Immersed tunnels

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Immersed tunnels

- Immersed tunnels have been in widespread use for about 100 years.

Immersed tunnels

Over 150 have been constructed all over the world, about 100 of them for road or rail schemes.

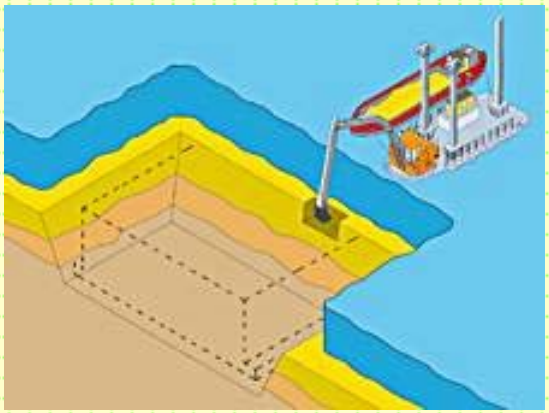
- Others include water supply and electricity cable tunnels.

Immersed tunnels

- The examples indicate the diversity of projects that have been realised.

Immersed tunnels

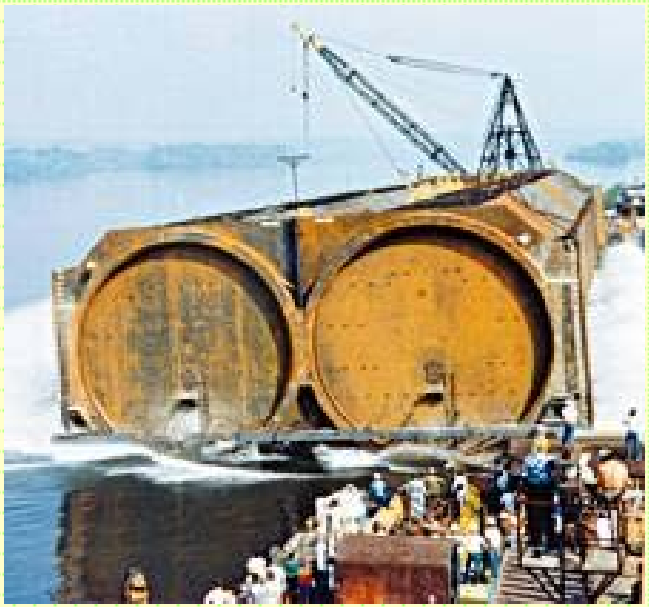
HOW IMMERSED TUNNELS ARE BUILT?



- A trench is dredged in the bed of the water channel.

Once completed, an immersed tunnel is no different operationally from any other tunnel. However, it is built in a completely different way. The technique is explained here.

Immersed tunnels



- Tunnel elements are constructed in the dry, for example in a casting basin, a fabrication yard, on a shiplift platform or in a factory unit.

