To Use Submerged Floating Tunnel for water way

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Abstract-The Submerged Floating Tunnel concept was first conceived at the beginning of the century, but no actual project was undertaken until recently. As the needs of society for regional growth and the protection of the environment have assumed increased importance, in this wider context the submerged floating tunnel offers new opportunities. The submerged floating tunnel is an innovative concept for crossing waterways, utilizing the law of buoyancy to support the structure at a moderate and convenient depth . The Submerged floating Tunnel is a tube like structure made of Steel and Concrete utilizing the law of buoyancy .It supported on columns or held in place by tethers attached to the sea floor or by pontoons floating on the surface. The Submerged floating tunnel utilizes lakes and waterways to carry traffic under water and on to the other side, where it can be conveniently linked to the rural network or to the underground infrastructure of modern cities.

Index Terms - crossing waterways, law of buoyancy, Submerged floating, traffic under water.

Introduction -SFT is a buoyant structure which moves in water. The relation between buoyancy and self weight is very important, since it controls the static behaviourf the tunnel and to some extend, also the response to dynamic forces. Minimum internal dimension often result in a near optimum design. There are two ways in which SFT can be floated. That is positive and negative buoyancy.

Positive buoyancy - In this the SFT is fixed in position by anchoring either by means of tension legs to the bottom or by means of pontoons on the surface. Here SFT is mainly 30 metres below the water surface.

Negative buoyancy - Here the foundations would be piers or columns to the sea or lake. This method is limited to 100 meters water depth

SFT is subjected to all environmental actions typical in the water environment: wave ,current , vibration of water level, earthquake, corrosion, ice and marine growth. It should be designed to with stand all actions, operational and accidental loads, with enough strength and stiffness. Transverse stiffness is provided by bottom anchoring

The SFT concept

Typically an SFT consists of the following -

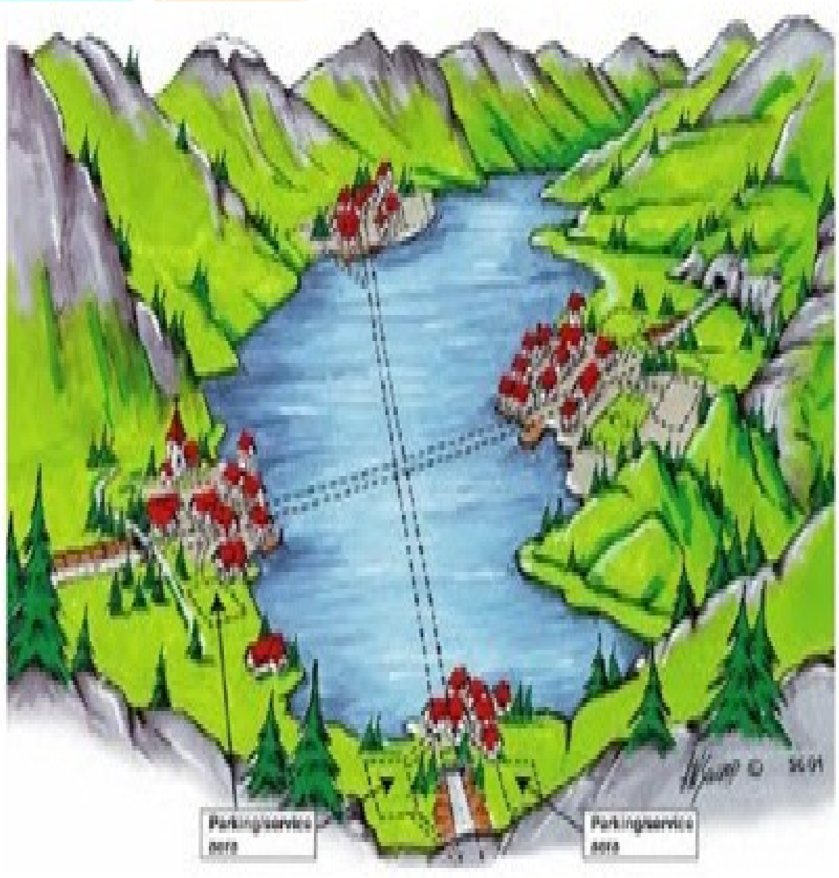
1. The tunnel tube which provides space for the road and/or railway traffic
2. Tethers, vertical or inclined fixing the tube to the seabed at certain spacing
3. Pontoons mounted on top of the tunnel and “anchoring”
4. Gravity anchors on the seabed providing support for the tethers
5. Shore connections at the ends of the tunnel

The tubes may be constructed of steel, concrete or a combination of the two. In Norway, the tube has up till now mostly been designed with circular cross-sections, primarily from hydrodynamic reasons. Other shapes as elliptical, rectangular or multiple-sided may also be of relevance. Tethers and pontoons are alternative ways of controlling the vertical position and motions of the tube. They may also be used in combination. Typically, the tube is a long and very slender structure thus requiring special measures.

