

Safety a **key consideration** for novel kinetic sculpture

A large kinetic sculpture – aluminium elements in the form of petals that move to specially composed music – is one of the artistic highlights at Changi Airport. Passenger safety was of course a prime consideration, with safety brakes being key

Soft music sounds. Slowly, 96 aluminium elements set themselves in motion high above the viewers – the rings are based on the shape of orchid leaves. In the rhythm of the music they move softly and precisely, coordinated with each other, constantly forming new constellations. This is the Petalclouds kinetic sculpture in Terminal 4 of Changi Airport in Singapore. The airport opened the new building in October 2017, and since 2018 the movable work of art has also been in operation as the heart of the artistic concept. A stylised orchid petal runs through the design of the entire terminal as a red thread.

What looks light and airy in the Central Galleria of the new terminal is technically a heavyweight: with a length of 200m and a weight of 40kg per element, a total of approximately 4 tons of steel and aluminium move over the passengers. Each element is suspended from four thin steel cables. Two servo motors with winches per petal ensure the flowing movements according to a given choreography.

Each motor is equipped with emergency stop brakes – the ROBA-stop-M series from Mayr Power Transmission is used, with two brakes applied per winch. For smooth control, each winch is supplied by a ROBA-SBCplus control module. The SBCplus modules are particularly suitable here because they are designed for security applications. So there is no cultural break when they are combined with special safety PLCs. Thanks to its fully electric functionality, the SBCplus dispenses with mechanical components - a big plus for reliability. In addition, the modules make a compact design possible. Each SBCplus controls two brakes at the Petalclouds, so

that both of its channels are fully utilised. This means less volume requirement in the control cabinet and a space-saving design of the control electrics. Another advantage of the modules is that they can evaluate the release monitoring of the brakes and thus provide information at any time as to whether the brakes are open or closed. The motors only run when the brakes are open, thus avoiding expensive damage to the drive from the outset.

Smooth running with no false alarms

The design for the installation comes from the Berlin-based Art+Com Studios. MKT AG from Olching near Munich converted Art+Com's vision into a TÜV-certified system and conducted all of the manufacturing, installation and commissioning. Takenaka Corporation from Japan performed all the building conversions that were required to fit in the kinetic sculpture. Werner Riebesel, responsible for the project at MKT AG, describes one of the biggest challenges: "We have installed hundreds of safety elements in the Petalclouds. The difficulty was to keep the system running smoothly without the safety components shutting everything down with false alarms."

Safety was a prime concern because the installation is not mounted in a shielded area. It floats above the passengers under the 25 metre high ceiling of the Central Galleria. If one of the petals got out of control and fell, the risk of injury in the highly frequented area would be enormous. This is why MKT AG relied on brakes from Mayr Power Transmission for its safety concept.

The electromagnetic ROBA-stop-M safety brakes work according to the fail-safe principle. They are closed in a

de-energised condition, and therefore also in case of a power failure or an emergency stop. When the current is switched on, the brake generates a magnetic field. As a result, the armature disk is pulled towards the coil carrier against the spring pressure. The rotor, which is connected to the bearing-mounted pinion shaft via a gear hub, is thus free, meaning that the brake is released. The motor can run freely, the wire rope hoist can work in both directions without obstruction.

In case of error conditions such as power failure or emergency stop, the ROBA-stop-M brakes intervene immediately and bring the wire rope hoist reliably to a standstill within a very short time. Even if the brake is damaged, for example due to cable breakage or failure of the magnetic coil, the braking torque is maintained.

Mayr says the ROBA-stop-M brakes by also score highly with regard to operational safety and ease of maintenance in comparison to many other safety brakes. They distinguish themselves through an enclosed constructional design and the high Protection IP 54 or IP 65 in sealed design. Designed for a duty cycle of 100%, the ROBA-stop-M brakes are maintenance-free for the service lifetime of the friction linings. Their compact and functionally safe construction enables quick and cost-effective installation. Installation and adjustment errors can be avoided thanks to the design-specific, tested and non-changeable working air gap. Furthermore, the variable spring configuration for different torques makes the safety brakes particularly flexible.

Mayr brakes reliably guarantee maximum operating safety. For this purpose, the company focuses on careful quality inspections: these include quality assurance measures during the course of the design process and a comprehensive final inspection. Prior to delivery, all brakes are intensively tested on test benches and function-relevant values are recorded. An electronic database in which the measurement values are archived together with the associated serial numbers of a

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