

Flexible building control technology for KölnTriangle

Building automation reaches the highest level



→ With a height of 103 m (338 ft) and 29 floors, the “KölnTriangle”, officially opened on the 2nd of September 2006 and is one of the tallest buildings in Cologne. Due to its height, the building designed by architects Gatermann + Schlossig had become a political issue from the outset and attracted public attention because of its transparency and unusual ground plan in the form of a triangle with convex sides.

The aim of this extravagant project was to create an object of superlatives, and not only from the outside, but internally with state-of-the-art technology for high occupant comfort, flexibility and energy efficiency. The triangular shape of the KölnTriangle, in conjunction with its circular core, enables varying room depths with great freedom in the selection of office types: open plan and cellular offices or combinations thereof are possible. A total area of 640 m² (6,889 ft²) is available at each level. Deutsche Bahn and EASA (European Aviation Safety Agency) are among the largest building tenants at present. Levels 27 and 28 are designated for conferences and events. They offer breathtaking views and on level 28, all the stops were pulled in terms of building technology. The viewing platform on level 29 is open to the public.

To account for the differences in climate conditions, the southern side – which is exposed to the sun and prevailing wind – features a ventilated double-skin façade; single-skin façades are used on the north-western and southeastern sides. Gill windows complement the innovative, energy efficient concept of the building and provide natural ventilation. In the event of a fire, the windows would also serve as

smoke outlet. In this case the stairwell would be pressurized, so that fumes can escape through open windows.

Decision in favor of Ethernet

The first eight levels of the high-rise building are equipped with conventional installation technology; the higher levels feature Ethernet-based individual room control. EIB and LON networks were no problem for Innecken Elektrotechnik GmbH from Euskirchen, Germany, who had been commissioned to implement the whole electrical installation (high and low voltage) and deal with system integration. “With Ethernet TCP/IP as an integrated, network-based bus system we were able to meet all requirements of the building owner in a perfect manner. The bus system is characterized by speed and flexibility”, said Andreas Gröne, project manager for Innecken. One of the primary concerns of the client, Rheinische Zusatzversorgungskasse (RZVK), was fast and simple adaptation of the individual room controls to spatial changes. “In this building complex office reconfiguration is part of the daily routine. Thanks to integrated Ethernet net-



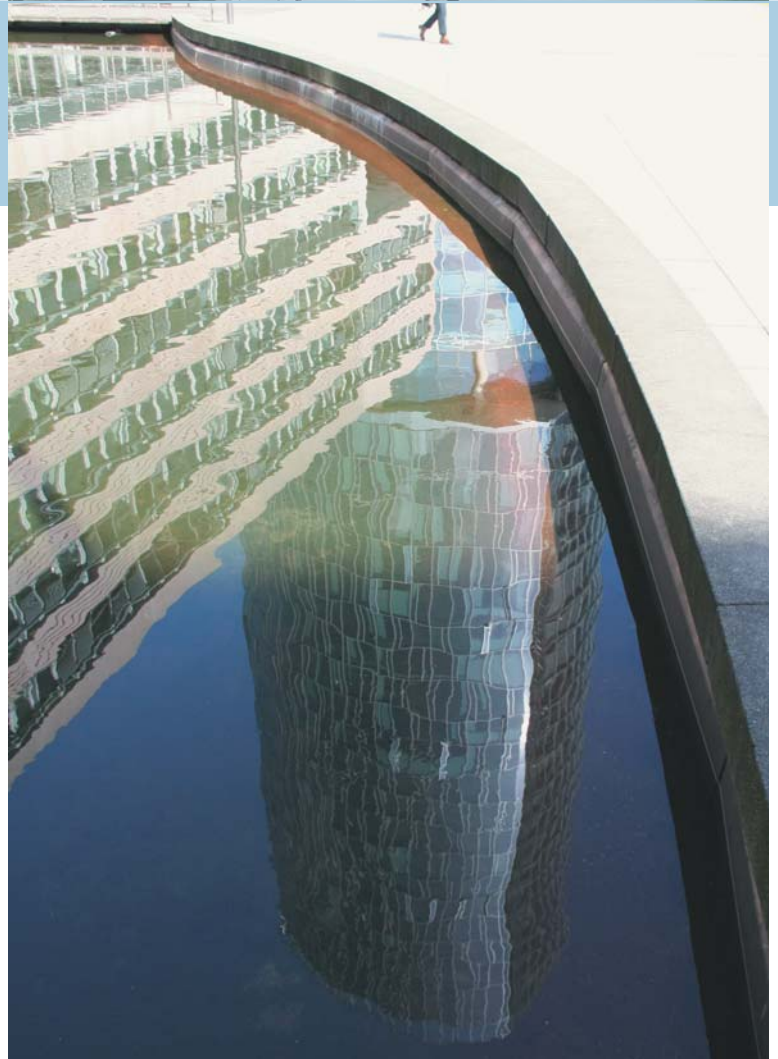
working we can adapt the associated technology very quickly and with minimal required effort.”