Competitive Features of SFT

Invisible - Crossing waterways, whether being from main land to islands in the sea or maybe more important crossing an inland lake, perhaps the one we are at now will in many cases meet protests both from tourist interests and also from the public in general. Lakes of special beauty or perhaps historical value should be preserved for the future, the crossing of such areas and lakes with SFT may make this possible.

Length only from shore to shore - The actual SFT structure is only as long as the distance between the shores. If desired the SFT may be connected directly to tunnels and then be completely out of sight for any desired distance.



Very low gradient - Crossings with undersea tunnels or bridges will frequently mean longer structures with consequently higher costs and this may offset the higher cost per meter for an alternative SFT. An SFT crossing may have a very gentle gradient or being nearly horizontal giving considerable savings in energy used by traffic.

Access to underground service-parking space at ends - As the SFT may continue in tunnels having crossed the waterway, it is possible to arrange parking places or service areas under ground and provide access to the surface by lifts directly into cities or recreational areas as shown in Fig. 3.2. These possibilities may be one of big advantages in future, in fact for all types of tunnels.

May surface just above shoreline - As an SFT may be positioned at any depth below the surface arrangements may be made that the SFT surfaces at or very near the shoreline. This may be an advantage for connections to new or existing road systems and gives the planners freedom to locate connections in a very flexible way.

Constructed away from densely populated areas - Construction of infrastructure is a major everyday problem in many cities, traffic is piling up, new one way streets daily and generally great frustrations by millions of people. One very interesting feature with SFT is that the actual construction may be done away from the densely or highly populated areas, a feature also for immersed tunnel construction. After the sections of the tunnel are finished they may be towed to the actual site and there joined together and installed at the desired depth. In some instances the whole length of the SFT may be assembled at the construction site and the complete structure towed to the actual site and installed. This would ensure minimum disturbances to the local area and perhaps the whole operation may only take months instead of years.

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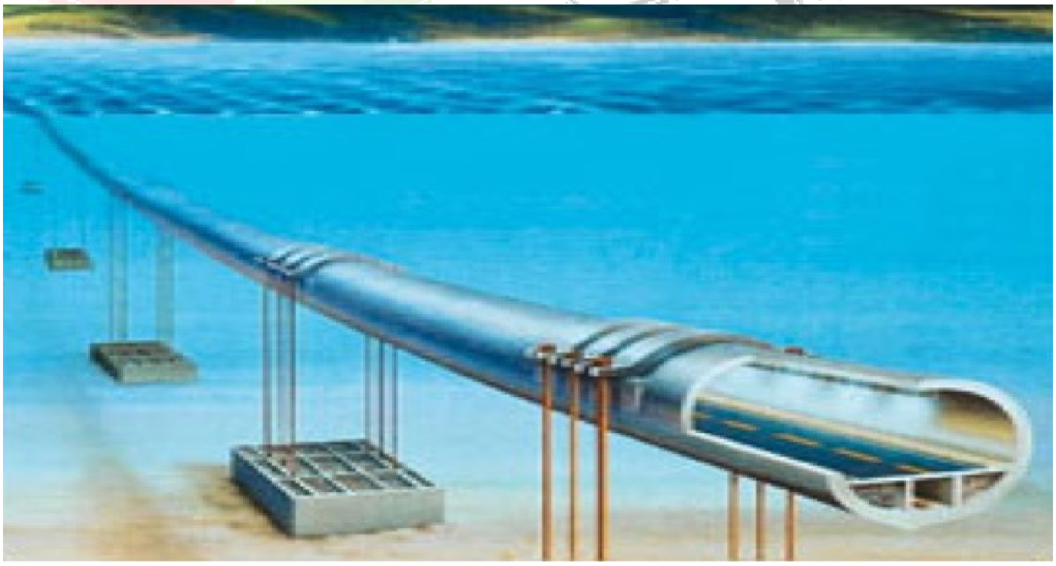
1. **Cost**: - Due to lots of material and machinery involved in project, estimated cost is nearly 1.2 Thousand core dollars.
2. **Fire**: - It is difficult to rescue people if fire will break out in train and also to face the problems due to the smoke of fire.

