

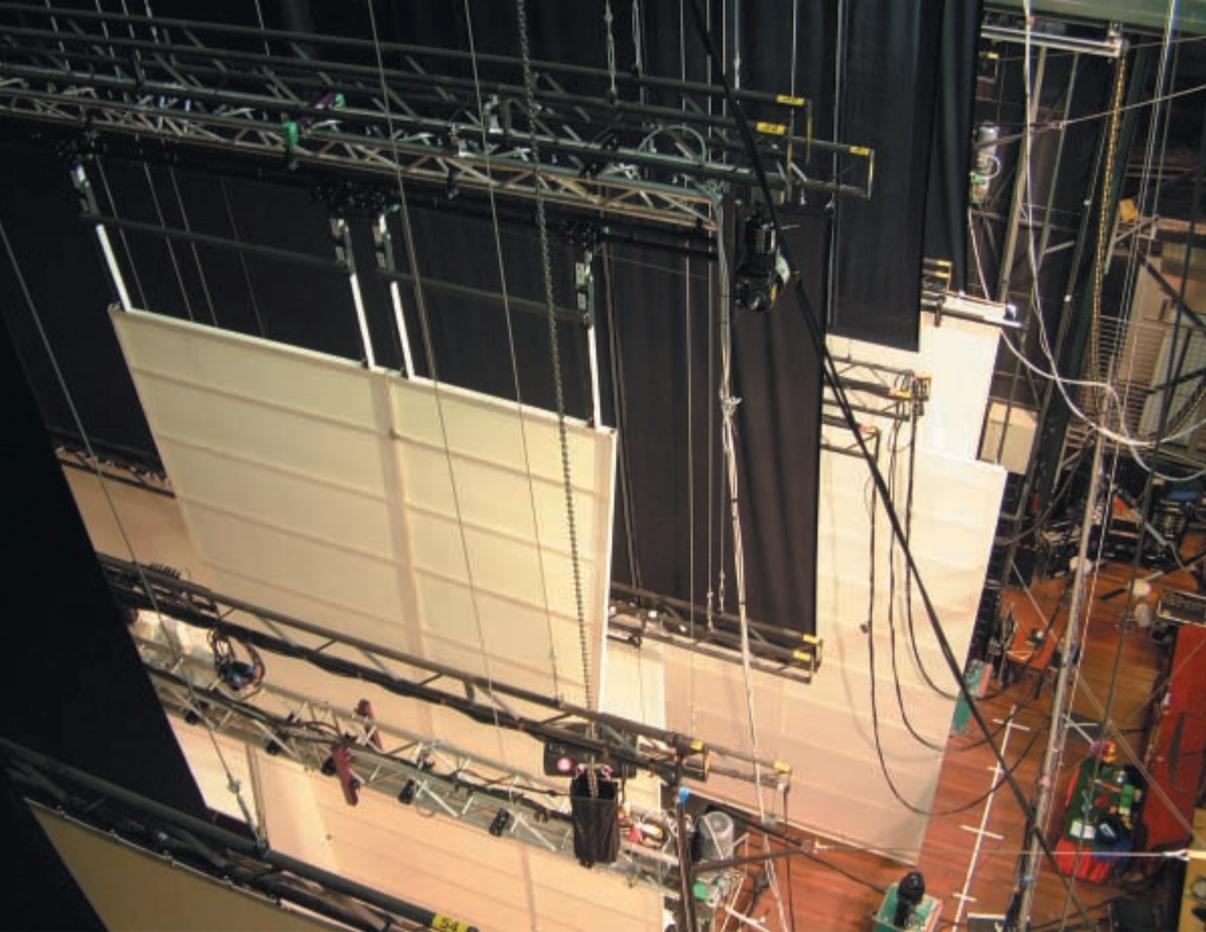
Complex theater technology with PC-based control

# The new, fully-automated Carré Theatre



→ The theater world is an extremely lively market. Continuously changing safety regulations and standards pose a significant challenge for suppliers of theater technology. Stakebrand Technische Toneelinstallaties, a long-established Dutch company, decided to implement a new stage technology concept: Control systems for stage curtains and pulleys at the Carré Theatre in Amsterdam and the Twentse Schouwburg in Enschede are PC-based throughout.





