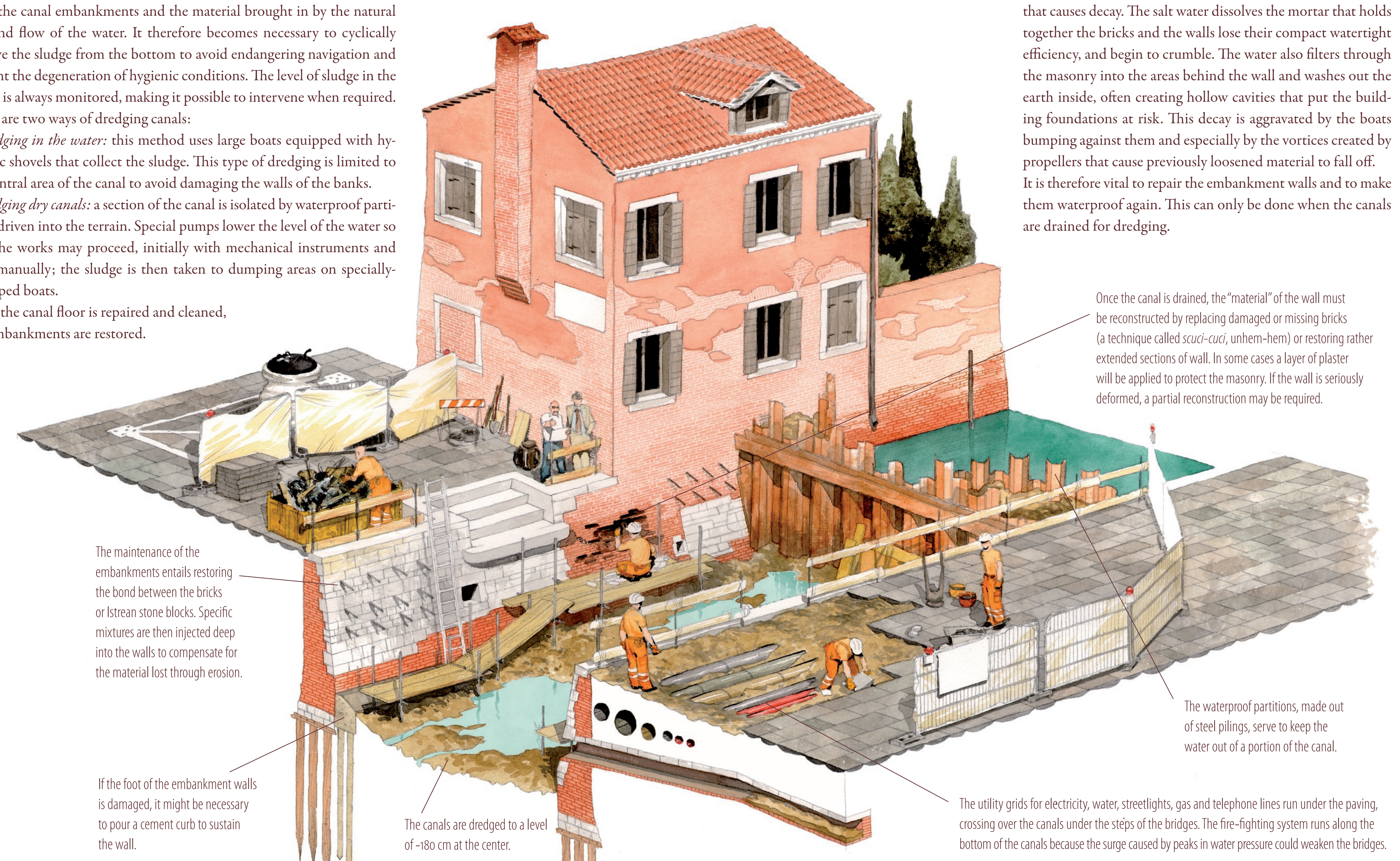


Dredging the canals

As time goes by, the canals inevitably tend to fill up because of the constant deposition of anthropic sediments in the lagoon, of material washed away from the canal embankments and the material brought in by the natural ebb and flow of the water. It therefore becomes necessary to cyclically remove the sludge from the bottom to avoid endangering navigation and prevent the degeneration of hygienic conditions. The level of sludge in the canals is always monitored, making it possible to intervene when required.
There are two ways of dredging canals:
– *dredging in the water:* this method uses large boats equipped with hydraulic shovels that collect the sludge. This type of dredging is limited to the central area of the canal to avoid damaging the walls of the banks.
– *dredging dry canals:* a section of the canal is isolated by waterproof partitions driven into the terrain. Special pumps lower the level of the water so that the works may proceed, initially with mechanical instruments and then manually; the sludge is then taken to dumping areas on specially-equipped boats.
Once the canal floor is repaired and cleaned, the embankments are restored.

