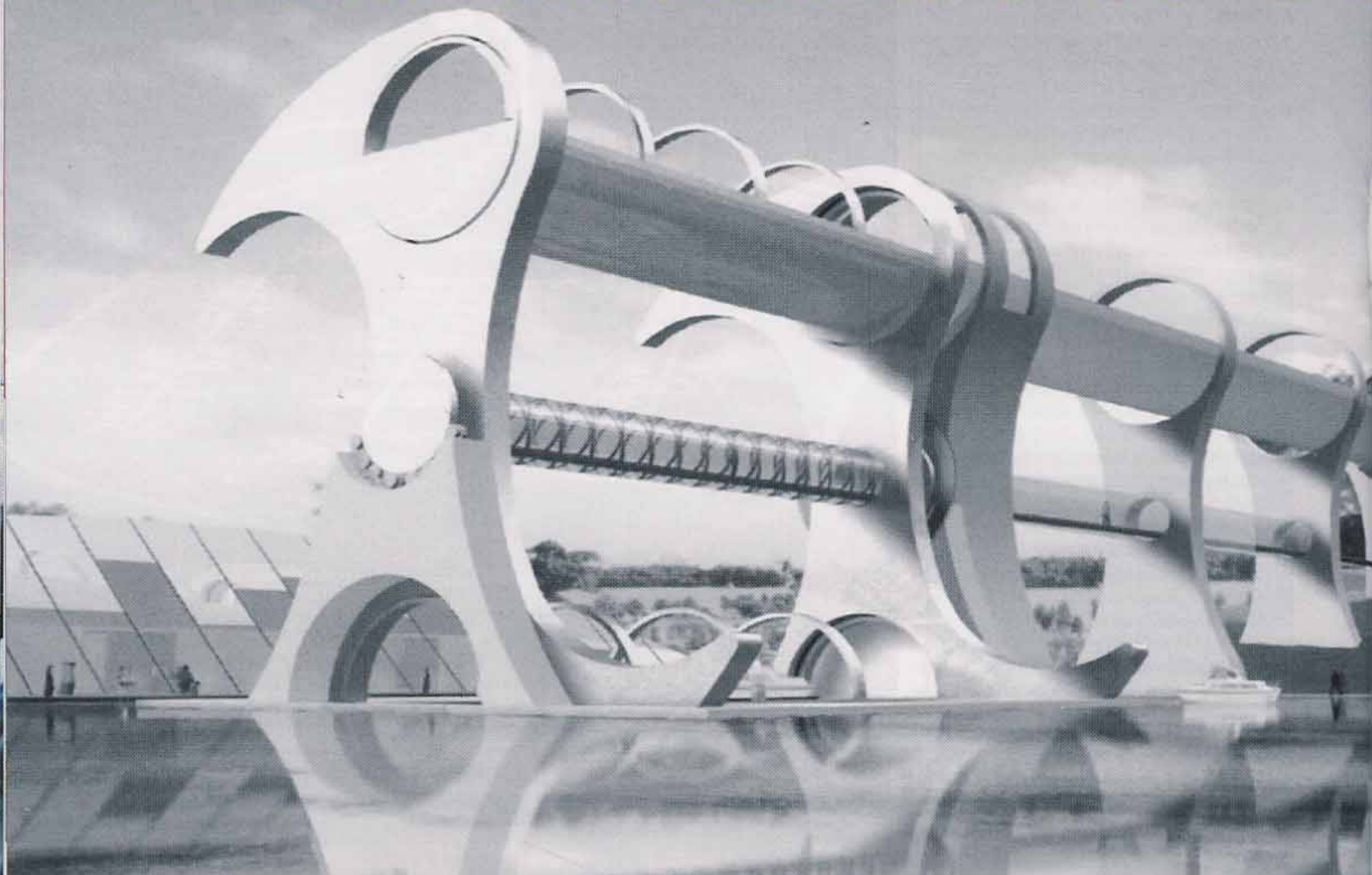


# A Landmark For Scotland



It's 35m in diameter, has an axle length of 28m and will simultaneously lift and lower two 22m caissons, each of which can carry 300-tonnes – it's THE GREAT WHEEL OF FALKIRK

**W**e always said that the Falkirk wheel should be something special; something elegant that people would want to come and see. The wheel will be a symbol for Scottish innovation and ingenuity as well as a unique, thrilling experience for visitors," said Jim Stirling, director of British Waterways, Scotland, who had the wheel built.