Reduced installation work

The Gesis connector system from Wieland Electric for the electrical installation and building automation further increased adaptability. At KölnTriangle, around 150 “Gesis Ran” distribution boxes are used for power supply and data communication at the individual levels. They are equipped and pre-wired with Beckhoff I/Os, thereby reducing the installation effort significantly. Hardware components can easily be added via plug-and-play and integrated or reconfigured at the software level via drag-and-drop.

PC-based control technology – from the basement to the roof

Four 19" C5102 plug-in PCs from Beckhoff (located in the server room on one of the upper floors of the tower) form the basis of the build-





Beckhoff products including four 19" C5102 rack-mounted PCs, a 19" C3350 built-in IPC, 20 CX1000/CX1020 Embedded PCs with Bus Terminals, a BC9000 Ethernet Controller, a BK9000 Ethernet Bus Coupler and the TwinCAT software ensure happy tenants.

The server cabinet on one of the upper levels at KölnTriangle: 19" C5102 rack-mounted PCs control the different building sections such as tower and low-rise buildings.



ing control system structure. They are equipped with Windows XP, TwinCAT automation software, and the building management system. TwinCAT is the software centerpiece of the building control system. It can be used to parameterize and configure a range of building functions such as basic lighting scenarios and daytime, night and weekend settings. Two of the plug-in PCs control the central building functions and deal with coordination of the local Ethernet terminal blocks in the individual building sections, i.e. the tower and the low-rise buildings arranged around it. The two other computers provide redundancy.

Climate control with CX Embedded PCs

At levels 9 to 27 and level 29, CX1000 Embedded Controllers running Windows CE are used and at the event level, a higher-performance CX1020 is used. Local I/O stations are distributed throughout the tower and networked with the central CX1000 PC control via Ethernet. Part of the standard Ethernet network is also used as bus system for building automation. The sensors of the roof-mounted weather station are connected to the Embedded Controller on level 29. It processes and analyzes the data and activates associated switching functions such as: closing of windows during high wind and rain, closing of windows depending on temperatures, lowering of blinds depending on sunshine, etc. The individual CX1000 devices on levels 9 to 27 and the CX1020 on level 28 poll the "weather station CX1000" every 5 seconds. In the event of this device not responding for more than 60 seconds (which would mean that no current data can be retrieved),

the windows move to the safe position and are locked. The same applies for wind warnings, rain or when external maintenance equipment is in operation. The windows remain in the locked position until current data can be retrieved again, wind speed has fallen below a certain level for a specified time, the precipitation monitoring device no longer indicates rain or external maintenance equipment is no longer in operation.

"All data points can be connected directly to the Beckhoff Bus Terminal system. A wide range of Bus Terminal variants are available so that direct connection of all sensors and actuators is possible", said Andreas Gröne, describing the benefits of the I/O system.

