The Chong Samrong Kiln Site in Cambodia: Report on a Training Excavation

Don Hein, Louise Allison Cort, Ea Darith, and the Course Members

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FOREWORD

Research on the production of Khmer ceramics at kiln sites in Cambodia, notably in Siem Reap province, began in 1996. Within the immediate area of Angkor, kiln sites were identified at the villages of Tani, Bangkaong, Khnar Po, and Sarsei and on the Kulen plateau at Anlong Thom. The first site to be excavated was Tani, in a joint research project begun in 1996 between the APSARA Authority, the National Research Institute for Cultural Properties, Nara (NRICPN) and Sophia University Angkor International Mission (Japan). Excavations of three kilns at Tani yielded green-glazed and unglazed stoneware and identified the kiln structure. A site museum now exhibits findings from the kilns in the Angkor area.

As research continued, other kiln sites for green-glazed ceramics at Bangkaong, Sarsei, Anlong Thom, and Khnar Po were excavated by a joint research project between the APSARA Authority, NRICPN, the National University of Singapore, and Osaka-Ohtani University. The kiln structures and ceramics from those sites show meaningful similarities.

Despite this progress, one major unanswered question that intrigued researchers pertained to the well-known brown-glazed stoneware ceramics of the Angkorean period: where and when had they been made? The study of Angkorean ceramics entered a new phase when the first sites for such wares were identified along the road connecting Beng Mealea and Bakan, east of Angkor. In late 2011, the initial excavation, at a kiln site at Torp Chey village, was conducted by a joint research project between the APSARA Authority and the Institute of Southeast Asian Studies (Singapore). The kiln structure at this site is different from those excavated earlier, distinguished by the technical feature of secondary firing trenches across the kiln body and measuring more than twenty meters in length. This distinctive kiln structure has not been known previously.

As Cambodia has experience to excavate the kiln and we would like to share this experience with researchers in the region, the APSARA Authority and the Freer and Sackler galleries, Smithsonian Institution, Washington, D.C., created an archaeological training course for archaeologists of Cambodia and other countries of mainland Southeast Asia. Another kiln for brown-glazed stoneware, at Chong Samrong in Kambo Or village, was selected as the site for the training workshop.

This publication presents the final report from the excavation of Chong Samrong kiln no. 1. We hope that this report will provide new knowledge to researchers in the field of Khmer ceramics and kilns.

Bun Narith
Director General
APSARA Authority
Siem Reap, November 2013

FOREWORD

The Freer Gallery of Art and Arthur M. Sackler Gallery are honored to receive the support of the Henry Luce Foundation and the Friends of Khmer Culture (FOKCI) for this collaboration with the APSARA Authority, for the purpose of conducting a training workshop in ceramic kiln site excavation for young archaeologists in Cambodia and other countries of mainland Southeast Asia.

As the museums of Asian art at the Smithsonian Institution in Washington D.C., the Freer and Sackler are fortunate to hold a large collection of ceramics from mainland Southeast Asia, both prehistoric and historic wares, including sixty Angkorean period stoneware ceramics. Through researching, exhibiting, and publishing these works, we are keenly aware of the dynamic progress of ceramics studies, notably through the archaeology of kiln sites. Active exchanges with researchers in the region have benefitted our staff greatly, and we aspire to contribute to the further growth of scholarship and to building an international community of collaborative scholars.

With the support and encouragement of the Luce Foundation and of the United States embassies in Laos, Cambodia, and Thailand, in 2010 we collaborated with the University of Pennsylvania Museum of Archaeology and Anthropology to convene an international workshop on Southeast Asian ceramic archaeology. Thirty participants from Vietnam, Cambodia, Laos, Thailand, China, Japan, Australia, Canada, France, and the United States gathered to share their research achievements and goals. One outcome was a listserv that now links some two hundred specialists. In 2011, again with Luce Foundation support, a workshop on kilnsite archaeology was held in Siem Reap.

The landmark excavation later that year of the Torp Chey kiln site—the first site in the Angkor region known to produce the brown-glazed ceramics so characteristic of the Angkor period—inspired us to join with the APSARA Authority to organize an intensive, extended workshop in Siem Reap. Seventeen young archaeologists received intensive on-site training and contributed to the evolving understanding of Cambodian, and Southeast Asian, ceramic history through their guided excavation of a second kiln site for brown-glazed stoneware, at Chong Samrong. The Luce Foundation once again enabled us to realize the project, and FOKCI underwrote the study-storage center. The project also includes the preparation of this final report of the excavation at Chong Samrong.

Julian Raby
The Dame Jillian Sackler Director
of the Arthur M. Sackler Gallery
and the Freer Gallery of Art
Washington, D.C., November 2013

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This report is the collaborative product of the project management team and members of the training course. (Some informal names are included to correspond with the text.)

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Fig. 1. Leaders and participants of the course (Photo by Wang Yawen)

THE PROJECT MANAGERS AND COURSE MEMBERS GRATEFULLY ACKNOWLEDGE THE SUPPORT OF

H. E. Seung Kong, Deputy General Director, APSARA Authority
H. E. Tan Boun Suy, Deputy General Director, APSARA Authority
H. E. Mao Vibol, Cabinet Prime Minister
Dr. Tin Tina, Deputy Director, Angkor International Center for Research and Documentation

The Henry Luce Foundation, Inc.
Friends of Khmer Culture, Inc. (FOKCI)

Mr. James Hein, who revised the Ceramics Classification System (CCS) Database program

The citizens of Kambo Or village

VISITORS TO THE CHONG SAMRONG KILN SITE

16 March 2013
- Sugiyama Hiroshi, director of APSARA-Nara Institute project
- Sato Yuni, assistant to the director
- Sok Keosovannara, staff of APSARA-Nara Institute project
- Lam Sopheak, staff of APSARA-Nara Institute project

17 March 2013
- Dr. Helen Jessup, president of Friends of Khmer Culture (FOKCI)
- Siyon Sophearith, representative of Friends of Khmer Culture in Cambodia
- Khieu Thy, independent guide, Siem Reap

24 March 2013
- An Sopheap, official of APSARA Authority
- Srun Tech, official of APSARA Authority
- Phon Kaseka, Royal Academy of Cambodia, Phnom Penh
- Michel Pison, official of INRAP, France

25 March 2013
- H. E. Seung Kong, Deputy General Director, APSARA Authority
- H. E. Tan Boun Suy, Deputy General Director, APSARA Authority
- H. E. Khuon Khun Neay, Deputy General Director, APSARA Authority
- Ms. Tan Sawathya, Deputy Director of a Department, APSARA Authority
- Khiev Chan, official of APSARA Authority
- Men Chandarareaksmey, official of APSARA Authority
- Sam Sareth, official of APSARA Authority
- Darryl Collins, researcher, Australia
- Teachers and students from Kambo Or Elementary School

INTRODUCTION
TO THE ADVANCED ARCHAEOLOGY TRAINING COURSE FOR CAMBODIAN AND INTERNATIONAL ARCHAEOLOGISTS

This project was held in Cambodia from 25 February to 1 April 2013. Designed as a training course for young Southeast Asian archaeologists in the methodology of excavating ceramic kilns, the project aimed to provide the essential knowledge and skills required for such research by using well-defined and tested methods under the tutorship of experienced professionals. It also hoped to bring together a cohort of archaeologists who would become leaders in future studies of the production, distribution, and significance of ceramics in the region.

The idea for the project first took shape as Ea Darith shared with Don Hein and Louise Cort the remarkable discoveries of the first excavation of a kiln for brown-glazed stoneware ceramics within Cambodia, at Torp Chey, in late 2011–early 2012. With the support of the Friends of Khmer Culture (FOKCI), Don Hein was able to travel to Siem Reap from Australia in time to see the open excavation site. The Torp Chey kiln involved more than a different type of glaze; it also proved to embody technology theretofore unknown at kiln sites in mainland Southeast Asia. It was critical to capture this emerging new information and analyse its significance for the history of ceramics in Cambodia and in the region as a whole. An archaeological excavation offers just one chance to do so. The three colleagues agreed that the time was right to find a way to offer advanced training to young archaeologists with an interest in ceramics, who represented the future of the discipline.

Following up on earlier support from the Henry Luce Foundation—for an international workshop on ceramic archaeology in Washington and Philadelphia in 2010 and a kiln site archaeology workshop in Siem Reap in 2011—Louise Cort successfully sought funding for a five-week training course involving a kiln site excavation. A memorandum of understanding was executed between the APSARA Authority and the Smithsonian Institution, through the Freer Gallery of Art and Arthur M. Sackler Gallery.