The only structure of its kind in the world, it's the centrepiece of the *Millennium Link*, a £78m project led by British Waterways that reopens and reconnects the Forth & Clyde Canal and the Union Canal between Glasgow and Edinburgh. The wheel's job is to transfer boats between the two canals near the town of Falkirk – bridging a 32m vertical gap between them.

Up until the 1930s, the two canals were linked by a series of 11 locks, but with the canals' demise the locks fell into disrepair and were eventually filled-in. As a result, the idea of connecting the canals via a rotating boat lift was put forward – originally conceived as a giant Ferris wheel with suspended gondolas. The final design has evolved over the years of planning into the radical concept that's now a reality – and for many Scots, already a new national landmark.

## DESIGN

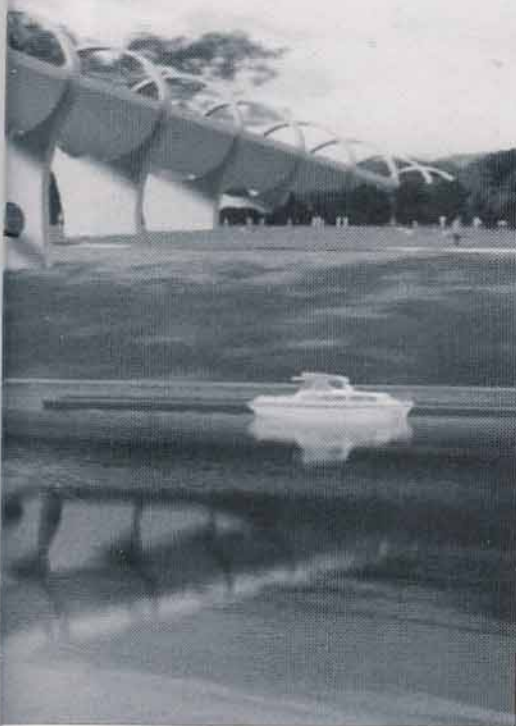
The wheel is the result of collaboration by several designers led by the *Morrison Bachy Soletanche Joint Venture*. It follows on from the much-acclaimed initial design by

Dundee architects *Nicoll Russell Studios* and the exemplar designs by engineers *Binnie Black and Veatch*.

Situated in a natural amphitheatre, the wheel itself is considered to be a form of contemporary sculpture and is endorsed as such by the *Royal Fine Art Commission for Scotland*. It's Celtic-inspired shape is that of a double-headed axe, in which two axe-shaped arms rotate in a continuous circle, 180-degrees at a time. The two caissons can each hold up to four boats (or 300-tonnes of water) and use a series of synchronous gears to positively keep the caissons in the horizontal plane.

*Butterley Engineering* of Ripley, Derbyshire, won the contract to build the wheel – and their engineering

# otland



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.

Slewing bearings are an unusual solution – they're normally used in applications with heavy axial loads, such as those encountered in the rotational movement of large cranes. *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 – fully laden, the wheel weighs 1800 tonnes (a radial load of 9095-kNewtons per bearing).

## How It Works

The wheel's rotated by ten hydraulically driven gearboxes, via the geared slewing bearing, and turns at a rate of around 0.125 rpm – which sees it lift and lower boats at an average rate of 4m 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.

In operation, the wheel will be maintained at close to perfect balance:

- With the caisson and the canal watertight doors open for loading & unloading, water levels in the caissons will depend on the level in the canals – any vessel that enters a caisson will automatically displace it's own weight of water back into the canal and thus have no net effect.
- When the caisson and canal watertight doors are closed, a pump system's used to equalize water levels in the caissons and establish near perfect balance.

