

A study on submerged floating tunnel

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Abstract

This paper deals with the study of A submerged floating tunnel (SFT), also called a suspended tunnel or Archimedes bridge, which is a proposed design for a tunnel that floats in water, supported by its buoyancy (specifically, by employing the hydrostatic thrust, or Archimedes' principle)

Keywords: underground structure, floating tunnel, buoyancy, Submerged structure, waterway

Introduction:

- It is a tube like structure made of steel & concrete that floats in water.
- It utilizes the law of buoyancy to support the structure at moderate & convenient depth.
- The tube is placed underwater, deep enough to avoid water traffic and weather.
- It is supported by cables either anchored to the Earth or by pontoons floating on the surface, respectively.

Need For Submerged Floating Tunnel:

- A “SFT” is considered when the depth of sea or ocean is too deep so that no tunnel or any solid body could sustain the pressure acting on it at such a deep level.
- In that case the tunnel is placed such as about 20-50m(60-150ft) from sea level

Basic Principle

SFT is a buoyant structure which moves in water. The relation b/w buoyancy & self weight is very important, since it controls the static behavior of tunnel & to some extent, also the response to dynamic forces. There are two ways in which SFT can be floated.

Positive Buoyancy: In this the SFT is fixed by anchoring either by means of tension legs to the bottom or by means of pontoons on the surface. Here SFT is mainly 30m below the water surface.

Negative Buoyancy: Here the foundations would be piers or columns to the sea or lake. This method is limited to 100m water depth.

Optimal Shape

- The shape of SFT as shown in fig has been chosen for the following reasons.

When the vertical curvature is concentrated in the middle of the SFT, it is easier to shorten the tubes during installation, variations in the buoyancy in the middle of the tunnel gives little bending & axial force

Construction

The concept of SFT is based on well-known technology applied to floating bridges and offshore structures, but the construction is mostly similar to that of immersed tunnels

- SFT consists of many structural components. These components should provide strength & stiffness against the various forces acting under the water surface.

- Tube
- Anchoring

Shore connections

Tube

It should accommodate the traffic lanes & the equipment. External shape can be circular, elliptical or polygonal. It may be constructed of steel or concrete. Tube is composed of elements of length varying from one hundred meters to half a kilometer

Connection:-

The connections of the tube to the shore require appropriate interface elements to couple the flexible water tube with the much more rigid tunnel bored in the ground. This joint should be able to restrain tube movements, without any unsustainable increase in stresses. On the other hand, the joints must be water tight to be able to prevent entry of water. Additional care in shore connections is required, especially in seismic areas, due to the risk of submarine landslides.

- **Advantages**
- Allows construction of tunnel in extremely deep water, where conventional bridges or tunnels are technically difficult or prohibitively expensive.
- Any type of cross sectional area can be provided since being prefabricated.
- No obstruction to navigational routes as compared to conventional bridges since all of the tunnel being placed underwater.
- Construction activities has less harmful effects on aquatic life.
- No harmful environmental effect as fog or storm since the whole structure is covered and is present inside the water.
- Low energy consumption due to more gentle gradient.
- Vehicular emission can be collected at one end of the tunnel thus reducing the air pollution.
- Tremendous speed for trains could be obtained by creating a vacuum inside the tunnel since it will result in negligible air resistance.

Competitive Features

- Invisible
- Very low gradient
- Length only from shore to shore

- Access to underground service parking space at ends
- May surface just above shoreline
- Constructed away from densely populated areas
- Easy removal at end of life
- Some possibilities of reuse or recycling

Conclusion

- The SFT will set up new trends in transportation engineering and which shows with the advances in technology that will reduce the time required for travelling & make the transportation more effective by hiding the traffic under water by which the beauty of landscape is maintained & valuable land is available for other purposes. Benefits can be obtained with respect to less energy consumption, air pollution & reduced noise emission. For wide and deep crossings the submerged
- Floating tunnel may be the only feasible fix link, replacing present day ferries & providing local communications and regional development.

References

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