

Report submitted to the 23rd Plenary Session of ICC-Angkor (December 4, 2014)

In 2014 World Monuments Fund's work at Angkor included the continuing restoration of the temple of Phnom Bakheng, various conservation activities at the temple complex of Preah Khan, and planning for the creation of a wooden ceiling at the Churning of the Sea of Milk Gallery at Angkor Wat. WMF has been working at Angkor since 1992 and has a close working relationship with the APSARA National Authority. Today, WMF employs approximately 130 Cambodian architects, conservators, engineers, archaeologists, and craftsmen. In addition, WMF consults international specialists to help understand specific conservation issues, to assist with the development of appropriate conservation programs, and to conduct training for the local WMF team.

Phnom Bakheng

Since 2008, the Phnom Bakheng conservation project has focused on the structural stabilization and waterproofing of the east half of the central temple. The current program includes disassembly of walls, terraces, and other structures that are structurally unsound, structural repair of the temple's foundations, stone conservation, and reassembly of walls and terraces following the installation of waterproofing systems to ensure long-term preservation. This program was developed in response to the degraded condition of the central temple and its foundations, with the approval of the APSARA Authority and the ICC ad hoc expert group for conservation, who have monitored its implementation. Disassembly of wall sections is carried out only where the structural conditions require it, with a view towards minimizing disturbance to the structure. The foundation repair program involves pinning the bedrock using rock bolts to ensure its long-term stability and inserting stone (laterite or sandstone) in areas of loss. The waterproofing plan involves covering the bedrock and laterite foundation with a PVC membrane and, at locations that will not be easy to access in the future, under sandstone terrace shrines, with an added layer of lead sheets (**Fig. 1**). In the reassembly of wall sections, stone blocks retrieved from the side of the hill of Phnom Bakheng and new stones from the original quarry are added as necessary in order to complete the repairs.

Taking advantage of the experience gained at Phnom Bakheng so far, in 2014 the WMF team carried out a systematic survey of the east half of the temple. The survey methodology was developed in February 2014 in collaboration with a structural engineer. It contains quantitative and qualitative information about the condition of the east half of the temple, including walls, terraces, and steps, as well as all surviving stone and brick shrines. This survey has helped clarify the need for dismantling and reassembly at the remaining sections of the east half of the temple. It has also been useful for calculating the number of stone blocks that will be disassembled, the number of stone blocks that will need to be retrieved from the hillside, and the number of pavers that will need to be cut. All data collected at Phnom Bakheng during this campaign are stored in a database that allows the WMF team to retrieve information by structure, risk level, and current status. The database can be used to produce reports and to monitor changes in conditions at the site over time. WMF hopes that the database will prove a key resource for future researchers and conservators.

According to this intervention plan, completion of the restoration of the northeast corner of Phnom Bakheng is now expected in February 2015, while work will be ongoing on the southeast corner throughout the year. On the northeast corner, in 2014 the work has focused on levels B, C, and D. Wall reassembly at level B has been completed, using both original stone units and unidentified stones

retrieved for this purpose from the side of the hill. At the northeast corner of level B, the WMF team worked with a structural engineer to determine whether the compacted soil and bedrock foundation could support the weight of stone shrine B11. To strengthen this area, a new laterite foundation was constructed for the shrine, and it was shaped and pitched so as to minimize water retention. Shrine B11 will be reassembled in 2015. Restoration at level C is currently focused on the area around stone shrine C12. The bedrock in this area was found to be in very poor condition, riven by deep gullies, and further decayed due to water infiltration over the centuries (**Fig. 2**). Sandstone blocks were inserted as infill material underneath stone shrine C12 and the abutting wall of level B. Laterite blocks were installed in the rest of the area under repair. This work will be accomplished by the end of the year, before shrine C12 is reassembled. In 2014, the restoration of level D was completed. Shrine D12 was disassembled in March 2013 and the bedrock underneath it was repaired, and reassembly of the structure was completed in February 2014. In prior years, WMF completed the restoration of levels E and F,