The wheel drive system has, of course, been designed to handle a degree of imbalance due to differing water levels in the caissons, but even allowing for this, the very low friction torque of the bearings means that a rated torque of only 2972kNm is required to rotate the wheel.

Even though the bearings come with their own integral seals and have a life expectancy of 120 years, *SKF* also supplied extra 4m and 2.5m diameter CR seals – designed specifically to withstand the conditions found in heavy-duty applications – to virtually guarantee the prevention of any ingress of water.

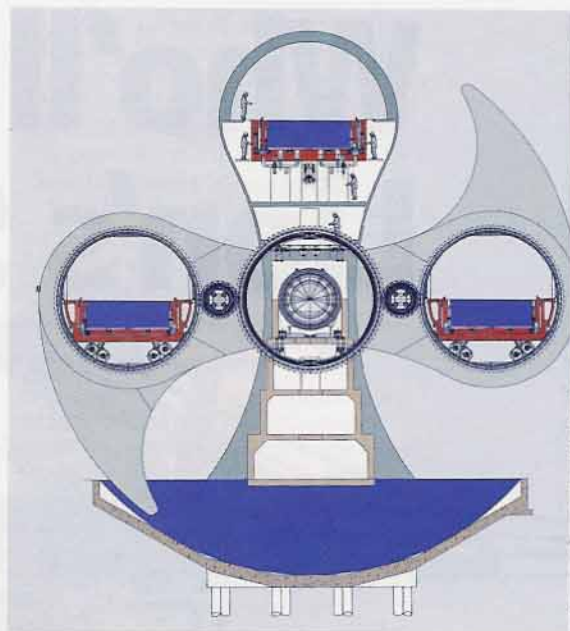
*SKF* has also provided cross roller bearings to support the idler gears, which will keep the caissons level at all times, plus sealed spherical roller bearings which the caissons themselves run on.

## FINALLY

As the centrepiece of the Millennium Link, the Falkirk Wheel is part of the largest canal restoration project currently underway in the UK. It will see the removal of over 30 obstructions on the Forth & Clyde, and Union Canals to make the 200-year-old waterways navigable once more.

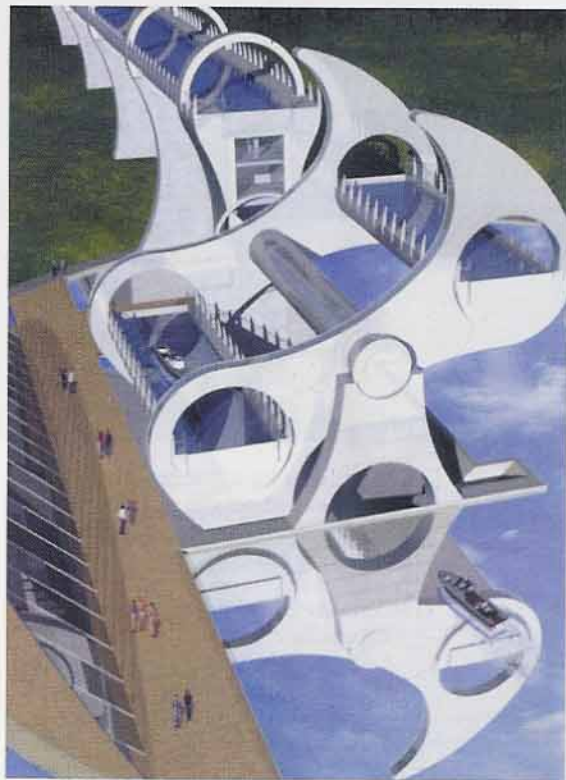
And this is just the beginning of the story.

It's expected that over the coming



▲ The wheel uses a series of synchronous gears to positively keep the caissons in the horizontal plane

In the shape of a Celtic-inspired, double headed axe, the wheel is expected to complete a half turn about once every 15 minutes ▼



years, the regenerated network will attract increasing numbers of boaters and visitors to the area with the waterways acting as a catalyst for further economic regeneration and the revitalisation of communities across central Scotland.

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