The training program was announced on the Southeast Asian Ceramic Archaeology listserv, an outcome of the 2011 workshop. Thirty-seven applications were received, and seventeen participants were selected on the basis of experience, balanced regional representation, available funds, and desired scale of the course, taking into consideration especially the plan to live on site for the duration of the excavation.

Ea Darith investigated potential sites for the excavation and selected Chong Samrong, a site near the village of Kambo Or on the ancient road leading from Angkor and Beng Mealea to Bakan. Chong Samrong had the advantage of relatively easy access to market towns as well as proximity to the Torp Chey kiln site; an excavation there would offer meaningful comparison for the finds at Torp Chey.

As basic training materials for the workshop, Don Hein updated his *Handbook on the Archaeology of Southeast Asian Historic Ceramic Kilns*, the fruit of his experience excavating kiln sites in the region beginning in the early 1970s. He also worked with his son, James Hein, to revise the Ceramic Classification System (CCS) Database, initiated in 1984 and refined through field testing at a number of excavations. The system was created to deal with the requirements of registering kiln site finds efficiently and with adequate detail to make possible later analysis and assessment. Each workshop participant received bound copies of both documents as well as electronic versions on a DVD, which also shared other publications by the project organizers.

All participants arrived in Siem Reap on 24 February and stayed together at a small hotel (except for those who lived locally but joined for the welcome dinner).The program began with three days of talks providing background for the history and culture of the Angkor region, ceramic archaeology in Cambodia, and current research projects in Angkor. The talks were held at the APSARA Authority facility, and speakers included Ea Darith and Don Hein as well as Australian potter Merrilyn Stock; Im Sokrithy, archaeologist and APSARA Authority deputy director of the Information Department; Kim Samnang, APSARA Authority specialist in archaeological integrated mapping, remote sensing, and GIS; and Damian Evans, archaeologist from the Greater Angkor Project (GAP). All participants donned matching T-shirts emblazoned with the workshop logo and posed for photographs. (fig. 1)

On the afternoon of 27 February the group moved to the site, arriving in time to set up mosquito nets, hammocks,and sleeping bags under the L-shaped thatch-roof shelter or pitch tents and then share the first meal in the thatched dining-kitchen shelter. The first of the twice-daily briefings led by Don Hein, as site director, took place the next morning. These briefings introduced principles and guidelines for the excavation process and reviewed or prepared for the day's specifics, but they also dealt with aspects of successful communal living. In the course of the month on site, the camp was made cosy by judicious purchases on visits to the nearest towns. The diverse members of the group became a true team, both at the kiln site and in the camp. The last evening at the site was celebrated with a feast of multicultural cuisine—interrupted by a rain storm—cooked by Big Hà, Vuth, and others.

The course concluded on 1 April with a closing ceremony held at the APSARA Authority facility. Big Hà spoke on behalf of the international participants, expressing her appreciation not only for the technical skills imparted but for the chance to live and work together with a group of strangers who became friends, and her conviction that this was the way "to make our world better." Tho Thon, speaking for the Cambodian members, reviewed what he had learned, by observation as well as instruction, about how to manage a kiln site and expressed confidence that he too could become an effective site director. Each course member received a personalized certificate of completion, written in both Khmer and English and signed by H. E. Bun Narith, Freer|Sackler director Julian Raby, and the three project managers. Everyone then assembled for a final group photo. (fig. 13)

REPORT ON
THE TRAINING EXCAVATION
AT THE CHONG SAMRONG KILN SITE

REPORT ON THE TRAINING EXCAVATION AT THE CHONG SAMRONG KILN SITE

1. INTRODUCTION

This report documents the conduct of an excavation on an ancient kiln site that formed the major part of the training program held in Cambodia from 25 February to 1 April 2013. Due to the project's purpose as a training exercise, the report places considerable emphasis on the methodology used throughout the work. Also included in this report are results of a supplementary excavation, conducted on the site from 8 to 10 August 2013 by Don Hein, Tho Thon, and Sorn Chantharn, to re-examine the exhaust vents and firebox of the kiln.

Twenty eight days,from 28 February to 27 March, were scheduled for the initial fieldwork. Due to the isolation of the excavation site, but also because of operational advantages, the team lived on site. To make that possible, a small advance team prepared shelters for accommodation, cooking, and eating and bathroom facilities. Once the entire group moved to the site, the course members carried out further essential preparations by rigging sun screen mesh over the excavation area, constructing a sieve point shelter, and completing the clearing of undergrowth. Arrangements were made for water and food supply and three local cooks were employed. Car batteries provided power for lighting and recharging mobile phonesand laptops.

The training staff consisted of Dr. Don Hein, acting as Site Director; Dr. Ea Darith; Ms. Louise Cort; Mrs.Toni Hein,who supervised the documentation team; and Mrs. Merrilyn Stock as advisor on production methodology, with Mr. Clayton Downs as her assistant. Unfortunately, after a couple of days on site Merrilyn and Clayton had to return to Australia for medical reasons. The seventeen trainees who formed the excavation team were professional archaeologists and represented seven countries. Eight were Cambodian, four of whom were employed by the APSARA Authority and two by the Preah Vihear Authority, and two were in their final year of the archaeology course at the Royal University of Fine Arts (RUFA) in Phnom Penh. Among those, Mr. Tho Thon acted as Excavation Supervisor and Mr. Sorn Chantharn contributed as a senior member. Ms. Nguyen Thi Hà, who led the Vietnamese group of three, assumed the role of Deputy Excavation Supervisor. Mr. Thu Ya Aung, the only member from Myanmar, proved to be the most competent in computing, and his contribution assured the completion of the database record. Two members were from Laos and single members represented Thailand, China, and Germany.

The five women and twelve men in the trainee group performed extremely well and handled the onerous conditions of climate and work program without complaint. Apart from the cooks, the team members conducted all of the work, and no local labor was employed.

Conduct of the program required frequent changes of duty so that everyone could gain instruction and experience in the various roles of the excavation process, including excavation, sieving, cleaning, and documentation methodologies, along with practice of entry of finds into the database.

This training approach was considered essential to the aims of the course, even though it tended to disrupt continuity at each process point and slowed progress. This was an example of the inevitable conflict between a concentrated training program and the needs of professional excavation.

The excavation site was chosen in consequence of ongoing research of kiln sites in the area and in particular the discovery of kilns at Torp Chey village, located about five kilometers west of the selected site at Chong Samrong village along the ancient road, where five kiln mounds were found (Hendrickson 2008). In 2011, Ea Darith found seven additional kiln mounds, for a total of twelve (Ea 2012a). An excavation in 2011–2012 of one mound at the Torp Chey site revealed use of production technology not previously known to have existed in Southeast Asia during the Angkorean period, and questions that arose from that excavation about the operation of the kilns and their origins were current in the aims for this work (Ea Darith 2012a, 2012b, Hein 2012). Therefore, frequent comparisons between the two sites are made in this report.

To a lesser degree, one other factor affecting progress of the fieldwork was that of visitors invited to the site. This was the result of a deliberate attempt to encourage visitors from archaeological departments, universities, funding organizations, schools, and the public to view the work and promote interaction. The ulterior motive of this activity is to allow people of influence to see the level of archaeological professionalism which in turn increases the reputation of the archaeologists doing the work. It is by this process that the level of confidence in the quality of the fieldwork is increased and its reputation improved.

2.THE EXCAVATION SITE

At the height of its influence, the Angkorean empire (traditional dates 802–1431) encompassed modern Cambodia as well as much of present-day Thailand, Laos, and Vietnam. Centers of political, cultural, economic, and religious importance were linked by well-maintained straight roads. One of these roads connected Angkor and Phimai, and much evidence of ceramic production has been located along it in recent years, both in Cambodia and within modern Thailand. The road passes close to Ban Kruat, where a large complex of Angkorean kiln sites once existed. Another one of the major routes connected the capital with outlying areas to the east, including the important religious and population centers of Beng Mealea and Bagan (Preah Khan Kampong Svay). (fig. 2) Along the road between those two centers, three laterite and sandstone bridges span water courses that cross the route, along which lie the remains of many stone temples and other buildings as well as a number of locations for ceramic production.

