ENGINEERING MARVEL

THE ESHIMA OHASHI BRIDGE

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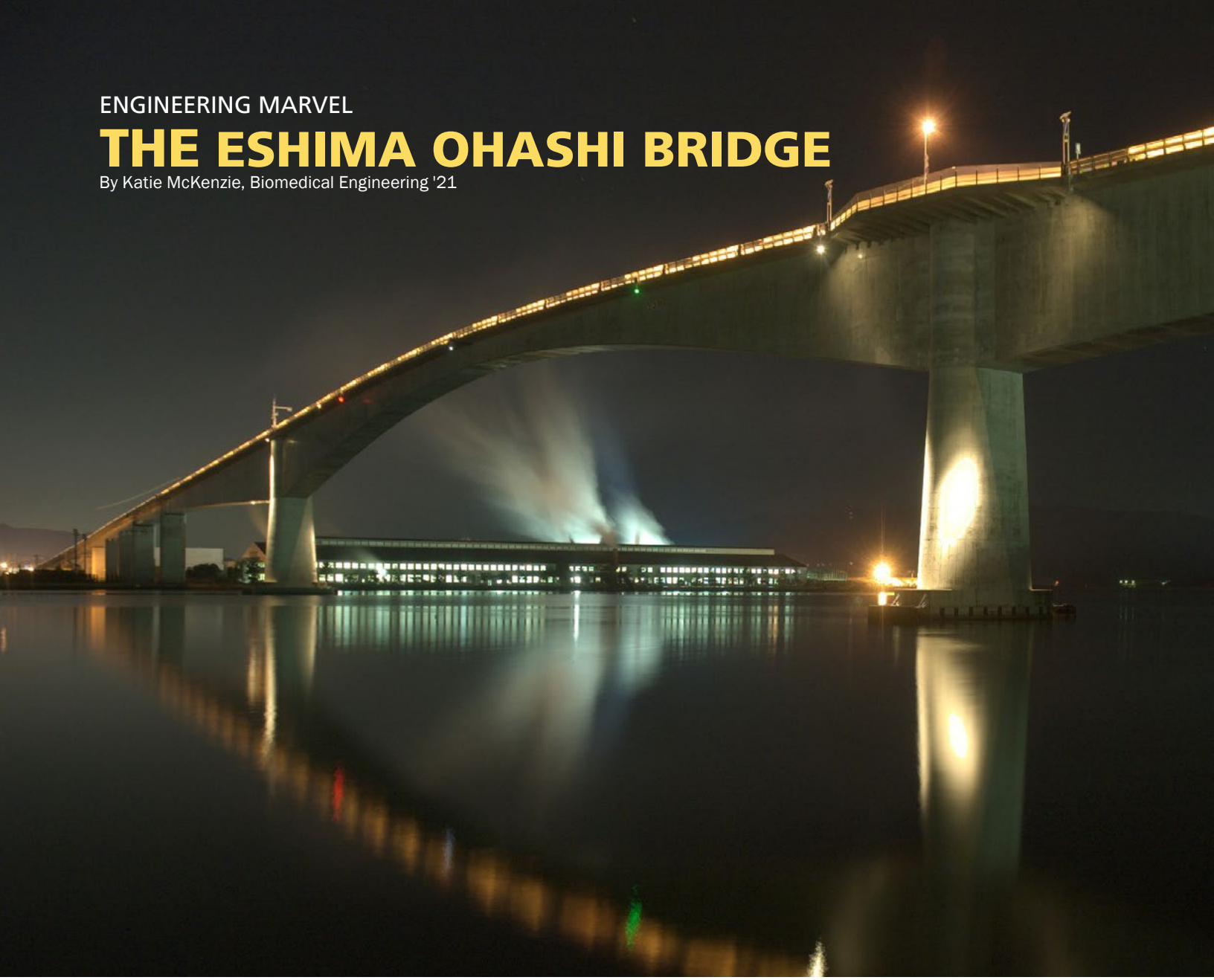

The Eshima Ohashi Bridge rises like a rollercoaster over the Nakaumi lake, connecting Matsue and Sakaiminato in Japan.