Work on the southeast corner of Phnom Bakheng follows the same approach and applies the lessons learned from work on the northeast corner, as described above and in previous reports. The main restoration activity during 2014 has been wall reassembly at levels E and F (**Fig. 3**). The wall is being reassembled using both original blocks and stone blocks that have been retrieved from the wooded hillside. Laterite blocks are inserted between the wall and the bedrock to act as an interface between them. Fiber-Reinforced Polymer cables are used to tie the wall to the bedrock through the laterite. Where necessary, laterite is also used to repair the decayed or collapsed portions of the bedrock. At level E, the section of the terrace between shrines E1 and E2 is badly fractured. Given the sensitivity of this case, the WMF team has decided to wait until the next visit of the ad hoc expert group for conservation to Phnom Bakheng to present a suitable proposal for this location.

The structural survey mentioned above has also allowed WMF to begin developing a systematic prioritization plan for the surviving brick shrines. Shrines that are in most urgent need of repair have been identified and a shoring plan and restoration proposals are being elaborated. In particular, in 2014, the WMF team studied the options for stabilization and conservation of brick shrines G4, G5, G21, and G30, and for the shoring of brick shrine G16, G29, and G31.

Following the recommendations of the 22nd Technical Session of ICC-Angkor (December 3-4, 2013), the WMF team has identified stone blocks that originated from the 5 shrines of level A and from a large seated Buddha that was constructed at the end of the 16th century. 119 stones were found scattered at levels A and B of the temple, while an additional 42 stones were found in the wooded side of the hill. Among the stones surveyed, the stones of the top level are identified by their larger size and carved decoration. Many display signs of alteration dating from the construction of the Buddha sculpture. In addition, in 2013-2014 two lingas were discovered by the WMF team (two lingas had previously been discovered, in 2009 and 2012). They were inventoried, numbered, and photographed, and are currently in storage at Phnom Bakheng.

As mines are still occasionally found on the hillside where stone blocks are being retrieved, WMF worked with the APSARA Authority to bring a demining team on the site in the fall of 2014.

Preah Khan

As has been previously reported, in 2014 work at Preah Khan has focused on East Gopura IV. Due to significant structural damage and the threat of collapse, as agreed with APSARA, in 2012 the superstructure of the Central Tower was dismantled to the springing of the arches. Restoration of the tower has been ongoing and is expected to be completed in November 2014 (**Fig. 4**). Some damaged or missing stones were replaced by new sandstone blocks. During the disassembly of the tower precious and semi-precious objects were recovered from holes in some of the blocks. Carefully documented, they

were all returned to their original locations and the APSARA Authority and the Heritage Police were informed.

In 2012, WMF worked on the structural stabilization of the north portico of the Brahma Complex, which is located immediately south of South Gopura II. The upper part of the roof was reassembled, while decayed concrete and rusted reinforcing bars and clamps were removed. This project resumed in 2014 after quality new stone to replace the missing door jambs of the portico was found. The new stones were installed, adjusted, and pinned to the surrounding blocks, while a carved stone lintel, previously lying on the ground next to the portico, was set back in place.

In August 2014 WMF completed the restoration of Garuda #38. The WMF team dismantled and reassembled the wall in the area abutting the sculpture in order to guarantee long term structural stability. Lastly, WMF and the APSARA Stone Conservation Unit carried out a joint consolidation project of 6 nagas at East Gopura III, North Gopura III, and near the Two-Story Pavilion.

Angkor Wat

Following the restoration of the roof of the Churning of the Sea of Milk Gallery (2007-2012), WMF was invited by the APSARA Authority to design a project to replicate the carved wooden ceiling that originally covered the underside of the vault of the gallery. At the 18th Plenary Session of ICC-Angkor (December 12-13, 2011), WMF was requested to continue its research in order to present a proposal for approval. Based on an appropriate design, the new ceiling would restore the integrity of the space of the gallery, in accordance with the spiritual significance of the Churning of the Sea of Milk bas-relief.