The restoration of the embankments

The embankment walls under buildings and the *fondamenta* (the sidewalks along the canals) are under constant aggression that causes decay. The salt water dissolves the mortar that holds together the bricks and the walls lose their compact watertight efficiency, and begin to crumble. The water also filters through the masonry into the areas behind the wall and washes out the earth inside, often creating hollow cavities that put the building foundations at risk. This decay is aggravated by the boats bumping against them and especially by the vortices created by propellers that cause previously loosened material to fall off.
It is therefore vital to repair the embankment walls and to make them waterproof again. This can only be done when the canals are drained for dredging.



Insula: a project for Venice

The canals, the paving, the embankments, the bridges, the underground utility grids, the systems for channeling waste water are all elements that "shape" the city of Venice, that make it alive and livable.

Insula spa, the operative arm of the City of Venice for urban maintenance, implements a vast and articulated program of works to preserve the integrity of its foundation structures, to improve hygienic and sanitary conditions and with them the quality of life, restoring the canals, pedestrian circulation routes and underground utility grids. Constant care is vital to guarantee the city's future.

The paving

The paving on the streets and in the squares of Venice is largely composed of *masegni*, large stones made out of trachyte quarried in the Colli Euganei. The need to intervene on the underground utilities grids (to upgrade or replace them) and on the sewers (to reactivate them) provide an opportunity to restore the paving, smoothing out ruts and uneven areas to guarantee safe circulation and ensure that rainwater or high tides do not leave persistent puddles.

Raising the paving

The plan to raise the paving in the city primarily concerns the lowest areas (the ones that are more prone to flooding even when the tide is not particularly high) to build to a level, where possible, of +120 cm. During construction, architectural and environmental constraints are respected, seeking as far as possible to maintain the original appearance of the walls and the level of the entrances to homes and public spaces.

Like everything in Venice, even the paving has historic significance. For this reason the existing *masegni* (which were introduced in the eighteenth century) are reused in the restoration work, and only when necessary are they replaced with newly quarried stone.

In some areas of the city, mostly peripheral, the paving is made out of porphyry, cement or asphalt. When these areas are being restored, the cement and asphalt are replaced with more appropriate materials that are more consonant with the rest of the city.

The bridges

Venice has 355 bridges which not only are vital to pedestrian circulation, they also carry the light and telephone cables and the gas and water pipes under their paving.

Most Venetian bridges are built out of masonry. Over the years they too suffer a certain degree of decay: loss of plaster under the surface of the vault, broken alignment of the voussoirs, cracking, loss of consistency. They therefore need constant repair to remain functional. Restoration work on bridges is preceded by thorough diagnostic exploration and ascertainment of the condition of materials and structure. The voussoirs are then consolidated and realigned, the brick soffit is repaired and the new channels for the underground utility grids are installed under the paving. Even when the bridges are made out of cast iron, the original material is preserved as much as possible, restored with welding and the application of bolts, and the profiles are refurbished.

The underground utilities network

In Venice, like in every city, the pipes for water and gas and the electrical and telephone grids run under the paving. When a construction site opens, it provides the opportunity for upgrading these utility grids, rationalizing their plan, replacing older pipes, moving overhead wires for public street lighting underground, replacing or adding electrical cables, laying the new optical fiber cable grid. A new fresh-water fire-fighting system is also being installed: it causes less damage to buildings than the salt water drawn from canals which has been used until now.

The *rio terà*

A *rio terà* may be totally filled (in this case there is no more circulation on the water) or partially filled (in this case a channel remains open under the paving). In the latter case, it is important to periodically dredge the channels of the sludge and sediment that accumulates to prevent it from becoming obstructed.

To do so, in many cases a new non-invasive avant-garde methodology is used: an opening in the vault of the underground channel allows special machines to activate a pump that sucks up the sludge into a tank. The sludge is then conveyed through waterproof hoses into a boat and taken to an authorized dumping site.

Venice

Preservation and urban maintenance

Insula spa
Company for urban maintenance in Venice
info@insula.it – 041 2724354 – 041 2724244 fax

www.insula.it

concept Studio Scibilia
illustrations Matteo Alemanno
print Grafiche veneziane

How does the "Venetian system" work?

What problems does such an ancient and unique city face?

How can we avoid the decay that blights it?