This evidence suggests that a sizable population once occupied the area along the road, but today only a few villages exist. Kambo Or is one of those villages, located about twenty kilometers east from Beng Mealea. (fig. 3) The kiln site known as Chong Samrong is about 100m northeast of the road, opposite the western edge of the village. Two kiln mounds are known. The one closest to the road, marked as Kiln Site 01 on the survey map, was chosen for excavation because of its poor condition due to human and animal traffic in the area.[1]

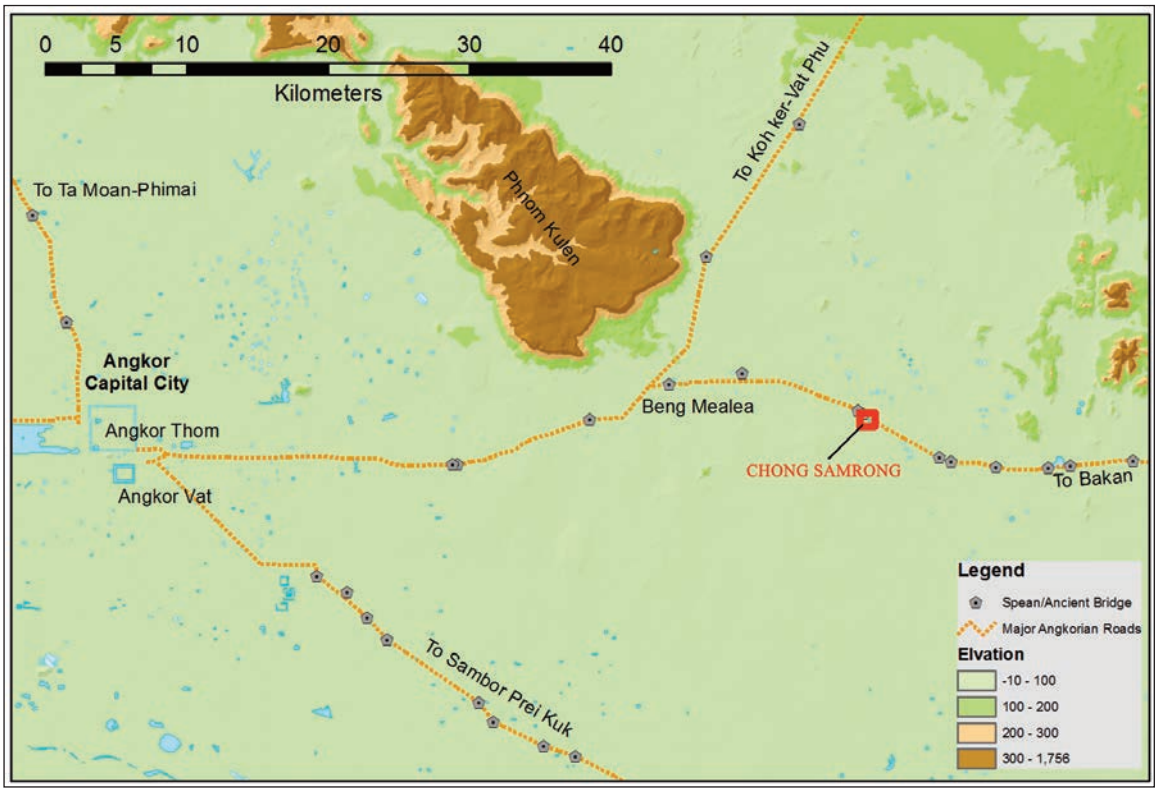


Fig. 2. Sketch map of the ancient road from Beng Mealea to Bakan (Courtesy of Kim Samnang)

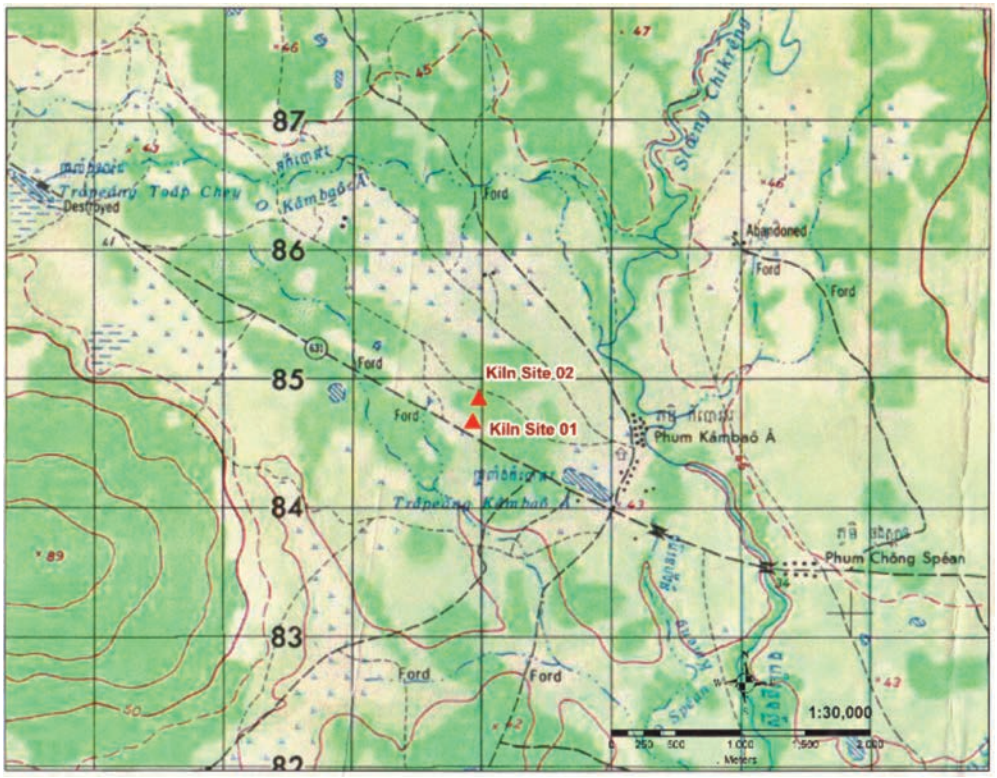


Fig. 3. Survey map showing location of Kambo Or village, Chong Samrong Kiln Site 01, and ancient bridges

The kiln mound is adjacent to a low rise that partly surrounds a circular depression commonly described as a pond but which in fact was probably dug out as the original source of clay. The immediate area is surrounded by secondary growth forest some of which had been cleared for rice fields or vegetable gardens. Generally flat, the landscape is cut here and there by streams, most of which drain in a southerly direction toward Tonle Sap Lake. The soil surface is iron-rich sandy loam with outbreaks of clay and laterite. Habitation is sparse, mostly limited to small clusters of houses scattered along the ancient road.

Seasonal climate affects the area. The hot weather during the February-to-March term of the main excavation, a product of the northeast monsoon, left the ground dry and very hard, and vegetation reduced. The supplementary work done in August experienced the wet season of the southwest monsoon, with heavy rainfall, soft ground, and prolific vegetation growth.

Following conventions of kiln-site archaeology, the kiln was identified by a code comprising the site code (K - Cambodia, C - Chong Samrong kiln site, C - Chikreng District), and the letter K (kiln), followed by the kiln number. The code for the Chong Samrong 01 kiln site was KCCK#1.

3. SITE SURVEY

On 28 February a survey of the site was led by Dr. Tin Tina, Deputy Director, Angkor International Center for Research and Documentation, and conducted by Mr. Kim Samnang, APSARA Authority GIS and IT Coordinator, and his team. They established two bench marks and five secondary survey points to fix the location of the kiln. (fig.4a) The survey data are given in Appendix 3. In 2012 the same team did a similar survey for the Torp Chey kiln site located further west along the ancient road near the village of the same name. Possible relationship between the two sites is discussed below in chapter 11.

4. GUIDING PRINCIPLES

Certain practices were followed in the conduct of the fieldwork and were introduced to the workshop participants as key to a successful kilnsite excavation.

On-site residence. One guiding principle was the conviction that, especially in regard to remote sites, better results occur if the field team lives at the site close to the excavation. This requires the advanced preparation of facilities for sleeping, storage, cooking, and bathing; toilets; and

[1] It is usual practice in beginning work at a new site with multiple kilns to first excavate one in poorer condition so that any errors of judgement will be of less consequence—in other words, to leave the best for more informed archaeology.

arrangements for the supply of food and water. The advantages of this system are that time and expense of daily movement to and from the site are avoided, security of the site is enhanced, and equipment can be left *in situ*. An important additional advantage is that distraction from the work is reduced.

