Pattullo Bridge Replacement Project

Bridge Design

How do we design a long-span bridge?

When you think of long span bridges, what designs come to mind? In Metro Vancouver, you may have come across many different types of bridges, including suspension bridges (the Lions Gate Bridge, opened in 1938), steel truss cantilever bridges (the Iron Workers Memorial Bridge, opened in 1960), through arch bridges (the Pattullo Bridge, opened in 1937), and more!

For the Pattullo Bridge replacement, engineers have designed a cable-stay bridge because it is best for this location.

Bridge type and size

Metro Vancouver is no stranger to cable-stay bridges. Driving around town, you'll notice that the Alex Fraser Bridge, Port Mann Bridge, Golden Ears Bridge, and the Pitt River Bridge are all various forms of cable-stay bridges.

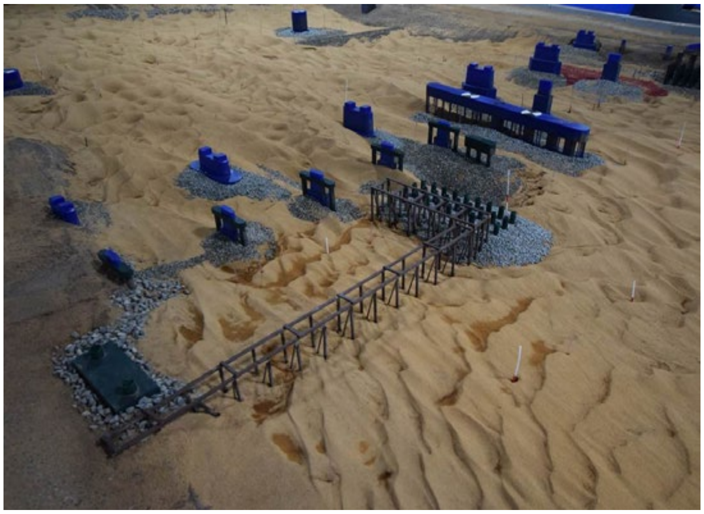
But the new bridge will be unique in its own way, with the bridge deck held up by 80 stay cables connected to a single tower. The tower is 167 metres high – the tallest bridge in British Columbia!

The entire bridge will be around 1,235 metres long, supported by two in-water and 10 on-land foundations (called piers and abutments). The cable supported section of the bridge, which spans over most of the river, is around 570 metres long.

Why this design?

River hydraulics: River hydraulics is a science that looks at how water flows. The new bridge is being built at one of the narrowest places along the Fraser River, and this means that water travels quickly here and the riverbed moves around. When we build bridge piers in the river, we could change the way the river sediment moves and how the water flows. That's why it is important to minimize the number of piers in the river.

The best way to check if the new river hydraulics are safe for boats and nearby structures is to build a scaled model and run engineering tests. And we did just that! We built a 1:80 physical model of the river channel and bridges and ran different flood scenarios.



Physical model of riverbed and piers.

The physical model used crushed walnut shells to simulate the riverbed. When water flowed through the model, we could see how the new bridge piers changed the water flow and riverbed. We completed 38 tests on the physical model of the bridge piers and temporary construction platforms.

