



Preserving Indonesia's heritage

by Katherine Lehmuller

Borobudur, a masterpiece of 9th century Buddhist architecture, is one of the most famous Buddhist temples. It is located in Magelang, on the island of Java in Indonesia, on a remote hill-top surrounded by volcanoes, one of which is still active. This massive 29-metre-high (95-feet) temple consists of nine stacked platform levels, six of them square and three circular, and is crowned by a central stupa, or dome, surrounded by nearly 3,000 panels and 500 Buddha statues. It is also aligned with three other temples. The structure is built without the use of any cement or mortar. Some claim it to be one of the Wonders of the World.

Built in the 9th century, Borobudur was used until abandoned in the 1400s. When it was rediscovered

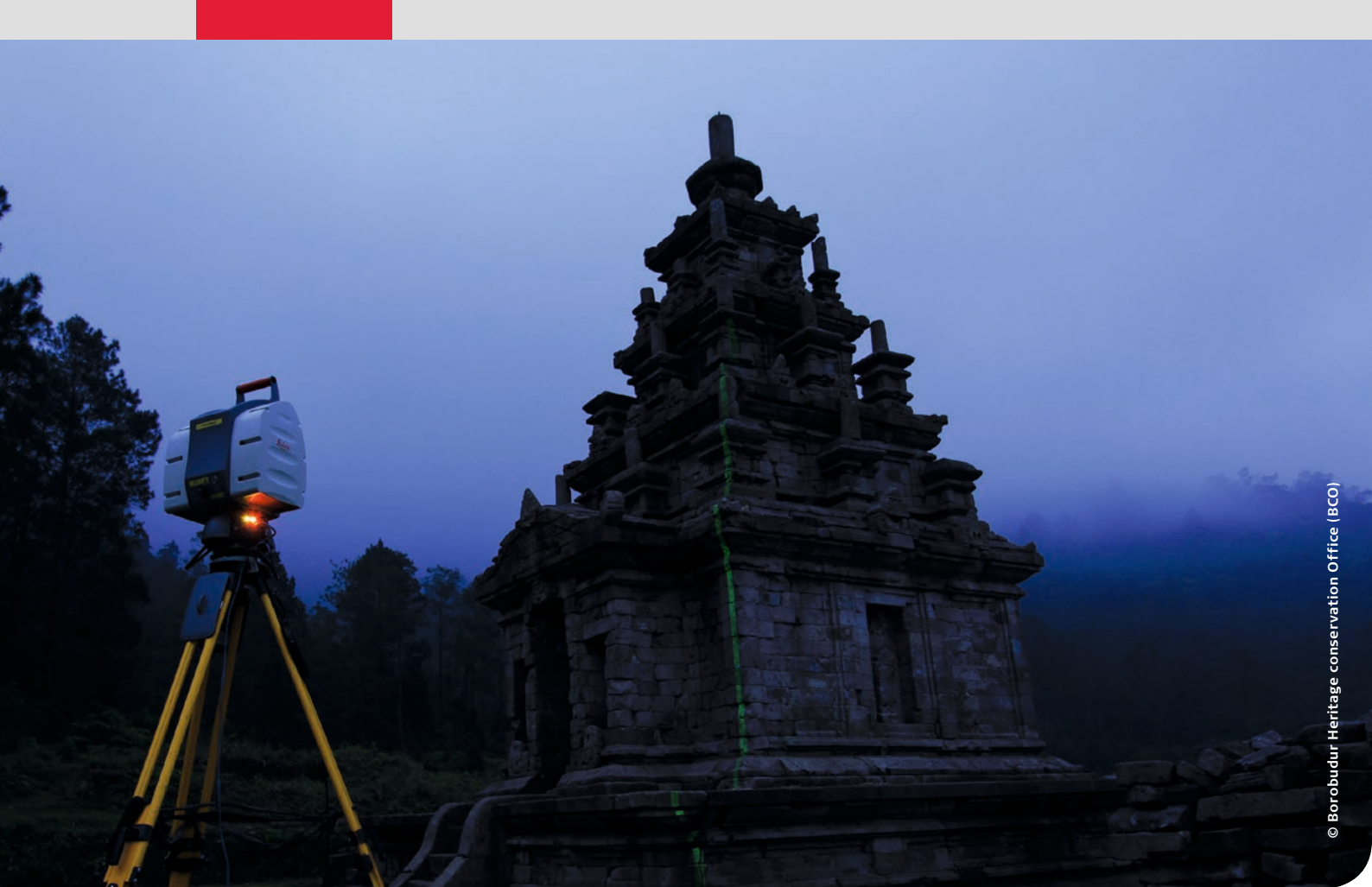
in 1815, it had been buried under volcanic ash and heavy jungle growth. Poorly executed excavations done at this time exposed the temple to elements and led to its decay. In the 1970s, the Indonesian Government and UNESCO took interest in this amazing monument and began renovating it, disassembling and carefully cleaning stones and building a major draining system as well.