At the Carré Theatre in Amsterdam, CX1000 Embedded PCs control the stage curtains and pulleys.

Stakebrand has been dealing with theater technology for a long time. As early as 1902, the great-grandfather of the current company owner, Han Stakebrand, supplied theater technology for the Carré Theatre. Last year's modification project was the fourth refurbishment of the Carré Theatre carried out by Stakebrand over the years. This latest refurbishment became necessary due to various new occupational health and safety laws and regulations. It was used as an opportunity to rethink the control concept. "The Twentse Schouwburg and Carré projects were 'development laboratories' for our new control concept, as it were," Thomas Nagels from Stakebrand explained. "With confidence in the technology and a little courage, we used reliable drive and control components from Beckhoff, SEW, Hitachi and other companies."

At the Carré Theatre, Stakebrand designed, built and installed the traction gear, various pulleys and the complete control concept. The traction gear is the equipment supporting the different curtains and backdrops. Objects can be raised or lowered via pulleys. The motors and pulleys are now controlled centrally via an Industrial PC.

#### Real-time Ethernet control

A glass fiber Ethernet ring with three intelligent switches was installed in the building. Should one line fail, a different switch will take over. Each switch is connected with three C5102 Industrial PCs from Beckhoff: Two PCs deal with control tasks, the third one monitors the complete system. Thomas Nagels explained: "All of the CX1000 Embedded PCs from Beckhoff control the traction gear, motors and pulleys in real-time. At the same time, large data quantities have to be read from a database in which all motor and position combinations are stored. This database contains the complete show. The associated data traffic runs over the normal Ethernet network."

The Carré Theatre features five operating stations, each of which is equipped with a range of operator control elements, a Beckhoff Control Panel, a C6320 series Industrial PC and a BK9000 Ethernet Bus Coupler with various Bus Terminals. The BK9000 communicates with the PC Control via real-time Ethernet.

The signals for the traction gear are transferred to a CX1000 controller via an intelligent switch. Jurjen Verhoeff, support engineer at IAL, the Beckhoff Dutch distribution partner, explained: "The CX1000 is able to execute PC functions via Windows XP Embedded. The Soft PLC running on the CX1000 handles the PLC tasks, and the CX1000 can also carry out various motion tasks."

#### High-precision positioning of the stage curtains

Each driven motor with frequency converter is associated with its own CX1000. Via PROFIBUS, the CX1000 communicates with the frequency converter that directly controls the motor. Both the controller and the frequency converter receive feedback about the curtain position. "In this way positioning can be made even more precise than before," said Thomas Nagels. "In view of the height, which may be up to 25 m in some theaters, a tolerance of 1 mm is pretty accurate in our opinion. In fact, this is actually less than the amount of distance that the steel cables stretch during operation."

According to Thomas Nagels, the Beckhoff components have many advantages: "First of all, the Beckhoff system is flexible with regard to the choice of fieldbus. We currently use Interbus, PROFIBUS and Ethernet, and in future, probably CAN as well. In principle, it is irrelevant whether we use a separate PC for each motor or whether we use a central PC that controls everything. In this way we are very flexible when it comes to configuring the control systems. After all, each theater is different. Flexibility in terms of the different I/O Bus Terminals is another clear benefit. In the past, we had separate modules for load measurement purposes. Now we simply plug in another terminal, connect our resistor bridge, and voilà – load measurement for our system is dealt with. This is linked back to the controller, which then takes the load into account as appropriate: A heavily loaded cable will run more slowly."

