LOADTEST

World Record Static Load Test Using O-Cell® Technology

Project	**Incheon Bridge**
Location	Incheon, South Korea
Main Contractor	Samsung Corporation
Foundation Contractors	Daewang E & C Company
Project Description	

The planned causeway and cable-stayed bridge structure to link the Incheon International Airport with the New Songdo City project got off to a record breaking start, with the static load testing of several preliminary piles along the proposed route. Load-testing for the 2.4m to 3.0m diameter bored piles to a planned maximum loading force of 210,000 kN was completed early 2005.

Assembly of the 5x 870 mm O-cell arrangement

Located 10 km south of the Yeongjong Bridge, which has been in operation since November 2001, this signature bridge project was constructed and financed through a Public Private Finance initiative. The concessionaire, KODA Development Co., Ltd. (KODA), a special purpose company, with 51% AMEC and 49% Incheon City ownership, will operate and maintain the bridge for a 30-year period, after which time it would be transferred to the Korean Authorities.

Assembly of the bearing plates for the O-cell arrangement

The total bridge length, including the cable-stayed bridge, approach bridges and viaduct bridges is approximately 12 km. The steel box girder cable-stayed bridge has five spans, with a maximum center span length of 800 m and a clearance height of 74 m for ship passage. Holding the bridge deck at a majestic 70 m above the water are twin inverted-Y shaped 238.5m tall pylons, the same height as Korea's tallest skyscraper in downtown Seoul. The bridge has a 33.4m wide road deck to accommodate three lanes of traffic in each direction.

A joint venture company, headed by Samsung Corporation, was awarded the contract for this project. In order to reduce the construction period, the contractor adopted a fast-track procedure, in which construction begins on one phase after it is approved, while the design work and construction planning is still in progress for the next phase.

Test piles W6 and W8

Four preliminary test piles were proposed along the route in water between 5 and 14 m deep. These test piles were with Osterberg cells (O-cells) to perform the static bi-directional load test, since trying to achieve these loads with kentledge or anchor piles was impractical. Construction of the piles was with a permanent casing through the sea bed and into the soft rock, at 38-48 m. Boring was carried out down to a maximum level of –56 m using reverse circulation drilling. Up to 9 levels of strain gauges and 3 sections of embedded telltales were employed.

An additional advantage of bi-directional testing is that concreting up to the top of the pile is not necessary, and for this project the concrete was brought up to the level of the sea bed.

Floating concrete plant

Source: contractjournal.com

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Top of pile instrumentation and reference beam as test on W8 was in progress

Cage sections in preparation
Several lengths of reinforcing cage had to be spliced together over the bore

Final assembly of reinforcing cage with O-cells

Bottom cage being prepared for insertion into the bore from the jack-up barge

Source: *iai-jakarta.org*

Bi-directional load test arrangement:
In order to achieve the test loads required, the only method available was the use of the patented bi-directional Osterberg Cell testing technique in which specially made sacrificial jacks (O-cells) are cast within the pile itself at a specific depth at which equal capacity exists above and below.

The O-cell is a hydraulically driven, calibrated, sacrificial jacking device installed within the foundation unit and derives all reaction from within the soil and/or rock system itself. Working in two directions, upward against skin friction and downward against skin friction and end-bearing, the O-cell automatically separates the resistance data. By virtue of its installation within the foundation member, the O-cell load test is not restricted by the limits of overhead structural beams and tie-down/anchor piles.

Load testing with the O-cell continues until one of three things occurs: skin friction is fully mobilised, ultimate end bearing capacity is reached or the maximum O-cell capacity or ram travel is obtained. Each O-Cell is specially instrumented to allow for direct measurement of the O-cell's expansion. By also measuring the top of shaft or pile head movement and compression, the downward movement is determined.

O-cells range in capacities from 0.7 MN to 27 MN. By using one or multiple O-cells on a single horizontal plane, the available test capacity can be increased to more than 220 MN. By utilizing multiple cells on different planes, distinct elements within a shaft or pile can be isolated for testing.

Pile Tests:
The four load tests were carried out as scheduled, and by request continued loading beyond the planned maximum loads. The following summary shows the maximum loads applied:

Diameter [mm]	Approx. Pile length [m]	Gross Mobilised Maximum Capacity *
3000	67	279,000 kN
2400	69	130,000 kN
2450	65	166,000 kN
2400	63	236,000 kN

* These values allow for the buoyant weight of the pile element above O-cell arrangement. The maximum load applied in each direction was 142,000 kN.

12.3km long, the Incheon Bridge opened in October 2009