3. **Collision**: - If in case of collision of two trains took place, it is very difficult to rescue the people.

4. **No Stoppage**: - It is very difficult to stop the train travelling on such a high speed.



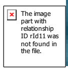
Reason for Choosing Floating Tunnel-Floating tunnel is the totally new concept and never used before even for very small length. It can be observed that the depth of bed varies from place to place on a great extent. The maximum depth is up to 8 km. also at certain sections. The average depth is 3.3 km. The two alternatives are available for constructions are bridge above water level or tunnel below ground level. Since the depth is up to 8 km it is impossible to construct concrete columns of such height for a bridge. And also the pressure below 8km from sea surface is nearly about 500 times than atmospheric pressure so one cannot survive in such a high pressure zone. So the immersed tunnels also cannot be used. Therefore, floating tunnel is finalised which is at a depth 30m from the sea level, where there is no problem of high pressure. This is sufficient for any big ship to pass over it without any obstruction.

Loading Conditions

Permanent Loads - The permanent loads acting on a SFT are the weight of the various structural and non-structural components, the water buoyancy and the hydrostatic pressure.

Functional Loads - Functional loads are related to the development of the functions for which the SFT is designed for, therefore these loads are associated with the passage of cars, trucks, trains and/or pedestrians, according to the destination of use of the SFT.

Hydrodynamic Loads - Hydrodynamic actions due to the water-structure interaction in presence of waves and currents often represent the most important and onerous environmental actions for a SFT.



Operation AndMaintanence

Operation conditions for SFT will not be known until the first structure of this type has been constructed. In fact all well developed projects include a very extensive monitoring of the tunnel behavior, in order to control SFT performance and to acquire valuable experience for future design. Parameters to be monitored include:

· Environmental parameters: current, wave, temperature, water density, etc;
· Structural parameters: stress, strain, static and dynamic response
· Material behavior: cracking, corrosion marine growth
· Parameters related to environmental impact (inside and outside the tunnel)

However a set of crucial issues, besides monitoring, related to operation and maintenance includes:

· Traffic control
· Corrosion protection
· Surveys and inspection
· Repair

Traffic control is aimed at ensuring that the crossing SFT fulfils the design assumptions, both in quality and quantity. While control of traffic flows, in order to avoid any traffic congestion in the SFT, can be easily achieved, with the same techniques applied for land based tunnel, more skill is required to prevent access to the SFT for such type of goods (explosives), that must be avoided for safety reasons.One of the most uncertain issues to the long term behavior of SFT, compared to other civil engineering structures, is the performance of corrosion protection systems and related corrosion control inspections. Experience from ship and offshore structures can be applied, as starting point to define standards and procedures for surveys and inspection. Structural behavior in damaged condition is a crucial for SFT repair. SFT design has to consider that damage can occur, during its lifetime, both to the tube and to the anchoring systems.

Risk Control Of SFT

The meaning of risk control is to minimize the risk loss through prior treatment and process control according to the result of risk assessment. The risk control measures can also be taken by three aspects as follows:

·Corresponding to the natural hazard risk of SFT, we should put forward reinforcement and protection methods against hazard under the construction of SFT to improve capacity of disaster prevention. In the one hand, we should establish the system of hazard monitoring and hazard early warning as well as hazard database of SFT project site, which includes hazard's type, duration, destructive degree and repair measures. On the other hand, the mechanism research of structure damage caused by hazard, nonlinear elastic-plastic analysis by using computer simulation technology and some control technologies and methods of SFT should be carried out.

· Corresponding to the operational risk of SFT, not only should we improve the SFT disaster prevention and relief system, but also ensure SFT facility integrity including smooth line shape, explicit traffic indicator sign and adequate ventilation as well as lighting system. Meanwhile, we may also research the influence of longitudinal ventilation on working fire and smoke emission. The comprehensive set emergency evacuation system are considered and designed, such as special evacuation channel.

· Corresponding to the constructional risk of SFT, we should consider the combined action between structure and environment in each constructionstage. The control section's structure parameters during the construction of SFT, such as strains and stresses should be monitored in time in order to guide construction and guarantee the constructional reliability of SFT structure.

Safety

Since the concept of an SFT is still innovative, acceptable risk levels may initially need to be higher than for comparable projects because new safety issues are raised. Safety requirements should therefore be quantified to determine acceptable risk levels compared with the expected benefits during the working life of an SFT.

SFT safety criteria may be viewed in two ways:

· As normal rail or road tunnel, emphasizing structural safety.
· As the comprehensive transportation system, emphasizing operational safety.

Conclusion

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

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