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A Study on Route 520 Floating Bridge

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ABSTRACT

This paper shows that several people opposed the idea of a brand-new floating bridge across Lake Washington, but once it was built, it quickly gained popularity as a commuter route between Seattle and the Eastside. In addition to reducing traffic, the bridge encouraged suburban growth in the 1970s and 1980s. By 2011, the bridge was carrying significantly more cars than it was intended to—about 115,000 per day.

Keywords: Floating bridge, Sub-urban, Reducing traffic and lake Washington

I. INTRODUCTION

The Governor Albert D. Rossellini Bridge-Evergreen Point, commonly called the SR 520 Bridge, is the longest floating bridge on the planet. At 7,580 ft. (2,310 m), it carries State Route 520 across Lake Washington from Seattle to Medina. The four lane toll bridge was opened in 1963 after four years of construction. Due to its age and deteriorated condition as well as increased traffic, the Evergreen Point Floating Bridge was replaced by a new floating bridge at the same site. The new bridge was opened in April 2016 and carries six lanes as well as a multi-use path for bicyclists and pedestrians. With its length of 7,708.49 feet (2,349.55 m) it is officially certified for the Guinness World Records.

The 520-marked bridge in Figure 1 is referred to as the State Road (SR) 520 Floating Bridge. The bridge was expected to transport roughly 65,000 vehicles daily to and from the city centre when it was finished in 1963. The bridge now carries an average of 115,000 vehicles every day as a result of the sharp rise in population. This worsening traffic shows how urgently a safe bridge across Lake Washington is needed.

Fig-1: The bridge crosses lake Washington between the cities of Seattle and Medina

II. CONSTRUCTION OF THE FLOATING BRIDGE

1. Bridge site selection:

According to the Washington State Department of Transportation, "A floating bridge is anticipated to cost three to five times less than a long-span permanent bridge, tube, or tunnel for a site where the water is 2 to 5 km wide, 30 to 60 m deep, and there is a very soft bottom." The average depth of Lake Washington is 33 metres, and the silt that makes up its bottom is quite compressible. The passageway where the bridge must be positioned is not straight as well. For this depth, a suspension bridge with an unrealistic tower over 183 metres high would be necessary. Additionally, only reasonably straight lines can be used to construct suspension bridges. Also, a conventional bridge would not be easily supported by the poor soft bedding. It is so obvious that a floating bridge needs to be built in order for vehicles to cross Lake Washington, which is 2.3 km wide.

2. Pontoons:

The entire bridge structure is kept afloat by 77 concrete pontoons. The pontoons are aligned in the configuration shown in the graphic below and are labelled alphabetically from west to east.

Fig-2: Pontoons

There are different types of pontoons are available. They are:

a. Longitudinal pontoon:

At almost 360 feet long, these pontoons are the biggest. They support the roadway superstructure and serve as the foundation of the bridge.

- ✓ The floating bridge was built in an Aberdeen facility and includes 21 longitudinal pontoons.
- ✓ Weight = 11100 tons.

b. Cross pontoons:

The floating bridge's ends and the transition to the east and west approach structures are marked by cross pontoons.

- ✓ The floating bridge has two cross pontoons, one at each end. It was built in an Aberdeen facility.
- ✓ Weight: 10100-10550 tons.

c. Supplemental stability pontoons:

When connected to the larger longitudinal pontoons, these smaller pontoons aid in stabilising and supporting the weight of the new floating bridge.

- ✓ The bridge was built at Aberdeen facility and Tacoma facility and contains 54 supplemental stability pontoons.
- ✓ Weight: 2500-2820 tons.

3. Concrete:

When the volume of water that the object displaces weights greater than the object itself, the object will float due to the natural law of buoyancy of water. This enables a floating bridge's dead and live loads to be supported by water. The problem with building concrete pontoons is that concrete has a propensity to crack. Whenever a pontoon develops a crack, water may seep inside, endangering its structural integrity and adding to the weight of the pontoon.

