A

Seminar report

On

SUBMERGED FLOATING TUNNELS

Submitted in partial fulfillment of the requirement for the award of degree
Of Civil

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Acknowledgement

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Preface

I have made this report file on the topic **SUBMERGED FLOATING TUNNELS ;** I have tried my best to elucidate all the relevant detail to the topic to be included in the report. While in the beginning I have tried to give a general view about this topic.

My efforts and wholehearted co-corporation of each and everyone has ended on a successful note. I express my sincere gratitude to ……..who assisting me throughout the preparation of this topic. I thank him for providing me the reinforcement, confidence and most importantly the track for the topic whenever I needed it.

CONTENTS

INTRODUCTION

Tunnels in water are by no means new in civil engineering. Since about 1900, more then 100 immersed tunnels have been constructed. Bridges are the most common structures used for crossing water bodies. In some cases immersed tunnels also used which run beneath the sea or river bed. But when the bed is too rocky ,too deep or too undulating submerged floating tunnels are used .

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.

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 can not 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.

BASIC PRINCIPLE OF SFT

SFT is a buoyant structure which moves in water. The relation between buoyancy and self weight is very important, since it controls the static behaviour f 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.

OPTIMAL SHAPE OF SFT

The shape of the SFT in Fig. 1 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 concrete tube during installation, variations in the buoyancy in the middle of the tunnel introduce little bending in the tunnel. Similarly an unusual amount of water in the middle of the tunnel gives little bending and axial force.

Fig 1. Optimal shape of an SFT

STRUCTURAL COMPONENTS OF SFT

Submerged floating tunnel consists of many structural components. These components should provide strength and stiffness against the various forces acting under the water surface. The three basic structural components are:

- Tube
- Anchoring
- Shore connections

Tube: It should accommodate the traffic lanes and the equipments. External shape can be circular , elliptical or polygonal. It may be constructed of steel or concrete. Corrosion protection is the main issue. Tube is composed of elements of length varying from one hundred meters to half a kilometre.

Anchoring:

There are basically fours types of anchoring:

- SFT with pontoons
- SFT supported on columns
- SFT with tethers to the bottom
- SFT unanchored

SFT with pontoons: It is independent of water depth, the system is sensitive to wind, waves, currents and possible ships collision. Design should be such that if one pontoon is lost ,then also the structure will survive.

SFT supported on columns: It is an "underwater bridge" with foundations on the bottom, in principle the columns are in compression but they may also be a tension type alternative. Water

depth will play an important role in this case and a few hundred meters depth is considered a limit at the present time. However, much deeper foundations are at present under investigation.

SFT with tethers to the bottom : It is based on tethers being in tension in all future situations, no slack in these tethers may be accepted in any future load cases. The present practical depths for this type of crossing may be several hundred meters, whether the tethers are vertical or a combination of vertical and inclined.

SFT unanchored: It is interesting as it has no anchoring at all except at landfalls and is then independent of depth. There is obviously a limit to the length but only further development will answer this. Perhaps an alternative for light traffic should be designed, possibly a 100 or 200 meter long .

The four types of anchoring are given in FIG 2.(a), 2.(b),2.(c), 2(d)