Immersed tunnels

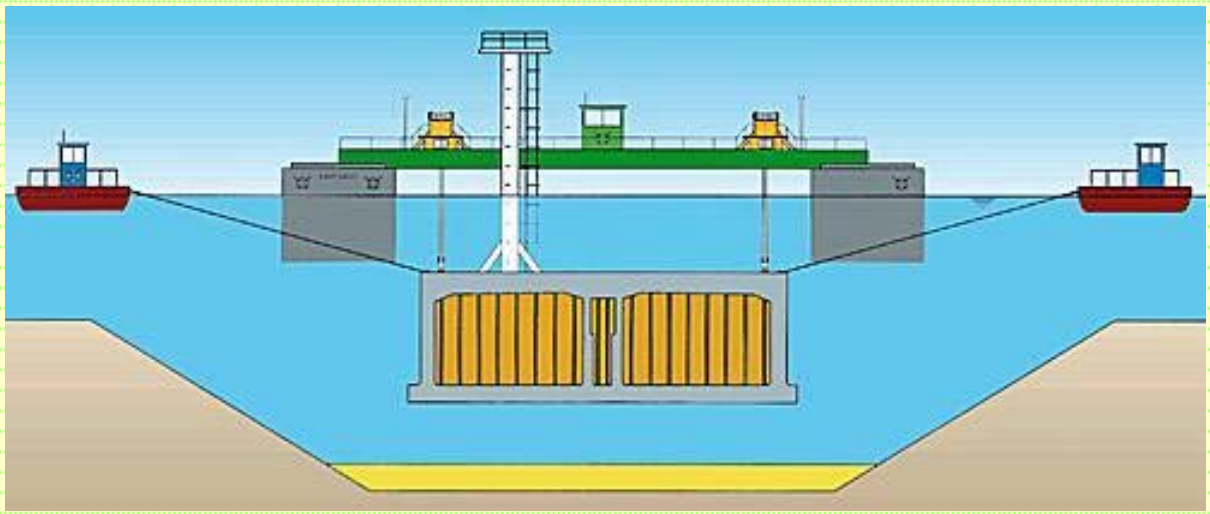
- The ends of the element are then temporarily sealed with bulkheads.

Immersed tunnels

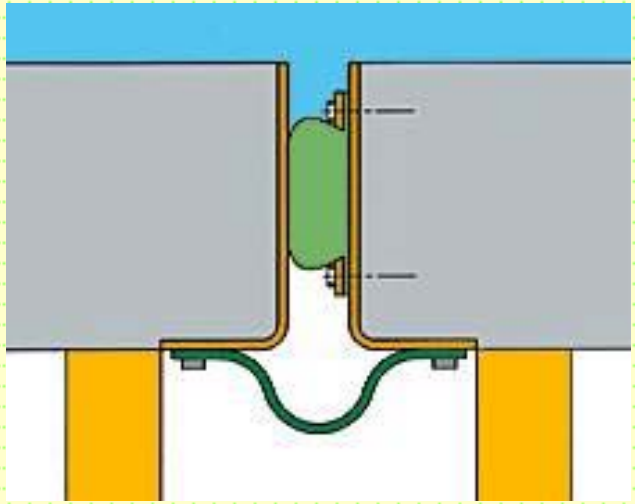
- Each tunnel element is transported to the tunnel site - usually floating, occasionally on a barge, or assisted by cranes.

Immersed tunnels

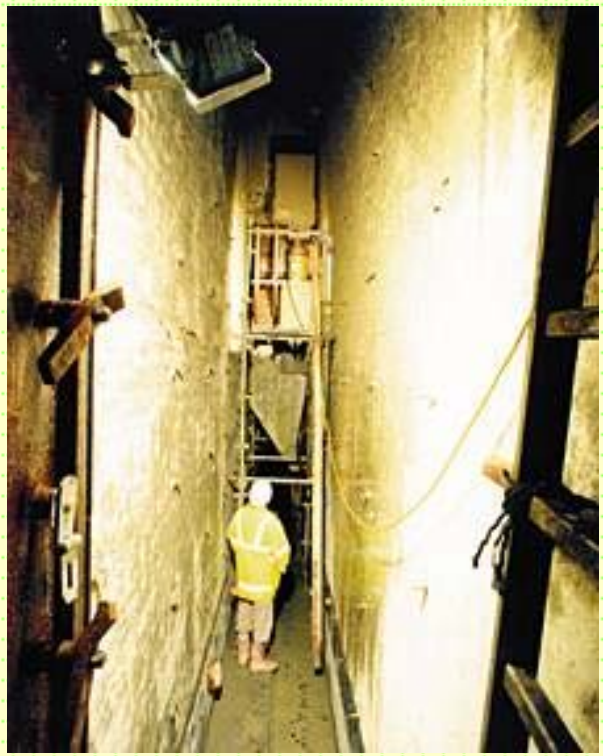
- The tunnel element is lowered to its final place on the bottom of the dredged trench. The new element is placed against the previous element under water. Water is then pumped out of the space between the bulkheads



