LOADTEST
New Supreme Court of Singapore

Project:	**Supreme Court of Singapore**
Location:	1 Supreme Court Lane, Singapore
Client:	Sato Kogyo (s) Pte. Ltd.
Foundation Contractor:	ZAP Piling Pte. Ltd.
Project Description:	For the new Supreme Court in Singapore, an existing building with four basement levels needed to be removed. Zap Piling Pte. Ltd. performed the bored piling for Sato Kogyo (s) Pte. Ltd. (general contractor) and Fugro LOADTEST performed the Osterberg O-Cell® testing. The piling work was done from temporary steel decking at ground level through access holes in the existing basement slabs down to the existing basement floor (16 m below ground). 255 new bored piles were to be constructed with plunged columns using a steel H-beam ("king post") inserted in the top of piles of diameters of up to 1400 mm.

Placing cages within excavation through existing basement car park

Installation of O-cell assembly through the existing multilevel underground car park.

Installation through the basement levels

Testing in an existing basement car park

Load tests inside the existing building using the Osterberg cell (O-cell) method was preferred since this technique requires no additional reaction system at the pile head as needed in traditional loading methods and was the only viable procedure for performing static maintained load tests to loads greater than 24 MN on the test piles, and the preliminary pile testing could be done ahead of the demolition of the existing basements.

The O-cell bi-directional static load test method works by installing the O-cell loading arrangement inside the bored pile prior to installation and casting of concrete. During testing, the loads applied by the O-cell act in two opposing directions, resisted by the capacity of the pile above and below (hence no external reaction system is required). The award-winning method is simple in its concept but requires expert assistance for successful execution. The cages are instrumented and prepared prior to installation with the O-cell assembly, mechanical extensometers and strain measurement devices. Prior knowledge of the soil parameters and scope of testing is used in determining the O-cell level in the pile.

Besides testing building foundations for some of the signature landmarks in Singapore, such as Marina Bay Sands, Marina Coastal Expressway, Resort World at Sentosa, One Raffles Quay and the MRT-NEL, Fugro LOADTEST has used the O-cell method for testing foundations for large infrastructure projects like bridges and rail lines all over the world. These include the Taiwan High Speed rail line, KCRC West Rail in Hong Kong, Dubai Metro, My Thuan River Bridge in Vietnam, Incheon Bridge in Korea, Bandra Worli Sea Link in Mumbai, India and bridge projects in remote areas of Bangladesh like the Rupsa Bridge and Paksey Bridge.

Source: iac.gov.sg

LOADTEST
O-cell Technology at Marina Bay Sands, Singapore

Project: **Marina Bay Sands**

Location: Singapore

Client: Sambo Geo-Tosfoc Co. Ltd.

Consultant: Arup Singapore Pte. Ltd.

Project Description:

On 27th May 2006, Las Vegas Sands was declared the winner of the Marina Bay site in the prime new business district of Marina Bay in a highly publicized bidding process for the first Integrated Resort to be developed in Singapore. Conceived to meet Singapore's economic and tourism objectives for the next decade, the Marina Bay Sands Integrated Resort will also include the first casino to operate in Singapore.

Foundation work starts in 2007

Source: marina-bay-sands-casino.com

Construction in full swing 2008

Source: flickr.com

Sky Terrace construction 2009

The resort was officially opened in June 2010, however, the grand opening was held in February 2011, marking the opening of the seven celebrity chef restaurants and the completion of the majority of the resort facilities.

Refer over page for a summary glance at the work carried out at this project by Fugro Loadtest.

Designed by Moshe Safdie Architects, the resorts 55-storey hotel towers were inspired by decks of cards being placed upright together and shuffled as typical of a casino croupier. Besides the 2,560 rooms and suites provided by the hotel, the resort comprises an ArtScience Museum, convention centre, a shopping mall, two theatres, skating rink, a one hectare sky terrace set atop the hotel towers named Sands SkyPark and the world's largest atrium casino. As with most major buildings in Singapore, the resort's architecture and major features were designed in accordance with nature's "ways" and approved by the Feng Shui Consultants.

The structural engineering for the project was headed by Arup Singapore. A world renowned engineering consultancy that described the integration of the varied and advanced technologies as the "most difficult to carry out in the whole world". Worthy of note is the design of the world's longest public cantilevered platform, being part of the sky terrace that overhangs the north tower by a staggering 67 m.

The main contractor for the project was SsangYong Engineering & Construction.

LOADTEST
O-cell Technology at Marina Bay Sands, Singapore

With such a prestigous project and an extremely tight piling works program, the foundation contractor engaged Fugro Loadtest to carry out a working pile load test program using Osterberg Cell bi-directional testing method. A total of six working piles and one working barrette were tested. Beside the high test loads, another important consideration for using the Osterberg Cell bi-directional test method was the depth of cut off level below the existing piling platform level.

Design cut off levels across the site ranged from 13.0 m to 25.5 m below platform level and working pile tests had to be carried out before the excavation was started. Concreting of the piles and barrette was carried out to cut off level with the empty excavated bore carefully backfilled with clean sand fill material to platform level to maintain bore wall stability and for safety reasons.

Even though concrete was only cast to cut off level, the reinforcing cage and O-cell related instrumentation was brought to platform level so that testing could be conducted from the existing platform level.

The site being previously reclaimed from the sea had a substantial layer of sand fill overlying a varying thickness of soft to firm Marine Clay. However, due to the deep cut off levels, all of the pile's capacity was derived from the soil below the Marine Clay layer. The soil profile across the site was uniform medium dense to dense silty/clayey sand underlying the Marine Clay.

Test pile depths ranged from 69.5 m to 82.5 m on 1800 mm diameter to 3000 mm diameter rotary bored piles and 2800 mm x 1000 mm for the barrette.

Testing of the rotary bored piles and the barrette were carried out using the ASTM quick test method but with a full 24 hour hold at test load. Bi-directional test loads of 22.0 MN to 54.0 MN were applied to piles using a combination of 870 mm and 610 mm O-cells in single and multiple O-cell configurations. Since all the test piles were intended to carry structural loading, the O-cells and annular void created as a result of the expansion of the O-cell were grouted to reinstate the structural integrity.