Efficient energy management

In addition to blind, window and temperature control, Beckhoff controllers also deal with lighting control. They communicate with the C5102 Industrial PC via Ethernet. Each floor is subdivided into three lighting zones: the lift lobbies and buffer spaces, the corridors, and the offices. In the lift areas the lights are on continuously between 7 am and 8 pm (normal operation) and off between 8 pm and 7 am (night mode). During the night the lights switch on automatically if the movement sensor installed in the ceiling of the lift lobby is triggered. The lights are switched off again if no movement was detected for 10 minutes. This lighting zone can also be controlled via the master computer located in the reception area.

The same DALI multisensors (brightness sensors and occupancy sensors) are used for automatic lighting control in the corridors and the offices. They are integrated in the ceiling luminaires of the respective offices. Digital light management is based on the Digital Addressable Lighting Interface (DALI), for which Beckhoff offers special terminals. The KL6811 DALI Master Terminal with integrated power supply unit is connected to the modular I/O system. Up to 64 DALI slaves can be connected to a master. "DALI applications usually cover individual rooms. The Beckhoff solution offers the advantage of being able to cover a whole floor", said Andreas Gröne. Georg Schemmann, director of building automation at Beckhoff Automation GmbH in Verl, Germany, added: "The DALI protocol is converted directly to Ethernet TCP/IP via Bus Couplers. This means that all components are integrated in the Ethernet network and treated as a single system on the software side." Accordingly, the system can quickly be re-parameterized and reconfigured in the event of spatial changes.

At KölnTriangle, the DALI lights on each floor are subdivided into three groups (east, south, and west). The dimming value for controlling the DALI lights in the corridor, for example, is determined by the mean brightness value of the sensors associated with the DALI group in the office lights. In general, the following rule applies: The light is switched off if no movement is detected for 10 minutes.

In the offices the lights can also be controlled manually. To this end, a touch panel with eleven dimming levels is available in each office space. Automatic mode can either be activated manually via the panel, or automatically if no presence is detected in the office for four hours.

The panel also enables manual control of the blinds, windows, sockets and temperature within individual rooms. To this end, the panel is switched to presence mode. Otherwise, automatic temperature control in the offices is split into comfort, normal and night mode. During the night the set value is 17 °C (63 °F), in comfort mode 22 °C (72 °F), and in normal mode 20 °C (68 °F). If no movement is registered within the office after a specified time, e.g. 10 minutes, the system automatically switches from the manually set value to comfort mode or normal operation after 30 minutes..

Maximum configuration on level 28

The "event level" in the tower is a special highlight in terms of building automation. In contrast to the other levels, this area is rented out for special events. The space with an area of 630 m² (6781 ft²) is also popular with fashion designers for fashion shows and receptions, for example. A total of 280 luminaires with electronic DALI ballasts (of which 220 RGB luminaires with red, green, blue and white lamps), subdivided into 54 DALI groups, provide suitable illumination for any occasion. Here too, KL6811 DALI terminals connected to I/O system are used. 30 further analog outputs enable control of additional lamps such as spotlights. "The idea of an event area occurred to the building owner at a relatively late stage, so that a separate 19" C3350 Panel PC was installed on this floor", said Andreas Gröne. In addition, more stringent requirements necessitated installation of a



CX1020 Embedded Controller in this area. The touch screen of the Panel PC, which also has an administrative function, is used for precise adjustment of the light conditions and colors.

The floor is subdivided into five sections, each assigned a small TFT touch panel that allows the occupants to manually adjust the intensity of the different light colors within the associated areas in ten steps.

Flexibility pays off

Together the partners involved in the KölnTriangle project managed to implement innovative and flexible building services systems in line with the client's requirements, while taking into account the increasingly important aspect of efficient usage of energy. The technology prevents unnecessary energy consumption for heating or lighting during the night. Andreas Gröne said: "The connector system and Ethernet-based networking are already paying off: EASA recently leased additional space and will shortly move into adjoining levels within the tower. At KölnTriangle this kind of move can be undertaken without time-consuming and problematic changeovers."

—> Züblin Direktion NRW, Niederlassung Köln www.koeln.zueblin.de

—> Innecken Elektrotechnik GmbH www.innecken.de

—> Wieland Electric GmbH www.wieland-electric.com

—> Beckhoff Building Automation www.beckhoff.com/building