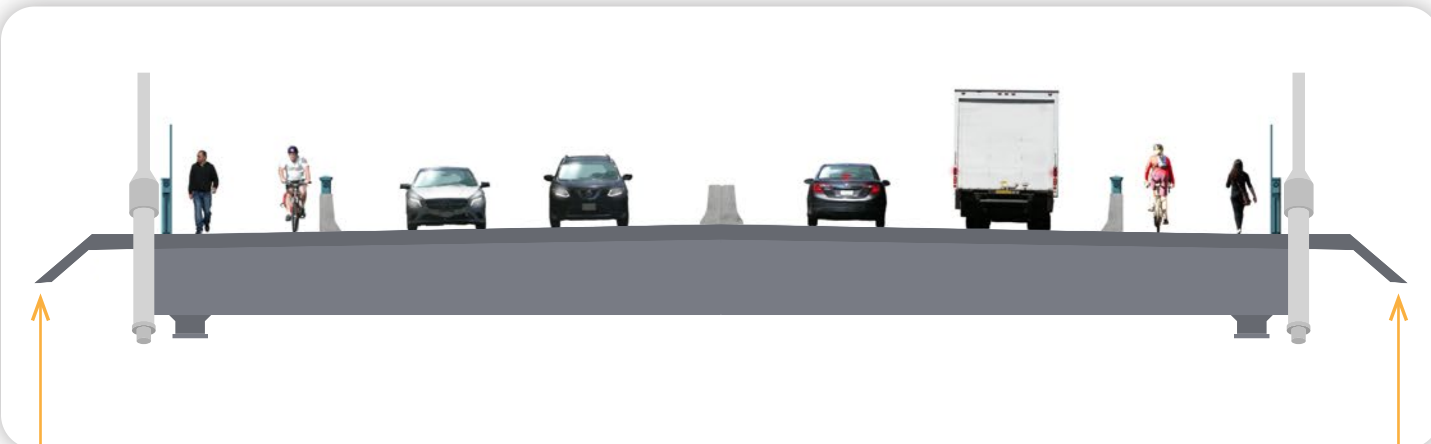
Snow and ice protection: the H-shaped tower means cables will not cross over travelling lanes. This design will help manage snow and ice on the cables from falling on travel lanes. Each cable will also be fitted with a snow removal system like the one on the Port Mann bridge.

Click here to watch a video about how the snow removal system works.

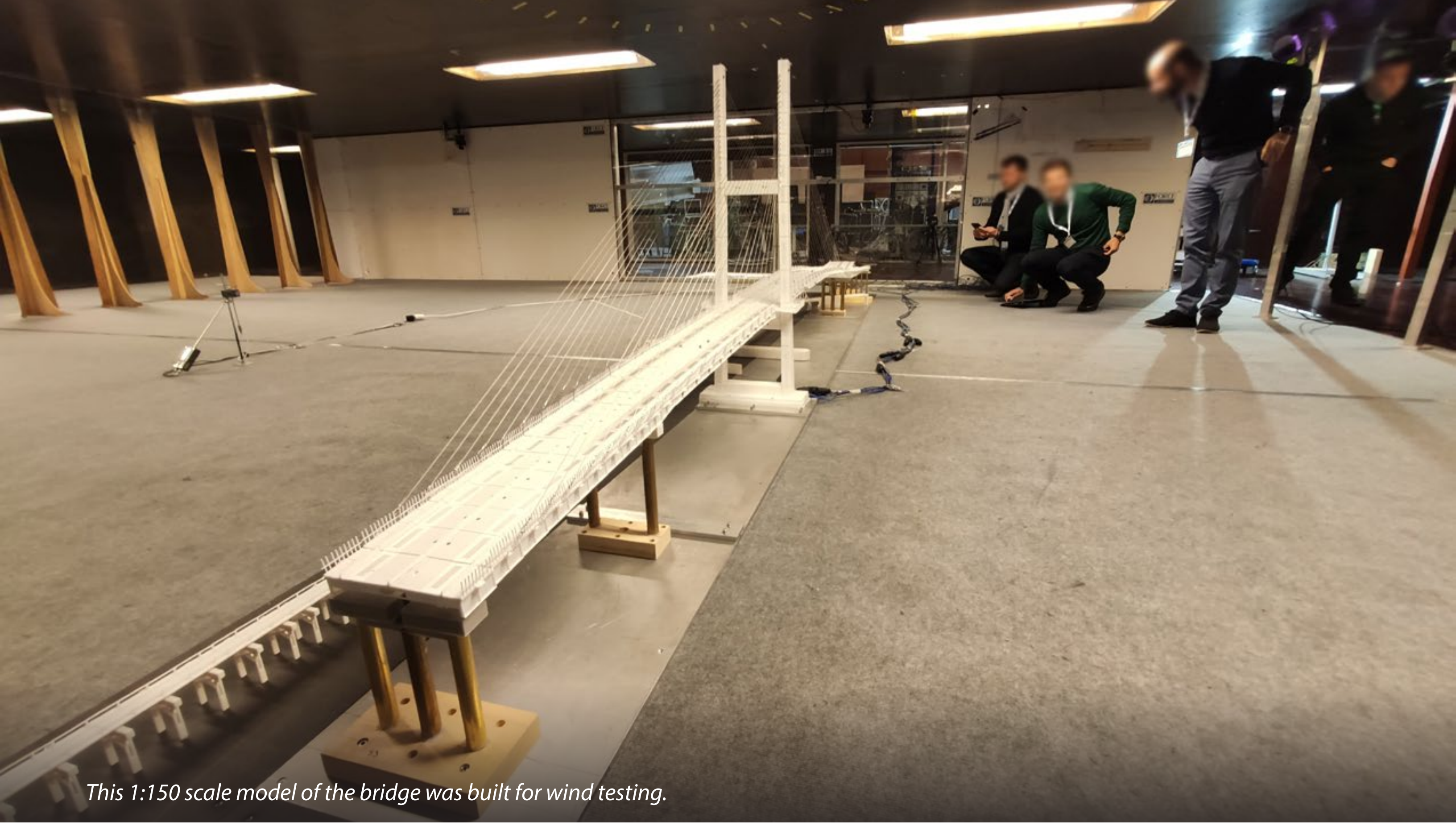
Environment: the cable stay design only has two piers in the river. This means less impact for fish because less time is spent on construction in the river and it is easier for fish to pass through the area. The less we build in the river, the better!