In a world where amphibious cars are not available on the mass market, humankind still relies on bridges to cross non-oceanic bodies of water. When civilizations first started growing in Mesopotamia, bridges became the go-to aid for crossing obstacles like rivers. The ancient Romans revolutionized bridge building when they learned that ground-up volcanic rock makes great mortar. After that discovery, the Romans were able to build better structures than ever before. Their discovery of arches allowed them to build lighter bridges able to support heavier loads. Yet, after the fall of Rome, the growth of bridge architecture slowed. Growth rates were renewed with the use of rope suspension and cast iron as construction methods. Then, when iron lacked the tensile strength desired, the use of steel rose to prominence. It was during this era of revolutionary architecture that the Eshima Ohashi Bridge in Western Japan was conceived.

When construction finished in 2004, the bridge crossed Lake Nakaumi and connected the cities of Matsue and Sakaiminato which are in Shimane Prefecture and Tottori Prefecture, respectively. Often called the Rollercoaster Bridge, because when looking at the incline from the road before the bridge, it appears as if cars are traveling to the precipice of a rollercoaster drop before disappearing over the edge. The bridge spans roughly a mile and was designed, at forty-four meters tall, to ensure that ships could pass beneath it.

As one of the largest fishing towns in Japan, Sakaiminato is famous for tuna and crabs and boasts some of the largest annual hauls of seafood in the nation. When the drawbridge was in use, it was extremely inconvenient for car travelers, as a multitude of ships passed to and from the port every day. The Eshima Ohashi replaced a drawbridge that would halt traffic every time a ship needed to pass. Without it, traffic stuttered at best.

The Eshima Ohashi Bridge is a rigid-frame bridge. Also known as Rahmen Bridges, these structures were first used in Germany in the early twentieth century, combining previous architecture techniques to use materials more efficiently than bridges of previous styles. Although they perform well at moderate span, rigid-frame bridges are more difficult to design and construct than other types of bridges. These bridges connect the superstructure and substructure into one complete unit. The superstructure is the area of the bridge that encounters the load being applied to it. The substructure is the portion of the bridge underneath the superstructure that creates the support of the bridge all the way to the ground. The internal connections within these two structural regions are rigid, which allows for the transfer of the bending moment, axial forces, and shear forces.

The allowance for the passage of ships causes the steep incline of the bridge. Yet, with respect to this bridge, steep is a relative term. On the Tottori side of the bridge, the gradient is 5.1 percent. The Shimane side of the bridge has a 6.1 percent gradient. This means that, in the case of the Tottori portion of the bridge, for every 100 feet traveled horizontally, the commuter also travels 5.1 feet vertically. For reference, the gradient of a standard U.S. Interstate on-ramp is somewhere between 3 and 6 percent, depending on the design speed of that stretch of road. So the grade of the bridge is not insanely large. The steepness of the incline has more to do with the length of the bridge and the fact that it is a bridge and not the ground. Despite this, people suffering from gephyrophobia, or fear of bridges, are still deeply intimidated by this bridge which looks as if it has a 45 degree incline.

Despite not being as extreme as some images make it out to be, this bridge is still very large as far as rigid-frame bridges go. It is the largest rigid-frame bridge in Japan and the third-largest in the world. One of the reasons the steep incline came into the world's limelight is because a company used the bridge in an ad that aired in 2015. The Daihatsu Motor Company made a commercial centered around their Tanto minivan that drove across the steep incline of the Eshima Ohashi bridge to show the durability of the vehicle. A lot of the angles the company used emphasized the optical illusion that made the roadway look like an insurmountable climb. Although this effect was primarily that of cinematic illusion, the commercial made the humble minivan look rather strong.

When engineers first conceived the plan for the Eshima Ohashi bridge, did they consider the media attention it would gain? Although most of the attention surrounding this structure is due to an optical illusion achieved by wide-angle shots from a camera, the bridge is still a work of art. Its construction is the culmination of thousands of years of waterway crossing innovation.