Immersed tunnels

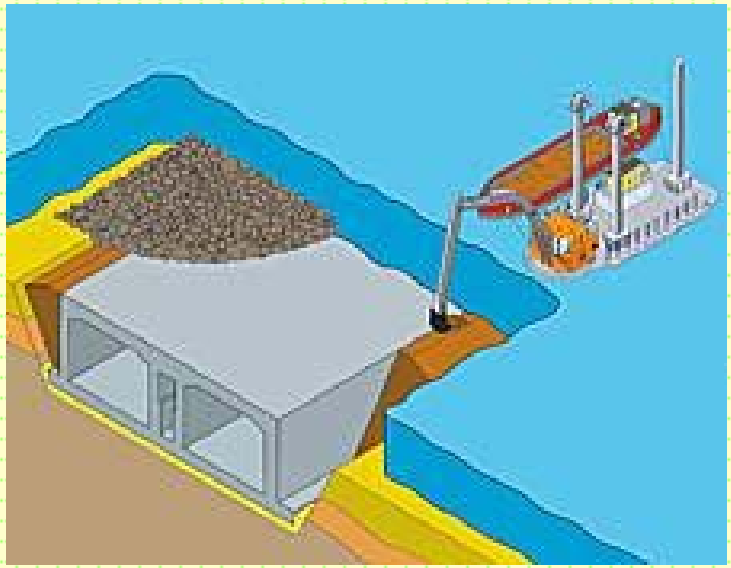


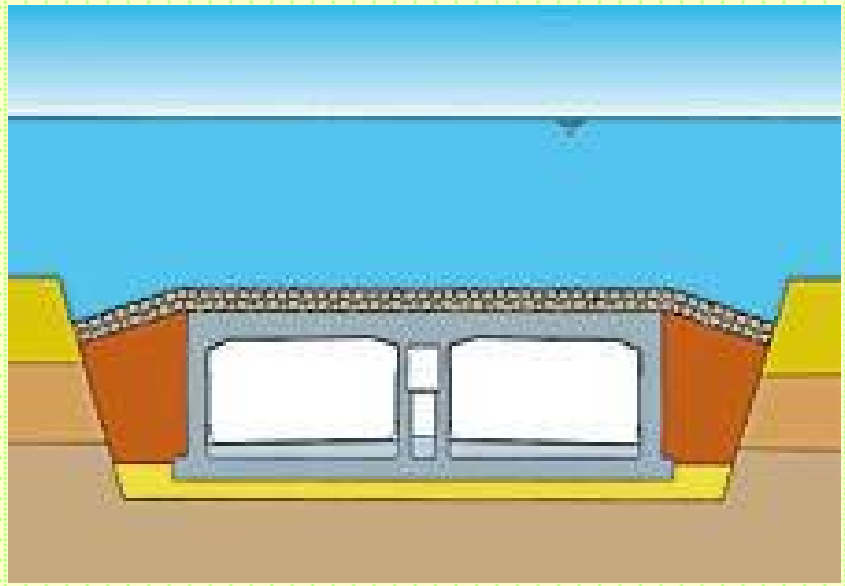
- Water pressure on the free end of the new element compresses the rubber seal between the two elements, closing the joint.



Immersed tunnels

- Backfill material is placed beside and over the tunnel to fill the trench and permanently bury the tunnel, as illustrated below.





Immersed tunnels

- Approach structures can be built on the banks before, after or concurrently with the immersed tunnel, to suit local circumstances.

Immersed tunnels – are there any special problems?

- Immersed tunnels are sometimes perceived by newcomers to the technology as "difficult" due to the presence of marine operations. In reality though, the technique is often less risky than bored tunnelling and construction can be better controlled. The marine operations, though unfamiliar to many, pose no particular difficulties. The perceived problems include:
- DREDGING
- INTERFERENCE WITH NAVIGATION
- WATERTIGHTNESS

Immersed tunnels

- Dredging technology has improved considerably in recent years, and it is now possible to remove a wide variety of material underwater without adverse effects on the environment of the waterway.