Site director. Another principle is that the site director should remain on site for the duration of the fieldwork. This is a necessary condition if that single person is to fulfill the required duties of leadership and management. Among these duties is the need to maintain an atmosphere of seriousness and close attention to the work, in which due focus on the responsibility of undertaking research of national antiquities is maintained. Distraction caused by inappropriate conduct, loud conversation, use of sound devices (radios, music players, and mobile phones), unregulated movement, etc. can seriously affect the quality of the work.

Maintaining focus on the job at hand depends to a large degree on everyone's understanding what is to be done—knowing what procedures are to be used, how the work is progressing, and what particular matters are to be kept in mind. These are the kinds of points made at the site director's morning and after-lunch briefings to all staff.

Excavation strategy. The excavation strategy was to excavate one half of the kiln along its longitudinal axis, a practice followed by the site director for many years. A number of principles underlie the strategy, the main one being to reduce the amount of work to be done and thereby leave more time for observation and consideration. As kilns are usually physically symmetrical about a central axis, one half being (more-or-less) identical to the other, in practical terms all or nearly all of the information and proportional data may be gained using this method. Also, the technique leaves a useful central profile. Another important reason for use of this method is that half of the kiln remains available to future research and confirmation (or otherwise) of the earlier work. When all of a site is fully excavated in the initial excavation, there is no capacity to verify results independently through later studies. This strategy presupposes that an accurate determination of the center line is possible, a factor that became pertinent in this case.

5. METHODOLOGY

Because the excavation was integral to the training course, emphasis was placed on methods, particularly in respect of the use of equipment and the system of maintaining the integrity of the source identification of finds.The purpose of the planned excavation was explained as twofold: not just to uncover a kiln known to exist, but also to carefully record its physical and historical context.

Definition. Achieving this goal of careful recording begins with the degree of definition imposed by the size of squares and depth of levels (spits). A kiln usually constitutes a limited area with a highly variable context involving significant change over short distances.Therefore small volumes of definition are necessary. Use of 1m squares with potential for further loci divisions is prudent. The depth of levels is largely determined by the matrix but should generally lie between five and ten centimeters. Layers of kiln floors, walls, sediment, or ash depositsare to be separately

excavated within levels. To a reasonable degree such definition allows the virtual reconstruction of the excavated matrix, and the evidential placement of finds close to their original position.This theory depends upon the integrity of the chain-of-evidence relating to the identity of finds from the place of their discovery to the point when they are permanently inscribed with a registration number or encased within an identified container.

Excavation. Only two hand tools were used to excavate. One (used by farmers in Thailand, where it is known as a *lek kut*) was a flat, narrow iron blade (about 40mm wide x 250mm long) set into a round (bamboo) handle about 400mm long, used more-or-less in a vertical orientation to dig. (fig. 4c) The other tool was a standard small trowel used either to dig softer sediment or to remove dug spoil using a plastic dustpan. No spades or hoes were permitted due to the high risk of damaging finds.

Excavated spoil, including finds, was placed in a plastic bucket with a marker[2] that identified the source square, or square locus.[3] Friable or special finds were contained in a sealed plastic bag and identified with the site code, grid, square, and level. Usually such bags are placed on the top of a spoil bucket and pass through the normal processes, but in some cases they were taken directly to the documentation point.

Charcoal finds were rare and none was found in a location that could be considered suitable for use in chronological dating. Had charcoal been observed by any of the excavators the protocol directed that the excavation supervisor should be immediately advised. A circle of about 30cm would be marked by chalk or incision around the sighting and a collection bag would be prepared by being labeled with the site reference, date, grid, square, level, and name of collector. With the bag placed nearby to serve as identification, a photograph would be taken. Then a slow and deliberate extraction of the charcoal would begin by digging around it so that damage did not occur to any lumps. Cotton gloves might be worn to reduce the risk of damage to the lumps. After collection another photograph might be taken. Then the sample would be placed in a dedicated (lockable) box.

Buckets were then taken to the sieve point and placed in square lots.

Sieving.To meet best practice in excavations of this kind, all material was sieved using a 5mm wire mesh. Roots and other natural material were discarded at this point.[4] Kiln rubble was separated at this time and recorded on a Rubble Record Sheet in excavation square and level lots. Rubble was divided into three size groups: small (less than 3cm), medium (between 3cm and 8cm), and large (greater than 8cm). Each size group was weighed, and notation was made of any peculiarities such as the existence of hotface,[5] grass impressions from kiln construction, or any surfaces indicating form such as that associated with stokeholes, the fire wall, etc. Samples were selected and

[2] The markers made of strips of wood, bamboo, or plastic are inscribed with a black spirit pen on both sides of each end with the square or locus code, and stand above the rim of the bucket by about 5cm so they are always observable. The buckets are under-filled to avoid spillage. At the excavation, the markers of a particular square are kept in an identified container placed near the square. (fig. 4e).

[3] No loci (segmented sections of a square) were needed during this excavation.

[4] Roots are not discarded at the point of excavation, due to difficulty of disposal and the accumulated mess, but at the sieve point, where deposit can be more systematic.

[5] Hotface is a potter's term identifying any wall surface facing into the kiln, therefore subject to heating, and is recognisable by sintered or fused condition.

contained in documented plastic bags; otherwise rubble was also discarded at this time.

Washing. Finds from particular squares were then passed to the washing (cleaning) point and a judgement was made on what kind of cleaning would be applied, if at all. Most ceramic shards were simply brushed clean in water. In this excavation, the low count of finds meant that space for drying was not a problem.

The finds, together with their identifying markers (contained in a plastic tray), were then passed to documentation.

Control of work flow. Commonly, the level being processed is not the same at all points. For example, although excavation level 7 is being dug, the sieve point may not have finished level 6, and washing may still be on level 5, while documentation may not have finished level 3. To ensure that each particular level lot remained isolated, narrow boards (in this case, strips of bamboo) marked with the term 'NOGO' (no go) were placed between lots, to indicate that nothing should pass that point.[6] At each processing point only one level was processed at a time. A level check-off sheet (LCOS) listing levels was displayed at each point so that all concerned could observe it. As an excavation level was started or finished, everyone's attention was drawn to the sheet as the site director or the excavation supervisor declared the fact and marked the particular level number.[7] The senior person at each of the other points (sieving, washing, documentation) used the same process.

Each processing point was in close proximity to, and in line of sight of, the excavation.

Documentation. Documentation of finds usually demands the largest number of people. In this case the quantity of artifact finds was relatively small, so only a few operating members were needed. Only one level in square lots was documented at a time. Each square was recorded on a separate set of level classification sheets (LCS). The database system used to document finds is called the Ceramic Classification System (CCS); it was developed by Don Hein and associates over many years to provide a workable method of recording a range of data for individual pieces or groups of similar ones.[8] At any one time an average of eight people was needed at the documentation point. This prohibited direct computer data entry. Therefore a primary hard copy system was used and the completed sheets were passed to those entering the data onto the computer database. All data entry was completed by the end of the excavation period while the group was still on site.

In designing the database the categories of classification were carefully chosen and limited by the practicalities of the documentation process. Source, attribution, physical and aesthetic description, quantity and weight were the main factors to be recorded in twenty-six fields. The system had the facility to contain images, such as drawings or photographs, and documents in any individual record. Microsoft Access was used to generate the statistical analysis used in this report.

[6] When in use the NOGO board is mounted horizontally on two stakes about a metre above the ground, but otherwise is hung nearby in a vertical (inactive) position.

[7] At the start of a level the particular number on the level check sheet was crossed one way. At the finish of the level, the number was crossed the other way, completing the X.

[8] Copies of the CCS system can be obtained through email contact to: don@hein.com.au.

6. SITE CONDITIONS AND ROUTINE

The weather was extremely hot during the field period, 27 Feb – 27 March, but shade cloth supported by rope lines over the excavation site provided adequate shade. Contrary to local advice, it rained on eight of those days, albeit mostly in the later afternoon.The thatch roofing over most of the eating and sleeping facilities provided shelter.

The schedule for the team work program was a morning session from 7 untill 11am, then an afternoon session from 1 to 4.30pm six days a week. Sunday was a free day, and visits to local monuments were arranged. Each day began with a briefing by the site director at 7am and another took place after lunch at 1pm.

