Bridges and Wheels, Tricycles and Squares

Tucked underneath the Cody Dock Rolling Bridge in London, you’ll find an unusual curved track. It swoops down, then up, then down again in a smooth wave. Resting atop the track is the bridge itself — a flat base, flanked by two large squares of steel and concrete through which pedestrians and cyclists enter and exit.

Wait around for a boat to come by, and you’ll learn the purpose of this strange setup. Powered by a hand crank, the bridge rolls upside down along the track, balancing on the top edges of those two square portals. With the base of the bridge now sitting high above the water, there is room for a boat to float below.

The Cody Dock Rolling Bridge is a recent and ambitious example of a “square wheel” that rolls without any slipping or jarring bumps. The curved track enables the smooth ride by keeping the center of the bridge level as it rolls. To do this, it follows a shape called a catenary, described by the mathematical formula:

\[
\frac{e^x + e^{-x}}{2}
\]

Square wheels also live west of the Atlantic. The Exploratorium in San Francisco hosts a square wheel exhibit. Inspired by this, the mathematician Stan Wagon enlisted his neighbor Loren Kellen in building a square-wheeled tricycle and catenary track in 1997. For years, you could ride the tricycle at Macalester College in St. Paul, Minnesota. The National Museum of Mathematics in New York also has square-wheeled tricycles that can be ridden around a circular track.

References:

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