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Airport ready for lift-off

In 2003, the Kingdom of Swaziland embarked on construction of the US$150 million Sikhuphe International Airport. This formed part of King Mswati III's US$1-billion millennium-project investment initiative to enhance Swaziland's position as a leading tourist destination. Gibb was responsible for designing the key structures of the airport. The project area is situated in the Swazi lowlands at Sikhuphe. Finding sufficient flat ground to accommodate the runways and the control buildings was not easy.

The Swazi consultancy DTA was tasked with the design of all the critical installations and buildings associated with administrating the airport.

Gibb engineer, Pat Masterson, says: "DTA subcontracted Gibb to do the structural design of the airport's critical structures, including the control tower, the air-traffic control building and the fire station. The most interesting facet of this project was the control tower. The contract for the construction of these buildings was awarded to Stefanutti Stocks. The design of the control tower was particularly interesting and challenging. Because of the position of the land, it had to be built on ground at a level below the runway yet still be capable of reaching high enough to see the ends of the runways."

A much taller tower than normally expected, with a total height of 57 m, had to be designed. Consequently, this presented a number of unique design challenges. There are also a number of unusually shaped transformations in the architectural concept of the tower. The main structure encompasses a rounded triangular shape (47,8 m high with 200 mm-thick concrete walls) built on a hexagonal base which is founded 5 m below ground level on rock. Above the 47,8 m-high tower walls is the technical level which is built on a cantilevering, octagonal-shaped, composite slab and comprises a 16-sided structural-steel cage. This, in turn, supports the visual control room (VCR) or cab (octagonal in shape and built on a composite slab supported on an upstand beam). There is a circular-shaped balcony at a slightly lower level. The VCR has been imported from the UK and lifted up onto the structure using a tower crane.

The natural frequency of the tower was an area of concern. Calculations indicated that, based on the ratio of the mass, moment of inertia and height of the tower, the natural frequency of the structure was in a zone where a more in-depth look into the design was required. The natural frequency of the tower fell just outside the 10% range of the wind-vortex shedding frequency that would cause resonance of the tower under certain design wind speeds. Different methods to change the natural frequency of the tower, without completely changing its architectural aspects, were considered. The chosen design was to reduce the functional height of the tower by increasing the rigidity of the lower portion of the tower. The wing walls were, therefore, added as braces at the bottom of the tower. These wing walls were built from the foundations up to a level of 2,6 m above the lower entrance to the tower. The mass of the tower and the effects of the moment of inertia had to be kept in mind when designing the wing walls. By adding the wing walls, it was possible to increase the moment of inertia of the tower and to achieve a reduction in the effective length without increasing the mass sufficiently. The shape transformations at the top of the tower, together with the size of the steel cage and VCR at the top of the tower, also change the wind-vortex shedding frequency to the benefit of the design with a final solution that reflects the architectural intentions while providing a robust structural solution. Stefanutti Stocks opted for a slip-formwork construction – similar in principle to the many other pours that it has completed successfully at other airports. Masterson says: "It was a pleasure to work with this professional team and the entire pour went ahead with minimal complications. The most unpleasant was pouring during the heart of winter: low concrete temperatures slow progress at night." The airport is due to open this year when Swaziland will be able to celebrate a modern, fully functional international facility which is capable of receiving the large aircrafts that fly to Europe and Asia.