7. PROCESS OF THE EXCAVATION

On Saturday 2 March the mound was examined to judge the location of the kiln based on the evidence of clear exposure of kiln walls on the eastern side and surface rubble. Because the mound had a long sloping face toward the north and a much steeper face toward the south, it was expected that the firebox end of the kiln was located on the north side and the vents (chimney) would be found on the highest point. A primary north-south line was pegged along what was judged to be the central axis of the kiln. Then an east-west 1m grid was set, measuring 4m wide and initially 5m north-south. (fig. 5) For setting out the grid, pins of bamboo were first used and were later replaced by metal ones with a yellow painted circular top. String lines were attached to the pins using rubber bands to allow accidental displacement of the lines without disturbing the pins. Each square was identified with a double-sided tag stapled to the grid lines and marked with the adjacent square codes (e.g. E6-F6). (fig. 4e) A plan of the grid showing each square was displayed on a nearby tree.

Survey. A Bosch GOL20D survey level and tripod was set at a position outside the area to be excavated at a height a little above the highest feature so that all readings would be below the temporary datum level. Datum marks were inscribed on two nearby trees that were approximately parallel to the datum line, one forward of the level and one to the rear, allowing a double check of the level's height position. The level was removed at night but the tripod remained in its reinforced position so that resetting of the level each day took very little time. To avoid errors, all survey measurements followed a standard procedure by three people. First one person checked the alignment of the survey level then, with hands free of the instrument (behind the back), took a reading in millimeters from the staff held upright on a feature. While still looking through the instrument, the person on the survey level then called out the height in millimeters—that is, the distance below datum, e.g. '1052'. (A survey staff usually has a millimeter scale on the reverse side and is ideal for short-distance readings.) A third person (usually the excavation supervisor or site director) recorded the measurements on the record sheet (LRS), then (in a loud voice) read it back. The first person then verbally or by hand movement indicated confirmation.

a. Dr. Tin Tina supervising survey (Photo by Hannah)

b. Setting out grid (Photo by Louise)

c. Excavation begins (Photo by Thu Ya)

d. Digging the SFT (Photo by Toni)

e. Recording finds (Photo by Louise)

f. Sieving and washing (Photo by Big Hà)

g. Documentation of finds (Photo by Toni)

h. Database entry (Photo by Louise)

Fig. 4. Progress of the Excavation

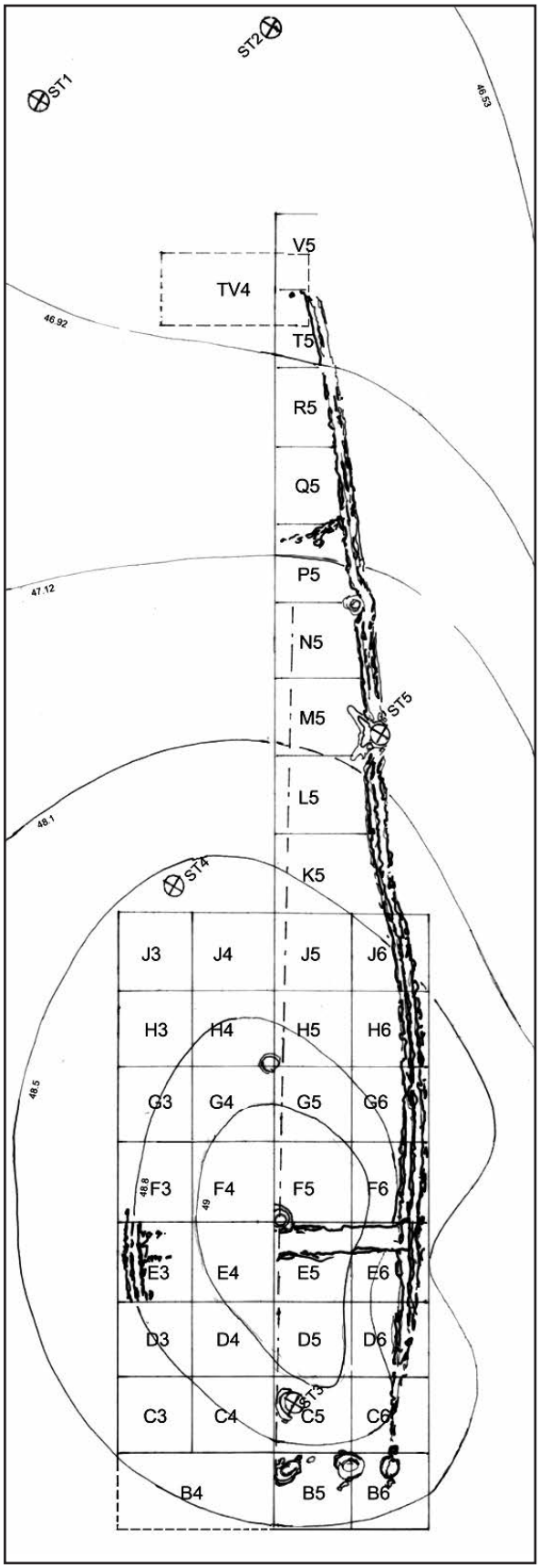


Fig.5. Excavation grid showing squaresTV4 and B4

During the excavation process, dug spoil was not allowed to accumulate as it hampered observation. Digging through already dug spoil was discouraged for the same reason.

At the conclusion of each level the grid lines were transferred (using the plumb bob) to the ground surface as a chalk line. Then the grid lines were placed to one side such that the square label could still be seen. The squares were then photographed individually. The detail of the square surface was drawn on the level record sheet (LRS) and, using the staff and survey level, corner and feature heights were recorded on the LRS. Finally, comments by the excavation supervisor were added. The LRS also has places to record start and finish times, find location measurements, photography completion, etc. (for each level).

Emergence of the kiln structure. The convention for describing the orientation of a kiln is to observe along its axis from the firebox toward the chimney or vent. On the upper surface of the mound three parallel and contiguous side walls of successive kilns were apparent, most clearly on the left hand (easterly) side, where greater erosion was evident. Those walls belonged to the firing chambers of three kilns, each of the latter two built successively within and slightly higher than its predecessor.While this resulted in a slightly narrower chamber for each successive kiln, the advantage was that the existing firing chamber base and firebox could be reused without major reconstruction. This circumstance is commonly found in historic kiln sites throughout Southeast Asia.

No sign was apparent of a chimney or vent at the top of the mound prior to excavation. On Monday March 2013, digging began at the uppermost squares (C3, C4, C5, C6; D, E, F,ditto) and it was soon apparent that compaction had occurred and the clay-sand-rubble matrix was very hard. Consequently,digging was extremely difficult and progress was slow. Therefore the

initial intention to excavate the grid area to find the opposite (western) walls of the firing chamber was abandoned after level 3. Only the excavation of E3 and E4 squares was continued to a depth of about 15cm to locate the western wall. Using the two opposite walls as a guide, the orientation of the longitudinal axis was judged to be coincident with the center line of the existing grid. As the distance from the center line to the innermost eastern wall was only about 1.4m at its greatest point, excavation was limited to a single line of squarescontained within that space. The squares, B5, C5, B5, C5, E5, F5, G5, H5, J5, K5, L5, M5, N5, P5, Q5, R5, T5, V5, were progressively opened as the excavation proceeded down the slope of the kiln.[9] (fig. 5)

During the excavation it was extremely difficult to distinguish layers due to the compacted and disturbed matrix.

Roof-supporting columns. In level 4 the first recognized feature was a roof-supporting column in square C5 on the center line. Later, another was identified in F5, then a third at the junction of squares G and H. All of the extant columns were located in the upper section of the firing chamber coincident with the lowest arch of the roof dome, which would not have been self-supporting. (fig. 12) The same logic and kiln design principles also suggest that the dome further down the firing chamber would have become higher and more semicircular and would have required no support. This configuration was similar to that of Torp Chey except that two laterally placed columns were used close to the vent wall.