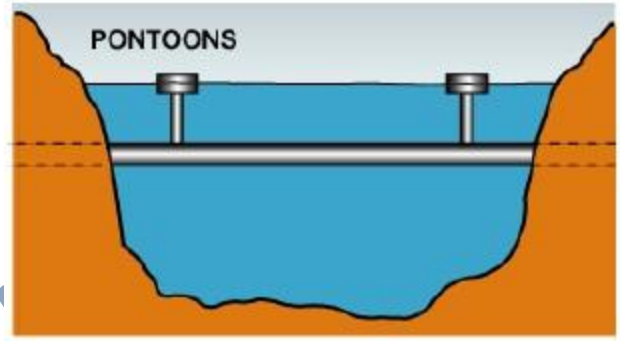

Fig. 2(a). SFT with pontoons

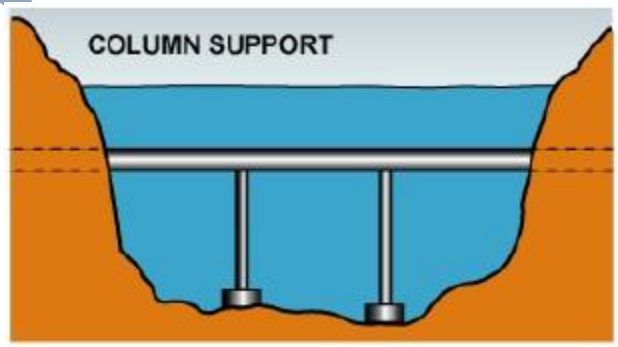

Fig. 2(b). SFT supported on columns

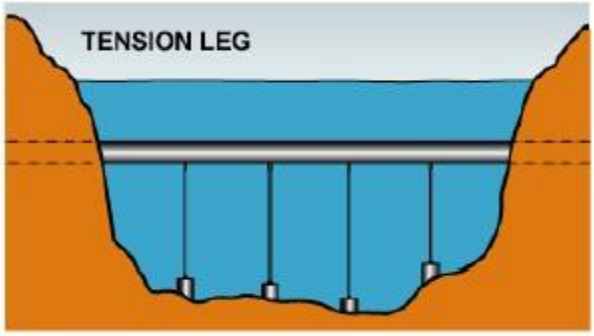

Fig. 2(c). SFT with tethers to the bottom

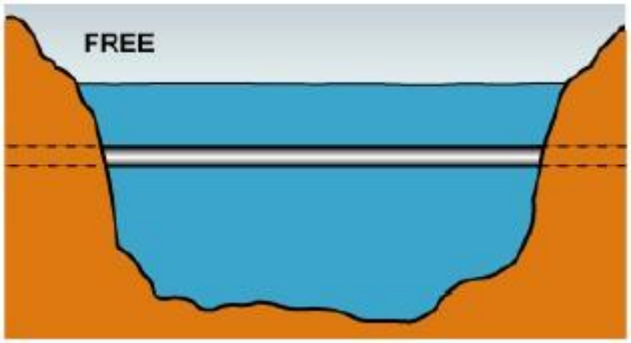

Fig. 2(d). SFT unanchored

Connections:

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.

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. An illustration of this may be seen in Fig. 3.1.

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.

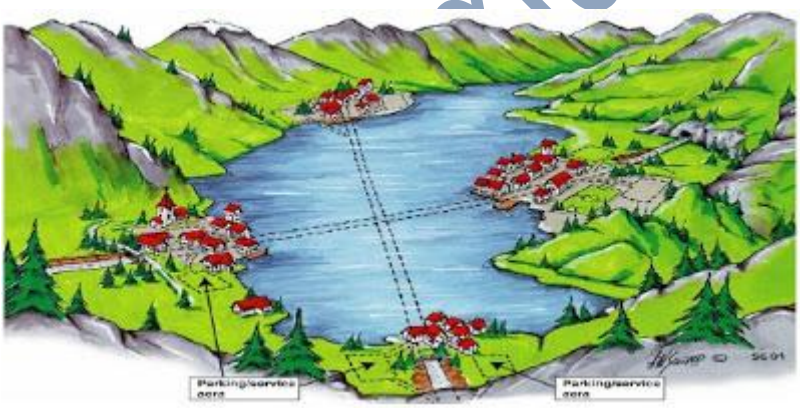

Fig. 3.1.SFT crossing of lakes

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.

