

I-5 Immersed Tube Tunnel

Washington and Oregon should evaluate an immersed tube tunnel for the Columbia River I-5 Crossing. In 2006, the states considered 23 river crossing options, including an unrealistic deep bored tunnel. Amazingly the design of a proposed immersed tube tunnel from Vancouver, WA to Hayden Island, OR was never evaluated. Only a few hundred miles north a solution to a new I-5 crossing was sitting under the Fraser River.

If you drive up I-5 to Vancouver Canada fifteen miles before you reach the city you will drive under the Fraser River through the George Massey Tunnel. Built in 1959 it was North American's first concrete immersed tube tunnel. An immersed tube tunnel was built because of the riverbed's deep sediment that could liquefy under bridge piers during a major earthquake. For 60 years four lanes of traffic have passed safely under the Fraser River. Today 80,000 vehicles a day use this tunnel. In 2006 the tunnel was retrofitted to withstand a 275-year earthquake. The tunnel is now beyond capacity and in a unanimous vote, Metro Vancouver's board of directors has backed a task force's recommendation to parallel the aging George Massey crossing with a new 0.6-mile eight-lane immersed tube tunnel, with six for vehicles, and two for light rail. Both a bored tunnel and a long-span bridge were considered but rejected.

Washington State has a long history of casting concrete boxes and using them to create floating bridges across Lake

Washington and Hood Canal. Similarly, concrete boxes can be cast and sunk to create a tunnel in the Columbia riverbed. This construction method would prevent worker injuries and possible deaths. A bridge would require thousands of dangerous man-hours working on the river, building cofferdams, piers, and trusses. The danger of working on the river is reflected in the Washington State workers' compensation rate of almost \$5/hour.

Governors Kate Brown and Jay Inslee agreed that seismic safety is the number one goal. High capacity public transit and additional vehicle capacity are numbers two and three. A bridge that can withstand liquefaction and accommodate rapid transit was estimated to cost \$3.4 billion in 2010. Construction inflation and right-of-way property price escalation could double the cost to \$7 billion by 2022. An immersed tube tunnel could save billions. It needs no costly piling and piers because liquefaction has little impact on an immersed tunnel. A tunnel would need less right-of-way acquisition. A tunnel also offers a simple and economical design for rapid transit (light rail or high-speed) and additional vehicle capacity. A tunnel could also be built faster and more safely than a bridge. The George Massey Tunnel was built in two years and two months.

In 1999 Sweden and Denmark built the Oresund Immersed Tube Tunnel connecting their countries. This 2.2-mile tunnel under the Baltic Sea has two high-speed rail lanes and four vehicle lanes. To increase capacity an immersed tube tunnel can be designed with any number of vehicle and transit lanes; 8, 10, or 12 without the complex

foundation and truss engineering and construction required by a bridge.

A two-mile elevated ten-lane freeway bridge, with 200,000 daily vehicles would have a negative visual and noise impact on the Columbia Riverfront. On and off-bridge ramps would extend more than half-mile into both Vancouver and Hayden Island. A tunnel will have no visual or noise impact on the river, have no elevated approach ramps, and be almost a mile shorter than a bridge. A new bridge could collapse if a bridge pier was hit by 14,000-ton barge tow. A tunnel will have no bridge piers.

A bridge will require trucks to climb a mile-long 3% grade, slowing freight mobility. A tunnel will have an initial 3% half-mile downgrade, allowing trucks to maintain or accelerate speed into the next uphill half-mile upgrade. A tunnel will also be safer to drive for both trucks and cars, protecting them from fog, wind, rain, and ice.

The 1999 Oresund Immersed Tube Tunnel links Malmo to Copenhagen. The 1959 George Massey Immersed Tube Tunnel links Richmond to Vancouver. Baltimore, Boston, Detroit, San Francisco, Norfolk, Hong Kong, Tokyo, Istanbul, Busan, and Sydney have all built immersed tube tunnels.

A Columbia River Immersed Tube Tunnel could link Washington and Oregon by 2027.