Borobudur is still used for a Buddhist pilgrimage once a year and anyone visiting the monument must walk up the nine platform levels to reach the top. These levels represent the consecutive stages that a Buddhist trying to achieve enlightenment must go through in order to attain Nirvana.

Deterioration at Borobudur

These pilgrimages, the complex's immense popularity as a tourist attraction, vandalism and weak regu-





■ Preserving the Borobudur temple for future generations using a Leica ScanStation.

lations of encroaching property development have all taken a toll on Borobudur, adding to its deterioration. A recent volcanic eruption also threatened the temple and covered it with destructive acidic ashes. In order to preserve Borobudur for future generations, the historical site needed to be properly documented and a highly detailed digital rendering made.

3D laser scanners play an important part in mapping and documenting cultural heritage. When deterioration or unexpected natural disasters, such as floods, volcanic eruptions, earthquakes or vandalism, occur, reconstruction of historic structures based on the scanner's delivered point clouds can be accurately done. Borobudur Heritage Conservation Office BCO, working for the Indonesia Ministry of Culture and Education, decided to undertake this vast project employing the Leica ScanStation C10 using Cyclone software to document the temple complex.

Documenting changes

In 2005, BCO received its first HDS scanner, the Leica HDS3000, from UNESCO. Before this, they used manual methods to acquire data and carry out documentation of Indonesia's cultural heritage. After

receiving the scanner, BCO made tremendous progress documenting sites with far more detail and collecting data quickly. Brahmantara, coordinator at the Photogrammetry and 3D Laser Scanning section for Borobudur Heritage Conservation Office, Ministry of Education and Culture, explains, "Working with the Leica Geosystems HDS scanner helped us tremendously. It's more quick, more fast and provides detailed data. We've had much success with Leica Geosystems products and upgraded to the Leica ScanStation C10, to collect even quicker and receive even more detailed and accurate data. When collecting data manually, we required more manpower, so it took longer to analyse data and make drawings. Now, with the new Leica ScanStation C10, we need fewer people and also have more time to analyse and make our conclusions."

BCO's goal was to complete and refine the cultural heritage site's database. Detailed digital documentation, such as for the site's spatial data, its dimensions and elevation as well as documenting the surrounding landscape and its contours, could help preserve and help maintain the site for many generations to come. The 3D scans delivered by the Leica

Other projects

The famous Indonesian Temple, Gedong Songo, with its nine different temple complexes built on the beautiful hillside of Ungaran Mountain, was also scanned using Leica Geosystems products. Difficult setups on steep inclining landscapes proved no problem for the Leica ScanStation C10.

Brahmantara explains, "We could still manage to get coordinates with good accuracy and output of the drawing with good dimensions. Another project, scanning the clock tower Jam Gadang in Bukittinggi, which was damaged by a severe earthquake, enabled us to decide how to restore and stabilise the building based on the data we collected."

ScanStation C10 would serve as a reference point, helping to monitor Borobudur for any occurring changes caused by regional property development. Another task requiring use of the laser scanner was to assess the stability of the building site itself and also of threatening slope inclinations of the complex's surrounding hills, which could change at any time due to natural disasters.

Challenging environments

Scanning the Borobudur complex is a vast and complex task presenting many challenges. For instance, many of the objects to scan are difficult to reach, such as prehistoric caves or temples located on hill-sides. Steep terrain, access to electricity and severe weather conditions, such as the Monsoon or rainy season, were challenging scanning tasks to say the least. Since BCO has worked with Leica Geosystems equipment for 10 years, they knew these laser scanners were highly durable and able to work under the extreme conditions that such an immense project required.

The Leica ScanStation C10 is not only scanning the Borobudur complex but also digitally documents



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numerous other historical forts, prehistoric caves, ancient pundek (stair-like) terraces in highly detailed accuracy – and all with great success. The scanner was also applied to assist other related cultural institutions to document and collect data of prehistoric bas-relief art.

A loss of our cultural heritage would be unthinkable. With the help of the Leica ScanStation C10, our world's precious cultural heritage sites, such as the monumental complex of Borobudur, could be documented in precise detail. Now should any unforeseen damage, great or small, happen from environmental change or other unpredictable instabilities, highly detailed 3D laser documentation can protect the past and preserve the future for many generations to come. ■

About the author:

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