Heating the concrete was one method used to lessen cracking. The temperature of concrete when it is poured varies from 50 to 60 degrees Celsius. It shrinks as it cools. Rebar connects the bottom panels to the walls, but the panels are poured in phases. Pipes were inserted into the bottom panels to raise the temperature of the previously poured concrete to match that of the already set concrete. Due to the cooling and joint shrinkage that results, the number of cracks is decreased. Pontoons with crack limits of 6/1000 of an inch are closely anticipated (0.1524mm). Greater cracks require the injection of an epoxy glue and waterproof covering.

A concrete mix made of fly ash and micro-silica was chosen to reduce the corrosive effects of sea water. The pontoons are built, moored, and towed in salt water even though the bridge will be situated on freshwater Lake Washington.

4. Anchors:

The new SR 520 floating bridge's pontoons are secured in place by a network of woven steel wires. Three distinct kinds of anchors on the lakebed of Lake Washington are connected to the cables, which are 3 1/8 inches thick and up to 1,000 feet long. They are:

i. Fluke anchors:

- ✓ Dimensions: 35 feet x 26 feet x 17.5 feet
- ✓ Weight: 107 tons
- ✓ Quantity: 45
- ✓ Locations: Deep. Soft soils of the lakebed and flat areas.

Fig-3: fluke anchor

ii. Gravity anchors:

- ✓ Dimensions: 40 feet x 40 feet x 23 feet.
- ✓ Weight: 420 tons as built; 587 tons fully loaded.
- ✓ Quantity: 48 anchors
- ✓ Location: solid soils with sloped topography near sea shore. Underwater grading and installation of gravel creates a level footing for anchor placement.

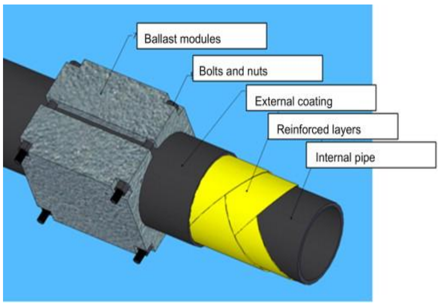

Fig-4: Gravity anchor

iii. Drilled shaft anchors:

Fig-5: Drilled shaft anchors

- ✓ Dimensions: 10-foot diameter drilled shaft, 79 to 92 feet long.
- ✓ Quantity: 05 anchors
- ✓ Location: solid soils near shore where gravity anchors may cause navigation hazard.

5. Electrical components:

Throughout the length of the bridge, workers installed more than 300 miles of electrical wiring, as well as other electronic parts and sensors. They were all electronically connected to Shoreline's northwest regional traffic management centre and Medina's new bridge maintenance facility.

6. Structural components:

i. Roadway duck:

The low-rise roadway deck consists of 776 precast deck panels. Kenmore is where these panels were made. There are 23 cast-in-place deck spans in the high-rise roadway deck, plus four more that were added to the transition spans between the floating and permanent portions of the bridge.

ii. Deck support:

The beams on which the bridge deck is supported include 331 concrete girders and 771 concrete columns.

iii. Bridge barriers:

Over the whole length of the bridge, there are 25,846 feet of barriers in place. The new regional shared-use route and the east and west bound lanes of the highway are divided by the barriers.

iv. Noise walls:

In Medina, workers built 1,600 feet of noise walls along the north and south sides of the bridge to lessen traffic noise in the surrounding regions.

v. Ballasts:

75,000 tonnes of ballast rock are placed within pontoons to ensure that they float at the proper height.

vi. Fire safety systems:

Firefighters can put out a fire on the bridge with the use of pipes, hydrants, and pumps installed for the fire protection system.

III. CONCLUSION

It is obvious that the SR 520 Floating Bridge needs to be replaced due to the rising traffic, regular road closures and repairs, insufficient earthquake resistance design, and more. Due to Lake Washington's poor soil characteristics, large width, and depth, a floating bridge must be chosen. The SR 520's highway was supported by a variety of concrete pontoons, and extra care was taken to guarantee that none of the pontoons' structural integrity was jeopardised by cracking. Seattle's people should be able to use the new bridge and any necessary additions should be simple to implement.

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