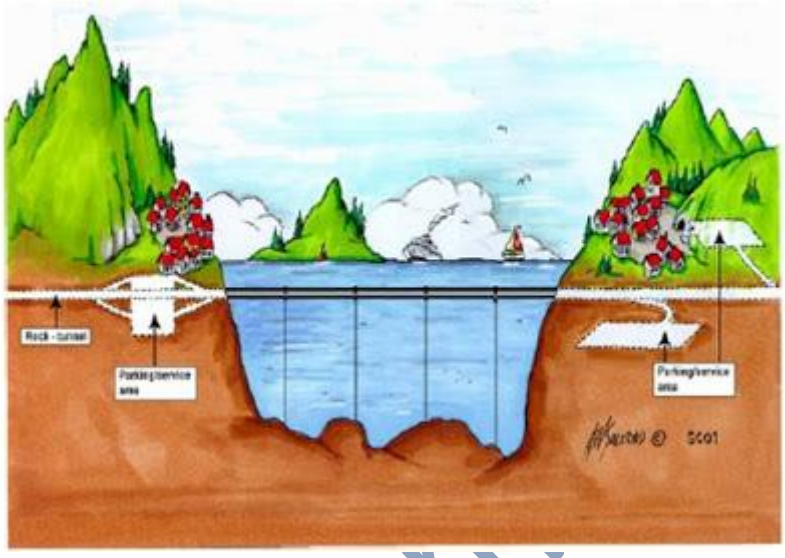

Fig.3.2. Parking and service areas

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.

Easy removal at end of life

All structures will have to be removed or replaced sooner or later and as the amount of structures increase it is important to prepare for these operations already at the planning and design stage. Removal, recycling or reuse of materials or parts of the structures will become increasingly necessary in the future, for both economic and environmental reasons. SFT is in most cases a floating structure as a whole and may therefore be towed away to some place where parts of the SFT may be reused. One may imagine such an operation by for instance placing bulkheads in the original elements and then separating the SFT in suitable lengths to be perhaps towed to different locations for reuse or destruction.

Some possibilities of reuse or recycling SFT

Sections of a tunnel may be used for many purposes, depending on its size and condition. One obvious possibility is for various types of storage facilities, whether in the sea or on dry land, a section of tunnel ,say 12 meters in diameter cut to a length of 10 to 15 meters would not present any difficulty to get up on dry land if that was desired. To cut a concrete tunnel into sections would not present big difficulties either; it’s more a question of overall economy than technology.

CASE STUDY ON A SFT: TRANSATLANTIC TUNNEL

A Transatlantic tunnel is a theoretical submerged floating tunnel which would span the Atlantic Ocean between North America and Europe. The transatlantic tunnel would be built of 54000 prefabricated sections connected by watertight and vacuum-tight gaskets. Each section of tunnel is to be attached to tethers which are to be affixed to an anchor at the see floor, which is, in some places almost 8 km deep. The tunnel would hover at about 45 meter below the see surface, ideal to avoid ships and still minimize pressure and also to sway a bit under pressure. A high-speed train could theoretically run from New York to London in 54 minutes. But the train would have to go at a speed of 8000 km/h through a 5000 km long tunnel, that is itself floating in the Atlantic Ocean. To reach this speed, almost a perfect vacuum would have to be maintained in the tunnel and the train would have to be magnetically levitated. There will be 3 rails. Two are bidirectional and one reserve, to be used during accidents and repairs.

Fig.4.1. Location of Transatlantic tunnel

COMPONENTS OF TRANSATLANTIC TUNNEL

Transatlantic tunnel consists of many components. The main components of this Tunnel are listed below.

- Gasket/shell
- Sea anchors
- Utility conduits and service port
- Vacuum pumps
- Maglev train
- Guide ways

GASKET/SHELL

As the tunnel is situated at a depth of 30m, it should be perfectly water tight and secondly it should resist the salty sea water and thirdly it should be withstand against hydrostatic forces coming on it.

It is made of 4 layers. Outermost layer is constructed of aluminium to resist the salty sea water. Second and third layer is made of the foam to float the tunnel easily in water. Fourth layer is of concrete which gives strength to the tunnel.