Vent system. In square B5 there were signs of a vent system,with two exhaust-vent apertures (in poor condition). There would have been four apertures altogether across the upper end of the kiln. Some remnants of a clay wall outside the vent apertures may have been the remains of a vent box.[10]

Secondary fire trench (SFT). In level 6 what seemed to be a secondary fire trench (SFT) of the kind found at Torp Chey in 2011–12 appeared in square E5. Marks were observed on the inner face of the eastern wall that seemed to match the lower trench walls. On closer inspection of the western wall earlier exposed in square E3, evidence of the same trench was found at a height coinciding with the marks on the opposite eastern wall. This proved that the top of the trench (and therefore the firing chamber floor of the uppermost kiln) had originally been nearly as high as the remains of the side walls. The trench had parallel clay walls about 30cm apart, the inner faces of which were hardened by heating. The trench extended across the width of the firing chamber. Excavation of the trench continued to a depth of about 1m, passing through fallen roof rubble without any change of width and without finding a discernible floor. Some sign of white ash was seen but no charcoal. Further excavation had to be abandoned due to the difficulty of access. It appeared that the trench had been used for each generation of kiln reconstruction, the top being extended to allow for the increase in height as each kiln was rebuilt on top of the earlier one.

Firing chamber floors. In the main body of the kiln, two small patches of firing chamber floor were found at descending levels, some covered with a layer of sand which suggested a means

[9] The letters I, O, S, and U, are not used as codes for squares due to the risk of confusion with numerals, especially in documentation.

[10] In central Vietnam, kilns of a similar type had a vent box—a surrounding wall to protect the vents from wind interference (Degraeve et. al.2006:82). No similar feature has been identified in Cambodia and in fact the vent system at Torp Chey was quite different.

of leveling to allow jars, the principle products of this kiln, to stand upright.

Firewall. At level 12 at the junction of squares P5 and Q5, what was thought to be the firewall of the firebox was observed. Later discovery proved this to be an error. It showed considerable damage due to collapse and fusion, and shards of some medium-size jars adhered to the remaining upper part. (See Appendix 1.)

Adjustment to center line; stokehole. As the remaining eastern side walls of the kiln were exposed by excavation, they narrowed toward the location where the stokehole was expected to be, such that there was insufficient space to accommodate the excavators. It was then realised that the assumed alignment of the center line was incorrect and that an adjustment was required. Therefore, the center line, while remaining fixed at the southern end, was moved 25cm to the west at the junction of squares N5 and P5 and the excavation of squares P5, Q5, R5, and T5 was extended to that new alignment.[11]

This adjustment of the center line was entirely arbitrary. On 23 March, degraded remains of what appeared to be the kiln stokehole were found at the junction of squares T5 and V5. It seemed to be of a single aperture belonging to a long narrowing firebox.

Test pits. At this time two 1m-square test pits were initiated to locate waste deposits from the kiln. Some shards were recovered in Test Pit 1 to a depth of 1m, while very few finds were made in the other pit which struck a laterite bed at 50cm.

Excavation survey. The excavation concluded on 24 March. Survey of the kiln began, using the survey level, measuring tape and plumb bob. In the drawings, all longitudinal and transverse measurements are accurate, but some transverse measurements may not represent exactly the half-width of the kiln due to the uncertainty of the assumed center line. For example, the assumed firewall measured 72cm, but 1.44m may not be an accurate measurement of its full width. Also the stokehole half width of about 25cm seems small for the half-width of a single stokehole. This indicates that while the half division of the upper section of the kiln, which had both side walls to accurately determine the center line at that point, was correct, the assumed direction of the center line from that point throughout the length of the kiln was possibly incorrect by some degree.[12] Time did not allow for any verification during the workshop, but a short follow-up study took place in August. (See Appendix 1)

Near the end of the excavation visitors—including Kambo Or villagers and about 100 children from the local school—were encouraged to visit the site to see and understand the excavation process and results, especially the point that nothing of market value had been recovered. (See the list of visitors to the site.) Following the survey the kiln was backfilled with sand, then covered and consolidated with sediment from the sieve point.[13]

Conclusion of excavation and return to Siem Reap. On 28 March, the dig was concluded with a general clean-up, pack-up of tools and equipment, dismantling of structures, payment of land use compensation, and gifting of surplus materials to the three land owners and other villagers. In the late afternoon two buses and several other vehicles transported all staff and stores back

[11] This correction maintained the principle of half-longitudinal excavation.

[12] Any error would have been extenuated by the apparent 16m length of the kiln.

[13] Several young men from the village were hired to bring eighteen loads of sand from a river bed source several kilometres away, using local vehicles via a track cut through the vegetation to allow access to the site.

Fig. 6. Kiln at conclusion of initial excavation (Photo by Bank)

to Siem Reap.

Study-storage. A temporary study-storage area had been set up in the library of the main APSARA Authority building to contain the finds from the excavation. There instruction was given on the operation of a study-storage facility. The need to examine finds from the excavation for a review of finds (a process not possible while on site) was explained. Finds were set out on tables in the excavation square and level order in which they had been found. Notes were made on features and particularities, and some pieces were selected for photography. Other workshop commitments reduced the amount of time for this process, but the possibility of a future study-storage training course was discussed.

8. SUBSEQUENT EXAMINATION OF THE CHONG SAMRONG KILN

After conclusion of the training program, discussion among senior members of the team revealed serious concern about some factors of the outcome. While the training course itself was considered a significant success, it was felt that the schedule had not allowed sufficient time for the work to be done to define the kiln sufficiently, especially in regard to the exhaust vents and the firebox. Dr. Darith sought and gained permission for further work to be done, and Don Hein, Tho Thon, and Sorn Chantharn returned to the site in August 2013 for additional excavation conducted over three days.

They set out 2x1m squares at the vent and stokehole ends of the kiln. Further definition was made of the exhaust vents by Tho Thon to show that there were a total of four apertures belonging to the second kiln, through which the exhaust gases passed. However it was the firebox that was to provide the greatest surprise. It was expected that the excavation would expose the stokehole area, but at 80cm depth three walls corresponding to the right hand (westerly) side of the kiln were found. They crossed the pit and continued beyond the confines of the pit. That meant the previous assumption

of the stokehole position was not correct. The walls were each about 16cm thick, contiguous, and in good order. The inner one (belonging to kiln 1) had a well-fired hotface.

At 1.2m depth, a curved sloping wall was found adjacent to the wall hotface which proved to be the firewall of kiln #1. The left hand part of that firewall was missing, and continuation of the excavation at that point revealed another firewall of the same nature about 20cm below and behind the first. That was part of the firewall of kiln #2. (fig. 7) This means the earlier find of a firewall during the training excavation was incorrect.

At that level of the excavation, broken rubble and shards constituted the main fill. However, many of the shards were in a vertical orientation, unusual in normal deposit. This circumstance strongly indicated activity by looters. This was confirmed when a degraded modern transparent plastic bag was found in the fill. Further excavation was made impossible by the presence of wet-season ground water.

From discussions with local people it was learnt that during the Khmer Rouge period the upper part of the mound had been dug 'to see what was there', something that had been suspected from early in the training excavation. That digging could have been the cause of the damage to the structure, especially of the firing chamber floors, and to the actual firebox and firewalls found in the supplementary excavation. It also explains the disturbance to the normal stratigraphy, and could also explain why no charcoal was found in the secondary fire trench. Looting may also be the reason why so few ceramic shards were found.

9. OBSERVATIONS MADE AT THE CONCLUSION OF THE EXCAVATION PROGRAM

In general the uppermost kiln appeared to be consistent in form with other Angkorean period kilns, more-or-less rectangular in plan but slightly wider toward the vent end. As far as could be determined, the two lower kilns in the mound, evident by walls and other features, were of the same type. All the kilns were built of clay, apparently manipulated over a framework of bamboo covered with reed, as indicated by the many finds of wall rubble with irregular striation on the inner face reflecting the imprint of the reed.The limitation of time allocated to the training dig program inhibited the use of a sondage to investigate the structure of the kiln mound. However, the mound most likely consisted of sediment from the adjacent clay pit area; it was probably built up with the overburden removed from the clay pit to expose the clay bed.[14] It was shaped to form the incline of about fifteen degrees required for the kiln. The firebox was partly dug into the natural ground.

It is a common circumstance of kilns built on mounds that, after their abandonment, much of the upper structure of the kiln is eroded over time due to animal and human traffic and natural causes. In the case of Chong Samrong the missing exhaust vents and associated floor of the

[14] A mound composed entirelyof sand would be subject to erosion, and some means of reinforcement would be advantageous. At Torp Chey this was achieved by the use of stone chippings used as a base.

