



## Automatic Multi-Purpose Dam Deformation Monitoring System Using SOKKIA's State-of-the-art NET1

### Implemented at 13 dams with the aim of realizing a “ubiquitous Korea”

The Republic of Korea is creating an infrastructure maintenance information network with the aim of creating a ubiquitous society known as “u-Korea”. The Korea Water Resources Corporation (KOWACO) has implemented a SOKKIA-made automatic multi-purpose dam deformation monitoring system in a plan to fully automate dam deformation monitoring. In this report we talk with those involved in the testing and operation of this equipment in Korea.

#### **New system employing “NET1” effectively manages dam safety control and operation**

SOKKIA KOREA CO.,LTD. provided the Korea Water Resources Corporation with an automatic multi-purpose dam deformation monitoring system using the NET1 as the core sensor. Installed at 13 of Korea's multi-purpose dams, this highly-anticipated system will effectively manage safety and dam operations in addition to fulfilling other vital roles.



The company that is implementing the system, the Korea Water Resources Corporation (KOWACO), is a public organization based in Daejeon with approximately 4,000 employees. It manages and operates 14 multi-purpose dams throughout the country and, in addition to water control operations to prevent flooding, it performs tasks such as providing water and sewage utilities and managing service water.

Incidentally, Daejeon is a major Korean city with a surrounding population of 1.5 million people. Nearby are the Yuseong hot springs which have been known as a getaway since the Baekje period (18 BC – AD 660). Daejeon is also widely known as a scientific city as it is host to the Daedeok Science Town which is known as Korea's “Silicon Valley”.

#### **High accuracy and unprecedented groundbreaking environmental protection surpassed KOWACO demands**

SOKKIA employed the state-of-the-art MONMOS Automated 3-D Station “NET1” as the core sensor for the newly developed automatic multi-purpose dam deformation monitoring system. NET1 features a motor drive and has the functionality to automatically sight the reflective prisms crucial to automatic deformation monitoring. The auto-pointing function uses a dedicated algorithm which has the ability to recognize and accurately sight the intended target even if multiple prisms and other reflective objects are in the telescope's

field of view. This target selection algorithm is extremely important in monitoring applications as predetermined points are automatically sighted and measured repeatedly to monitor the changes over time. In addition, the NET1's high IP64 environmental protection rating means that it is extremely reliable.

The environmental protection rating is maintained even with cables attached, which is a first in the industry. It also goes without saying that the distance meter and angle measurement units have also met the high accuracy demands of KOWACO.

#### **Automatic measurement using reflective prisms to understand 3D deformation in real-time**

Using the NET1 as the sensor, the system has the ability to automatically measure prisms placed on the dam body and surrounding slope in three dimensions to monitor dam deformation in real-time. A completely automatic system, the NET1 is situated in an unmanned observation room in full view of the multiple prisms placed in specific locations mainly on the dam body.

Monitoring control and data processing are automatically performed from the remotely located dam control office using monitoring control software according to a predetermined schedule. The acquired data is compared to reference data and graphic displays are immediately displayed for a visual representation of the processed data.

### Planning and installation under extreme conditions

SOKKIA Korea handled everything from installation to testing, overcoming the many challenges to setting up the unmanned observation room designed for the NET1. The following were the conditions for the unmanned observation room:

1. Assured visibility of approx. 40 measurement points on the dam and surrounding embankments
2. Solid footing allowing the NET1 to be securely fastened
3. A position that is out of the reach of the general public while providing easy access to maintenance personnel
4. A location that doesn't disturb the scenery of the public tourism resource

Prism placement was also a challenge. Dams are roughly broken into two categories: concrete dams, and fill dams made with compacted earth and stone, and this system was employed mainly on fill dams. One of the dams this system was installed on has a dam crest over 1 kilometer in length causing workers to descend the steep rocky slope countless times in order to place the prisms.

Even more concerning was the fact that the construction of the unmanned observation room was scheduled to take place in the winter. Looking at the latitude of South Korea, Busan is roughly the same as Tokyo, and Seoul is roughly the same as Washington DC, but due to geographic factors and ocean currents, Seoul drops to -10°C in the winter and temperatures drop even further in the mountains. However, worries about the cold were quickly put to rest as Korea experienced the warmest winter on record and construction was completed without incident.



### Increased data reliability fuels future demand

By implementing a multi-purpose dam automatic deformation monitoring system, operations that were previously done by hand are now automated. Fully automatic prism sighting, data collection and storage ensure data reliability by eliminating human error. Another major benefit of this system is the instantaneous graphing of the acquired data allowing effective use of the recorded data.

Currently, the government of Korea is advocating a national strategy called "u-Korea" (Ubiquitous Korea). The goal of u-Korea is a society that joins the physical space in

which we live with the knowledge information space introduced by the digital revolution. All levels of government are computerizing and networking with the aim of a ubiquitous society focused on construction of infrastructure and technological advancement. The automation of multi-purpose dam deformation monitoring by KOWACO is a major step toward this goal. The multi-purpose dam automatic deformation monitoring system was delivered without a hitch. Based on this success, we would like use the high accuracy and functionality of NET1 to proactively develop the various measurement markets.

