

## Begnagh Bridge

### Longford, Republic of Ireland

Begnagh Lift Bridge is the first moveable bridge to be completed on the Shannon Canal in the republic of Ireland. It has been designed and constructed to be a completely unmanned installation, which has provided many challenges to the design team.

The deck is a concrete structure, designed by the client, which is lifted by a series of four hydraulic cylinders acting at each of the four corners. The deck is of trapezoidal shape, which means that each cylinder has a slightly different load as the deck lifts. As the deck is of concrete construction, there is little margin for error in deck twist, otherwise cracking of the deck could occur.

In order to achieve unmanned operation, the bridge detects approaching crafts automatically. This is achieved by a pair of laser scanners mounted on each approach to the bridge. The scanners, and associated software, detect large objects moving towards the bridge and notify the bridge PLC controller.

Upon receiving notification, the control PLC notifies the boats that they are detected using matrix signs. It also switches on the approach wig wags to notify road traffic that the bridge is about to lift. In sequence, the road is closed, barriers lowered and the bridge raised. When raised, the boats are allowed to proceed by navigation traffic lights. After the boats have passed, the bridge is lowered and the road barriers lifted.

To operate without a bridge operator, many safety functions, with SIL ratings between SIL 1 and SIL3, have to be carried out automatically. To achieve this, safety laser scanners are positioned at each side of the bridge to monitor objects approaching the structure, and to check that the bridge is clear before starting to lift. Likewise, barrier proximity sensors and a light curtain under the bridge protect these zones.

These input devices are processed by a safety PLC to achieve all safety functions. The use of a safety PLC greatly simplifies the installation, particularly as all of the sensors have to be muted at various points in the process.

The safety PLC also monitors the position of all four cylinders, and uses these measurements to mute the other input devices, and also check for twist in the bridge. Four twist criteria are set up within the bridge specification. If any one of these four are breached then the bridge stops with a safety function integrity of SIL 2.

The use of a safety PLC rather than hard wired logic also produced a secondary advantage. As all of the control systems are under the control of the PLC, then logic can be used through each form of control, even manual pendant control. This proved useful as the hydraulic powerpack is located approximately 50m away from the bridge. The resulting oil compressibility of approximately 30mm is significantly greater than the allowable misalignment of the two master cylinders of 7mm. This problem was overcome by using feedback control on the cylinders, but also ensuring that the system was pre-pressurised before attempting any movement to allow the feedback systems to work. Keen observers will therefore see a slight lift of the bridge before any lowering cycle. However, the cylinders will always remain totally aligned as a result.

Bennett Associates (originally founded in 1984) was acquired in 2008 by Atkins; bringing their proven technical expertise to the UK's leading engineering consultancy.



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