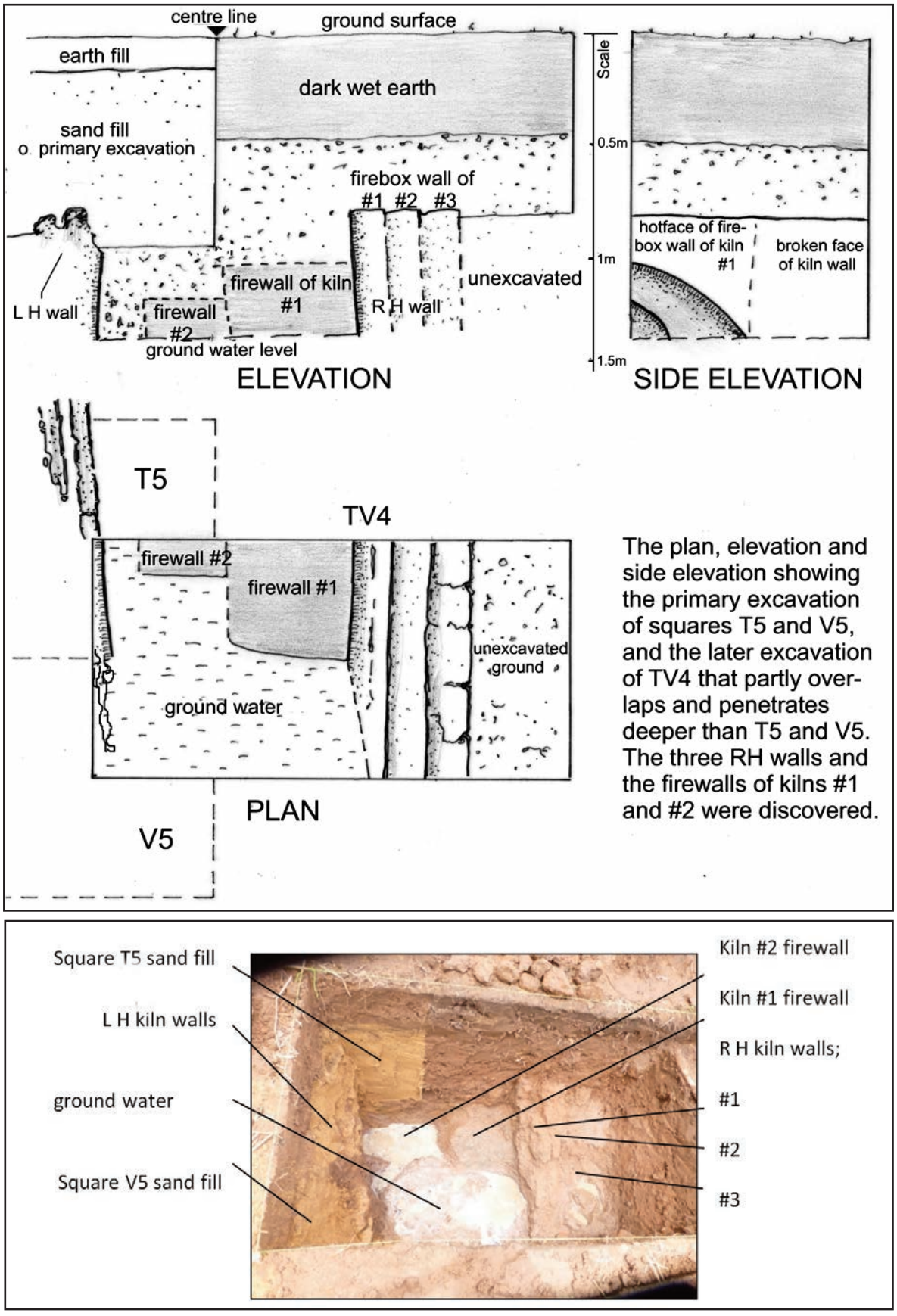


Fig. 7. Drawing and photograph of squares T5, V5, and TV4

uppermost kiln were represented by rubble found down the slopes of the mound.

Rubble from the kiln dome was found collapsed onto the floor of the kiln and into the firebox. In contrast to Torp Chey, where floors and infill layers were intact and clearly defined, Chong Samrong kiln floors were difficult to distinguish due to disturbance and the similarity of the material and its compaction into one hard but fractured mass. This degree of damage to the Chong Samrong kiln seemed excessive and could not be fully understood other than as the result of deliberate human activity, although at the time of the primary excavation no obvious evidence of looting was apparent. What was thought to be the firewall of the firebox was extensively damaged by fusion and appeared to have partly collapsed. Its construction could not be properly observed but appeared to be simply a wall of clay.

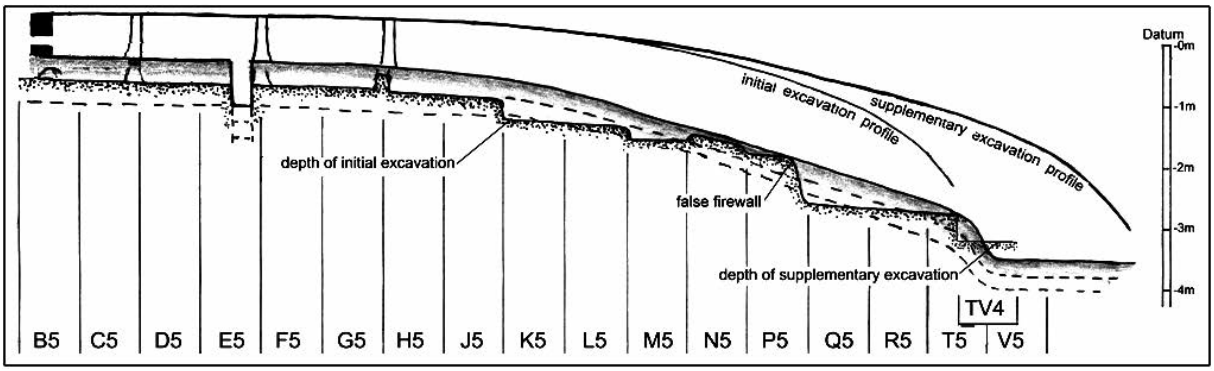


Fig. 8. Profile of kiln KCCK#1based on initial excavation assumption and supplementary excavation finding

To this point the form of the kiln was consistent in general with other Angkorean kilns: clay construction, widest at the vent end, the main body with more-or-less parallel sides before narrowing slightly toward an offset firebox. The structure of the vent end of the firing chamber is a distinguishing feature. Roughly contemporaneous kilns of northern and central Vietnam have a vent system composed of a low wall at the upper end of the firing chamber (on which the roof rested) penetrated by a number of apertures through which the exhaust gases passed to exit the kiln. Commonly, an additional wall protected the passage of the exhaust gases from interference by the wind (Hein 2008).[15] (Following a different paradigm, historical kilns of Thailand, Burma, and Laos generally have a single round chimney.)

Apart from the protective wall, which has not been identified for Angkorean kilns to date, it appears that a similar vent system was used in Cambodia. Although previous kiln site excavation reports describe erosion of the upper structure that left no sign of the vents, for the first time in Cambodia, Torp Chey and Chong Samrong present clear evidence of exhaust vents of underlying kilns, although with a particular difference to those of Vietnam.[16] In both regions the firing chamber ended in a lateral wall penetrated by apertures, but at Torp Chey the apertures continued horizontally through the mound for about 1m to exit at the outside sloping mound surface. (fig. 8) The vents of the uppermost kiln at Chong Samrong were completely eroded, but evidence of vents that

[15] This condition is clearly illustrated by the excavation at Go Hoi, in central Vietnam (Degraeve et. al. 2006).

[16] Excavation below the uppermost kiln has been uncommon in Cambodian archaeology but recent work has begun to reveal discoveries at depth such as several generations of exhaust vents at Torp Chey.

belonged to the second kiln could be observed in the remains of a wall with four apertures.[17] That there were at least three kilns in the mound of Kiln 01 at Chong Samrong was clearly demonstrated by the three walls on the eastern side. Those walls ran parallel without break for the full length of the kiln, indicating that the kilns were all of approximately the same length.The secondary fire trench was very deep and appeared to have had its height progressively increased by the addition of clay, which suggested reconfiguration of the trench to suit successive generations of kilns. While some patches of fine compacted grey ash were found at the lower levels of the trench, no charcoal was evident. This absence indicated either that small pieces of fuel were used for side stoking and the woodhad burned completely, or that some other explanation was involved.

