Civil engineering industry

British Waterways

Slewing bearings

Large diameter seals

Sealed spherical roller bearings

Prestigious water wheel relies on large SKF bearings

Slewing bearings and large diameter seals from SKF were chosen to support the Falkirk Wheel, a giant rotating boat lift, which transfers boats between the two canals, over a vertical gap equivalent to the height of eight double-decker buses.

The Falkirk Wheel, which is located close to the Scottish town after which it is named, is the only structure of its kind in the world. It is the centrepiece of the Millennium Link, a £78 million project led by British Waterways, which reopens and reconnects the Forth and Clyde Canal, and the Union Canal between Glasgow and Edinburgh. The wheel measures 35 m in diameter, with an axle length of 28 m.

Up until the 1930s, the two canals were linked by a series of 11 locks. However, with less and less commercial traffic on the inland waterways, the locks fell into disrepair and were eventually filled in. As restoring the locks proved unfeasible, the idea of connecting the canals via a rotating boat lift was put forward and was originally conceived as a giant ferris wheel with suspended gondolas.

The final design, however, evolved over the years of planning into the radical structure that is now in operation.

Situated in a natural amphitheatre, the wheel takes the shape of a Celtic-inspired, double headed axe, in which two axe-shaped arms rotate in a continuous circle, 180 degrees at a time. It simultaneously lifts and lowers two 22 m long caissons which each hold a payload of 300 tonnes, comprising of water and up to four boats. The wheel uses a series of synchronous gears to keep the caissons horizontal.

Butterley Engineering, of Ripley, Derbyshire, won the contract to build the wheel and its engineering design consultant, Bennett Associates of Rotherham, Yorkshire, invited SKF to provide a new bearing solution. To support the wheel, SKF developed a solution which uses a pair of purpose-designed, four metre diameter, three row, slewing bearings, one positioned at either end of the wheel, with outer rings bolted to the support structure and inner rings bolted to the arms.

The inner ring of one of the bearings is equipped with gear teeth to transmit the drive to the wheel. Each slewing bearing has three rows of cylindrical rollers, one for the radial load and two with smaller rollers for the axial loads.

The use of the slewing bearings was an unusual solution, as these bearings are normally used in applications with heavy axial loads, such as those encountered in the rotational movement of large cranes. However, SKF specially designed these slewing bearings to be positioned on a horizontal axis and to cope with the specified combination of radial and axial loads. When the wheel is fully loaded, it weighs 1,800 tonnes, which results in a radial load of 9,095 kN per bearing.

The wheel is rotated by ten hydraulically driven gearboxes, via the geared slewing bearing. It turns at a rate of approximately 0.125 rpm, which sees it lift and lower boats at an average rate of 4 m per minute. With consideration given to the time taken for loading boats, the wheel is expected to complete a half turn about once every 15 minutes. The very low friction torque of the SKF antifriction bearings means that a rated torque of only 2972 kNm is required to rotate the wheel.

The bearings were supplied with their own integral seals and have been designed to have a life expectancy of 120 years. Furthermore, SKF also supplied additional seals of 4 m and 2.5 m diameters, specifically designed to withstand the conditions found in heavy-duty applications and, in this instance, able to virtually guarantee the prevention of any ingress of water, increasing reliability further.

In addition to the slewing bearings, SKF also provided cross roller bearings to support the idler gears, which will keep the caissons level at all times. The caissons themselves will run on a wheel arrangement on circular rails, with each wheel mounted on two SKF sealed spherical roller bearings.

Jim Stirling, Director of British Waterways, Scotland, which co-project managed the construction, is proud of the final design that SKF engineering knowledge has contributed to, *'We always said that the Falkirk Wheel should be something special, we wanted to create something elegant that people would want to come and see. The wheel is a symbol for Scottish innovation and ingenuity as well as a unique, thrilling experience for visitors'.*

Large diameter seals

Sealed spherical roller bearings

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