As the length of tunnel is very large, it is not possible to construct the tunnel at situ. Therefore it is made up of 54000 precast units. These units are casted on shore and transported to place where they have to fix the units with two large floating platforms .A diagram of shell is given in Fig.

Fig. 4.1.1. Shell

SEA ANCHORS

As the tunnel is in the Atlantic Ocean, it should have to face high current velocity in Atlantic Ocean. The tunnel should not deflect much with water current. Therefore it anchored to the sea bed with the help of steel anchors.

The procedure is as follows :

First, ropes are attached to a block and this block is inserted in sea bed water come out from top and forms a hydro-statics seal which holds the block firmly in sea bed. A diagram of sea anchor is given in Fig. 4.2

Fig. 4.2.1 Sea Anchor

VACUUM PUMP

The train is running with such a thrilling speed of 5000 mph in the tunnel. The air resistance is too high on such a high speed. Therefore to reduce it and increase the speed of train, vacuum is created in tunnel. But creating vacuum in such a long tunnel is very difficult task. With available equipments, 100 propellers of most powerful boing jet are require to evacuate the air continuously for 15 days. The vacuum pumps are installed throughout the length of tunnel to maintain the vacuum in it.

SERVICE PORT

The tunnel is powered by electrically which should be available for entire length of tunnel. These electrical wires are carried out through utility conduits. The two service ports are provided in tunnel, one above and other below the track conduit. These are provided for communication and access for repair works. Figure showing the service port is shown in Fig.4.4.1

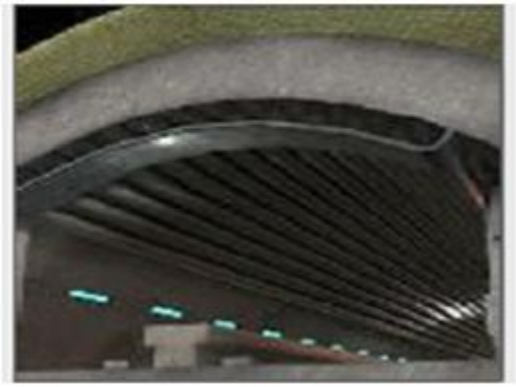

Fig.4.4.1 Service Port

MAGLEV TRAIN

These are magnetically elevated trains. These trains do not run over the track but floats slightly above the track. Thus we can achieve practically zero tractive resistance between train and track. Further this train will pass though vacuum, which increase the speed of train. The sensation of flying at 400mph with no engine noise or vibration will make the journey through the tunnel a unique experience. Special rotating and pivoting seats are provided to further reduce the effect of gravitational force. A diagram of train is given in Fig. 4.5.1.

Fig. 4.5.1 Meglev Train

Figure showing the various components of transatlantic tunnel is given in Fig 4.5.2

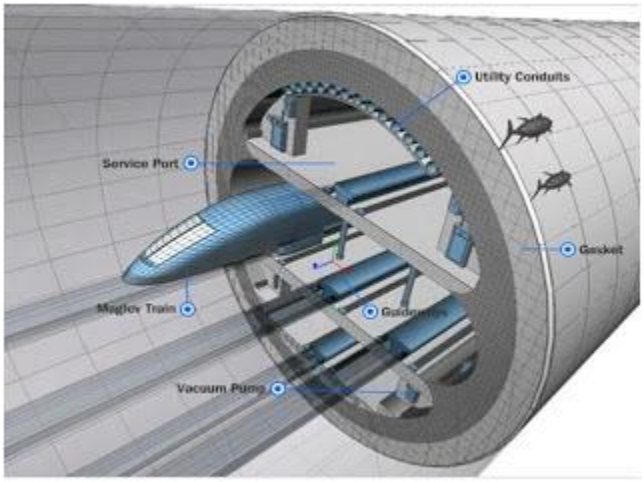

Fig 4.5.2 Components Of Transatlantic Tunnel

CHALLENGES TO BE FACED

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.

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.

REFERENCES

- www.google.com
- www.wikipedia.com
- www.studymafia.org