Application note
ABB industrial drives in bridge control systems

A typical movable bridge which benefits from AC drives used with the bridge control system.

Application principle

At the heart of bridge control systems are AC drives that feed power to the electric motors which drive the span or deck of the bridge and control the bridge's mechanical disk or drum brake.

Low voltage AC drives are increasingly being used on a variety of movable bridges, either as part of a new build or as part of a refurbishment or renovation program and tend to replace hydraulic drives or DC drives operating with DC motors.

The drives control the speed of the electric motors that are used to either lift or turn the deck around its axis. They can positively control the speed of an AC motor when the motor is being driven, or back-driven or overhauled, such as when a span heavy bascule or vertical lift bridge is being lowered.

Benefits of using AC drives

The ABB industrial drives range extends from 0.55 kW to 5600 kW and provides smooth, stepless, variable speed and torque control for motors used on movable bridges over a wide range of operating speeds and loading.

The drive features the motor control platform, direct torque control (DTC), which allows accurate control of speed and torque with or without pulse encoder feedback from the motor shaft. The control program utilizes DTC to provide accurate slow speed control with high torque levels.

Master-follower for motors working together

When several drives are connected to the same machinery, the master-follower arrangement can be used. This is where one of the drives operates as master to the other drives. It allows co-ordination and load sharing for different kinds of motors connected to the same system.

Within bridge applications there are two common master-follower control methods.

Master speed, with follower in torque control mode: If two motors are connected to each other via a mechanical shaft, for instance when two motors are lifting opposite sides of a bridge at the same time, then the master drive is speed controlled. This determines how fast the bridge raises or lowers. The follower is torque controlled which results in the load being shared exactly between the master and follower.

Master speed, with follower in synchro control mode: If two motors are not connected to each other, such as when the bridge is designed for each motor to work independently in raising or lowering the bridge, yet at the same time, then the master is speed controlled. This determines how fast the bridge raises or lowers. In this instance, the follower is

operated in synchro mode to enable symmetrical lifting. This means that the two parts of the bridge are synchronized to lift at same time and at the same angle.

Symmetrical lifting with synchro control

Often the drives on either side of the bridge need to be perfectly synchronized when raising the bridge. To ensure a good accuracy, a standard incremental encoder can be used to feedback the deck position with respect to each variable speed drive. The encoder is essential in synchronizing the drive, based on the position of the master as measured by the encoder.

The solution to the accurate, synchronized control lies within a special application program for ABB industrial drives. The program features synchro control, which, when operating together with DTC, provides the required level of synchronization. Synchro control can be used on a system with one master and up to four followers.

Electric motor mechanical brake control and torque memory

The control program features an integrated brake control logic which in turn utilizes torque memory and pre-magnetizing to open and close the mechanical brake safely and reliably.

The mechanical brake may be inside the motor (disk brake) or outside the brake (drum brake). Alternatively both can be used at same time for additional safety.

The brake control logic within the drive includes a function which enables the drive to hold the shaft stationery until the mechanical brake takes over.

Safety control

The ‘slow down’ safety control function limits the speed to a pre-set level in critical zones. High and low limit sensors stop the drive at the end positions. The ‘fast stop’ safety control function is used in emergency situations.

Speed monitor and speed matching

The speed monitor function ensures that the motor speed remains within safe limits to prevent over speed. The speed matching function continuously compares the speed reference and the actual motor shaft speed to detect any possible difference. One of these functions will stop the motor immediately if a fault should occur in the operation of the motor.

Adaptive programming

Function block programming - known as adaptive programming - eliminates the need for an external PLC and enables the user to integrate external control logic, create new functions or to modify existing logic, so the software can be customized quickly and easily, such as variable ramp times during the opening cycle of a bridge.

For more information please contact:

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