"Like the stage curtains, the 58 pulleys are also controlled via the central network. Pulley control is grouped and distributed over four control cabinets, each of which is equipped with a CX1000. Three Bus Terminals are used for each pulley: One Bus Terminal provides the new tension group, the second one (with dig-



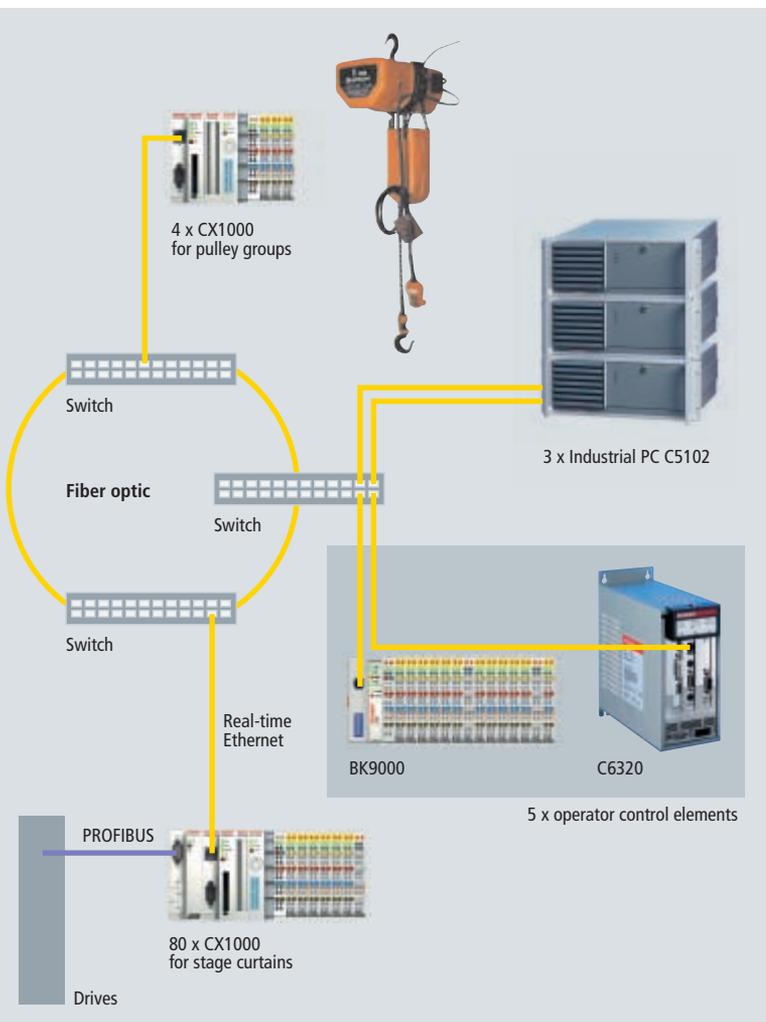
ital output) controls the pulley, and the third terminal (with digital input) provides feedback of the actual function of the pulley.”

“The system can be expanded at any time,” said Thomas Nagels. “If we install another pulley, all we need to do is insert three more Bus Terminals and enter a few parameters. The software automatically detects whether a pulley is present or not. Our installers can, therefore, commission and parameterize a complete system without a programmer.”

### Reduced development time

Stakebrand uses the TwinCAT automation software from Beckhoff as the basis of the control system. The system is superimposed by “Stalogic Centurion” operating software, which was developed in-house by Stakebrand. “We developed the PLC program for TwinCAT ourselves, but we still make use of a large number of standard function blocks, for example, for motion control purposes.” Integration with the PC is an important factor for Stakebrand: “The visualization software is based on standard platforms such as Windows XP. We were able to develop the pulley control system for the Carré Theatre very quickly.”

“The system was ready after only one and a half months,” Thomas Nagels said. “We can now integrate the pulleys in the Ethernet network wherever we need them, without having to lay control cables everywhere.” Building safety is a vital consideration for theatres. This makes the control system somewhat more complex than for other applications. “We placed a kind of protective layer over the control system in order to meet the different requirements,” Thomas Nagels said. According to Jurjen Verhoeff, the plan is to use the TwinSAFE system from Beckhoff in the long run. The TwinSAFE safety terminals can be integrated seamlessly into the Bus Terminal system. “This means in the future, we will no longer need a separate safety system.”



→ Stakebrand Technische Toneelinstallaties BV:  
[www.stakebrand.nl](http://www.stakebrand.nl)

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