Aerodynamics – wind tunnel testing: it is important to perform wind testing during the design of the bridge.

Our engineering team built a 1:150 scale model of the new bridge for testing in a wind tunnel located in Copenhagen, Denmark. The results of the wind testing provided important engineering design considerations for the engineers, including the layout of the wind fairing that will be installed on the outside of the bridge deck.



Wind fairings are structures that attach to bridges to deflect strong winds.



This 1:150 scale model of the bridge was built for wind testing.

Seismic design: the new bridge is designed to be usable by emergency services after a major earthquake or disaster event, and usable by regular traffic after a minor earthquake. The design includes rubber bearings and devices to absorb movement during an earthquake. The new bridge will have different types of sensors which will enable engineers to monitor the overall health of the bridge and assess damage after an earthquake.

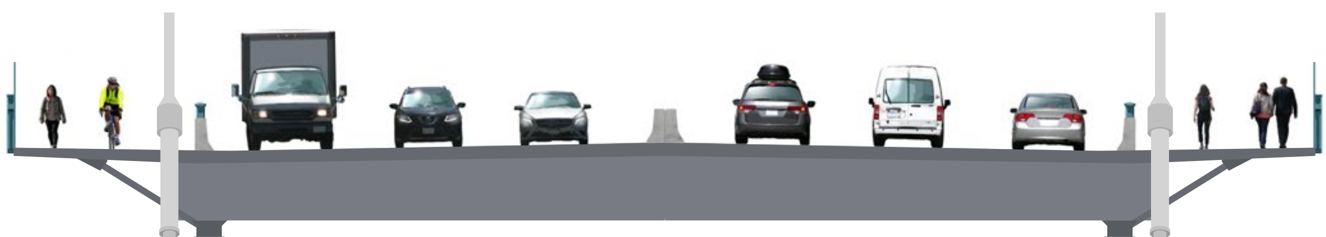
River traffic: the bridge is designed to be tall enough to let larger vessels pass beneath it. The open area under the bridge for ships to pass through is called the 'navigation protection zone'.

The existing Pattullo Bridge has six piers in the river, which are obstructions to boats. The new bridge has just two piers in the river. This can allow larger vessels underneath and make it possible to ship things on the Fraser River.

Vehicle traffic and active transportation: the new bridge is just upstream of the existing bridge and connects into the existing road network. It will be a safer crossing for drivers, with wider lanes and a centre median barrier. It will also be safer for people who are walking, cycling and rolling with pathways that are separated from traffic by a barrier.

Potential for future expansion: when the new bridge opens in 2025, it will have four vehicle travel lanes, plus a path for pedestrians and cyclists on each side. The bridge was designed so it could be increased to six lanes in the future if needed. To make room for the extra vehicle lanes, a new pedestrian path would be added to each side of the bridge.

2025: four lanes



Potential future expansion: six lanes