Immersed tunnels

- On busy waterways, it is sometimes assumed that construction of an immersed tunnel would be impractical as it would interfere with shipping. In fact, such tunnels have been successfully built in some exceptionally busy waterways without undue problems.

Immersed tunnels

- It is often assumed that the process of building a tunnel in water, rather than boring through the ground beneath it will increase the likelihood of leakage. In fact, immersed tunnels are nearly always much drier than bored tunnels, due to the above-ground construction of the elements. Underwater joints depend on robust rubber seals which have proved effective in dozens of tunnels to date.

Immersed tunnels – when should I choose an immersed tunnel?

- Whenever there is a need to cross water, an immersed tunnel should be considered. The final choice of crossing type will of course depend on many factors.

Immersed tunnels

- **Alignment**

  Immersed tunnels can be built shallow, permitting shorter tunnels and flatter alignments than bored tunnels.

- **Cross section**

  Immersed tunnel cross sections are highly versatile, making them particularly suitable for wide highways and combined road/railway crossings**.**

- **Water depth**

  Typically built in between 5m and 30m of water, although schemes have been postulated for 100m depth. Submerged floating tunnel technology will make water depth immaterial.

Immersed tunnels

- **Ground conditions**

  Most types of ground can be dealt with, including soft alluvial materials. Conditions unsuited to bored tunnelling do not usually pose a problem. Design for earthquake zones has shown to be perfectly feasible.

- **Land availability**

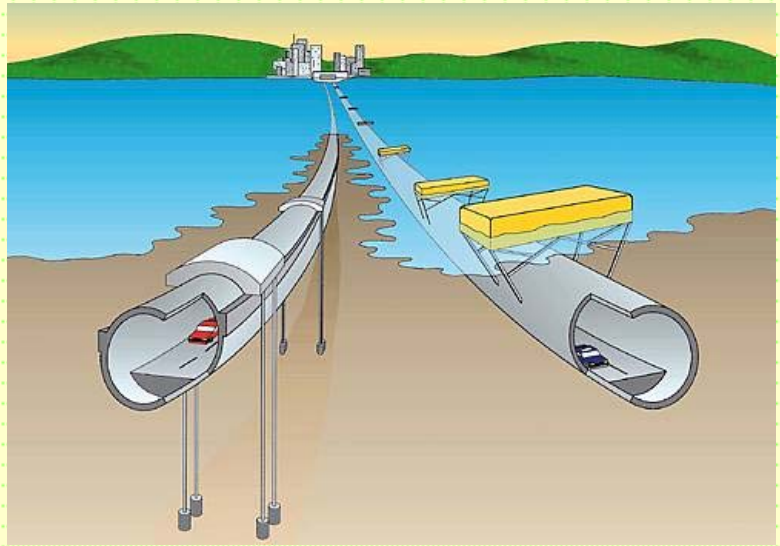
  Immersed tunnels are often prefabricated remote from the final immersion site, allowing installation in extremely congested (e.g. urban) locations where nearby land is not available.

- **Reclamation**

  Dredging operations present an opportunity to reshape riverbanks and coastlines as part of a tunnel construction scheme. They are, for example, commonly associated with land reclamation schemes.

Immersed tunnels - a new development – the submerged floating tunnel

- Traditional immersed tunnelling results in a tunnel buried beneath the waterway which it traverses. A new development- the submerged floating tunnel - consists of suspending a tunnel within the waterway, either by tethering a buoyant tunnel section to the bed of the waterway or by suspending a heavier-than-water tunnel section from pontoons. This technique has not yet been realised, but one project, in Norway, is currently in the design phase.



- The submerged floating tunnel allows construction of a tunnel with a shallow alignment in extremely deep water, where alternatives are technically difficult or prohibitively expensive. Likely applications include fjords, deep, narrow sea channels, and deep lakes.