WMF commissioned a report on the current state of knowledge about the wooden ceilings of Angkor Wat from independent researcher Dr. Olivier Cunin. Dr. Cunin's report contains detailed information on all five ceiling fragments that are known to have survived from Angkor Wat, which are currently in the collections of the National Museum of Cambodia in Phnom Penh and the Guimet Museum in Paris. Dr. Cunin's research considered published and archival sources about the history of the ceiling fragments, as well as remains of wooden ceilings surviving in place in the Bakan of Angkor Wat.

In consultation with Dr. Cunin, WMF has now finalized a proposed design, consisting of rows of four lotus flowers carved onto wooden planks. The design most closely follows that of a ceiling fragment currently in the Guimet Museum (MG 23513), which was recommended by Dr. Cunin as the most appropriate model for the Churning of the Sea of Milk Gallery. According to Dr. Cunin's research, it is very likely that this fragment originated from one of the 3rd enclosure galleries, based on the location where it was discovered and on the dimensions of its carved decoration. Dr. Cunin has provided WMF with drawings and a 3D model of the proposed design (**Fig. 5**), which has been further refined in the process of carving (**Fig. 6**). A mock-up consisting of four planks will be installed at the gallery, and details about the installation of the ceiling will then be finalized. The installation will be designed so as to keep bats and other animals from entering while allowing for ventilation and for periodic removal to inspect the condition of the vault. The planks are being carved by a skilled wood carver based in Siem Reap, to a thickness of 10 cm, matching the dimensions of surviving ceiling fragments.

October 2014



Fig. 1: The northeast corner of level D of Phnom Bakheng during restoration, prior to the reassembly of stone shrine D11, showing the waterproofing system used by WMF.



Fig. 2: The bedrock near the northeast corner of level C was found to be in very poor condition and was repaired using new sandstone blocks.



Fig. 3: Wall reassembly at the south side of level F of Phnom Bakheng.



Fig. 4: Reassembly of the Central Tower of East Gopura IV at Preah Khan.

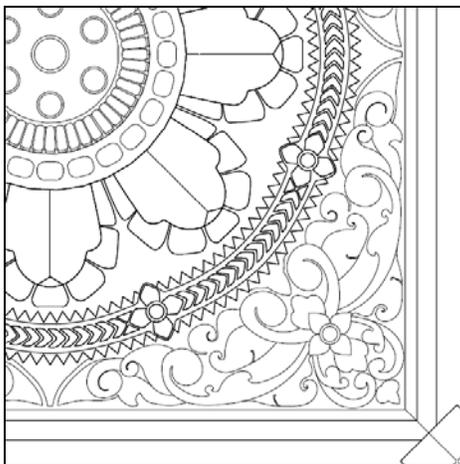


Fig. 5: Detail of proposed design for a new ceiling at the Churning of the Sea of Milk Gallery by Dr. Olivier Cunin.

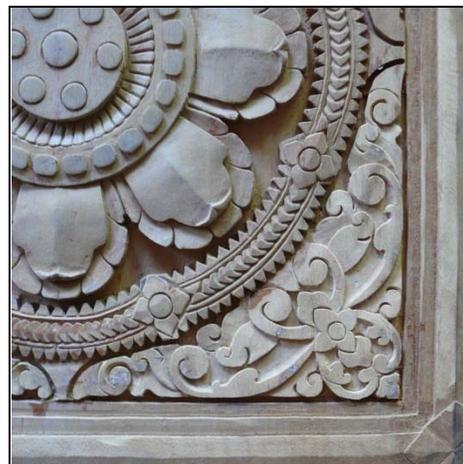


Fig. 6: Detail of plank carved according to the selected design by a carver in Siem Reap.