The excavation also revealed the confounding aspects of the damaged condition of the kiln structures. No intact floors or related layers existed. This gave rise to a suspicion that the site must have been disturbed by looting, but no other sign was found, such as backfilled holes or evidence of inappropriate or modern material. Natural erosion did not appear to be causal and no convincing reasoning could be offered other than the growth of trees over centuries. The other puzzling issue was the general lack of charcoal, other than that on or close to the surface, probably resulting from recent burning of forest fires or actions of farmers. As a result, no sample was considered reliable for scientific testing.

10. FINDS

As the main excavation was limited to the kiln itself, few shards of ceramic ware were found in the excavation, and those recovered were fragmentary and small in size. (See Appendix 2.) Only a few small shards were of foreign origin. All appeared to be Chinese. The small number of ceramic finds seems to be a consequence of the looting process that had probably collected most of the larger and more significant pieces. Another reason for the lack of shards is that the excavation was largely confined to within the kiln structure, where it is usual that fewer pieces are found.[18] The majority of the shards found were in the earthenware fired state but, to judge from their form or wall thickness, were intended as stoneware. This judgment was reinforced by immature glaze on one surface of many shards.

The limited range of form types found at Chong Samrong was of interest. There was no sign of roof tiles, animal models, or lids. The absence of supports (setters) of any kind lead to the assumption that objects were placed one on another, although the scars usually resulting from such placement were not observed. The only non-vessel objects found were a wheel of a type associated with a toy and pieces of a earthenware support (of a type that supports a cooking vessel over a fire).

Of the shards recovered, nearly all were fragmentary and represented only a small part of the

[17] Two of the apertures were exposed in the half excavation.

[18] In the operation of kilns, wasters were dumped a short distance from the kiln, either downslope or into convenient holes such as abandoned clay pits.

complete vessel. No form type could be determined with certainty. Pieces of base, body, and mouthrim could be readily identified. Most shards belonged to medium to large stoneware jars, many with a wall thickness of between 10mm and 15mm, although some were greater. The largest piece was of large portions of several black glazed jars of medium size that had collapsed and fused in the firing. They appeared to form the top of a firewall and had been left *in situ*. Some of the largest pieces came from the two test pits and appeared to be discarded material from the kiln. A few lugs were found, representing both functional and vestigial types. Most were still firmly attached to a jar shard, but the finds included several separated loop lug types.

The typology offered here is arbitrary, based on what is considered to be a median type of a large variety. All drawings are actual size. Only rim types and one variation of the base type are listed in the typology. Where possible they are grouped by type and type of ware. Type codes, e.g. FPB2 (meaning form/part/base/type 2) and, if appropriate, the registration number, e.g. RKCC18 (meaning registration/site code KCC/registration serial number 18), are attached to the drawing. Only rim types and one variation of the base type are listed in the typology. FPR refers to a rim, FPM refers to a mouth (usually including the mouthrim), FPB refers to a base, FPL refers to a lug, and FW refers to a wheel.

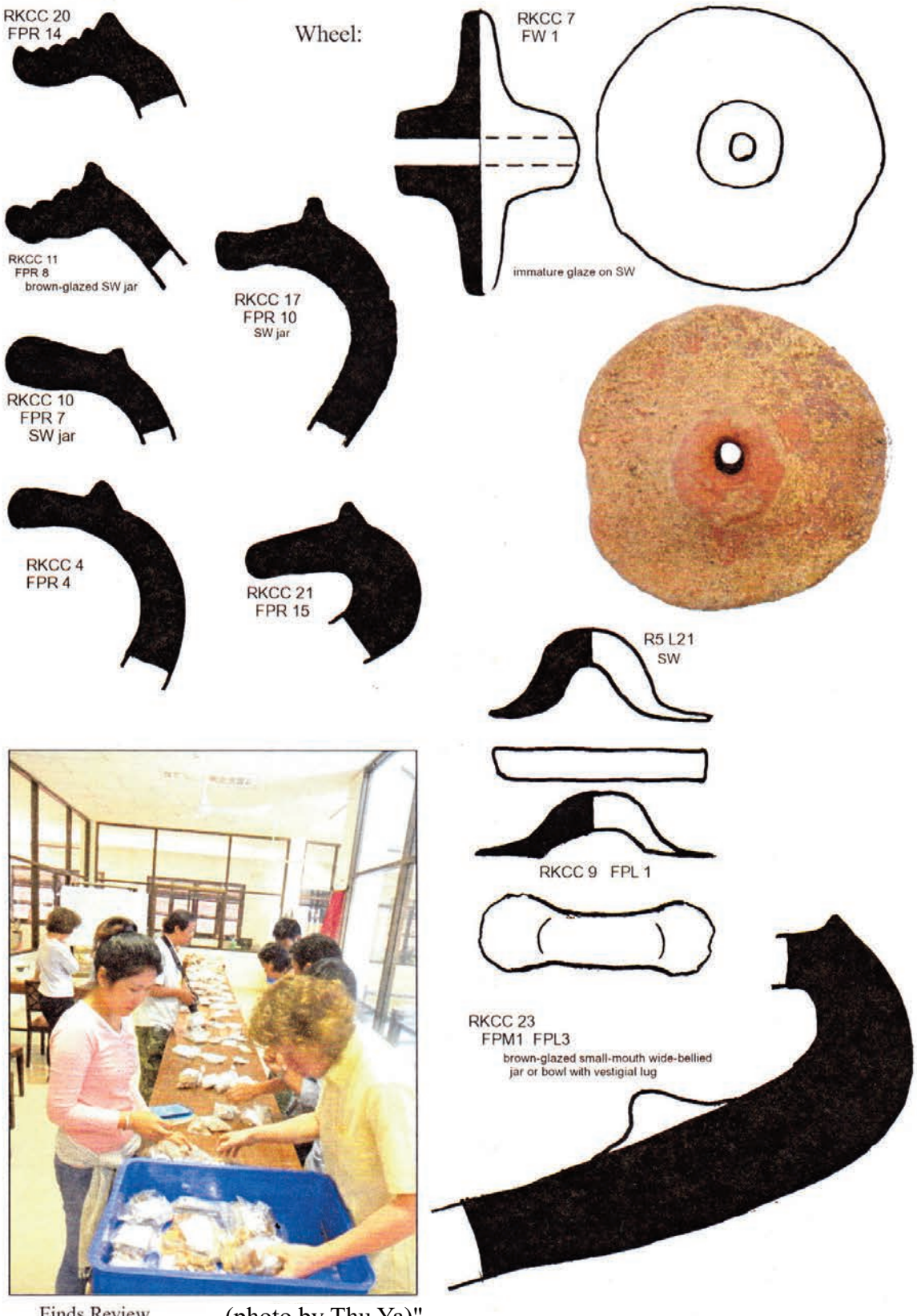
Stoneware of earthenware quality. Mostshards were the debris of stoneware vessels that were probably damaged in the final firing and allowed to remain on the firing chamber floor. The fabric of many shards was earthenware, but to judge from their shape most were intended as stoneware but had failed to reach stoneware maturity in the fire. An indication of the intent to make stoneware was a greater wall thickness not consistent with earthenware forms. In many cases, residue of immature glaze adhered to the outer surface.

Most stoneware (or intended stoneware) shards were of jars with a small mouth with an everted mouthrim and a bulbous high-shouldered body. Generally, the jars had a short neck such that the mouth protruded only a little above the body. In terms of decoration, jars were more fully incised, stamped or sprigged with design on the outer surface. However, too few examples were found to develop a design typology for the site.

To a lesser extent, stoneware shards were from wide-mouth bowls, also with an everted mouthrim. Although the type is included with jars in the report listing Torp Chey finds, the type may be judged sufficiently distinct in shape and usage to warrant its own order of classification. Given the lack of completeness of finds at Chong Samrong—in fact the preponderance of small fragments—the main guide to the distinction between a jar and a bowl was the shape of the mouthrim. The mouthrims of Angkorean jars tend to have a prominent lip, defined by a upper ridge, that points downward or horizontally outwards, whereas the mouthrim of bowls points more upwards and forms part of a continuous curve.

Glaze. Glaze color varied from black or brown to dark green. Often those shades were on a single vessel, either variegated or as vertical runs. The glaze on jars was usually only on the outside and inside the mouth. Glaze covered the inside of bowls, in which case the glaze would have been open to vision, and would have aided cleaning. Most often the glaze was thin, sometimes thick, but always opaque, probably applied by pouring or immersion.

Earthenware. After allowance for the factor of insufficient firing to account for the intended outcome for most vessel shards, there remained a small number of earthenware shards representing



Finds Review (photo by Thu Ya)"

Fig.9.Typology 1

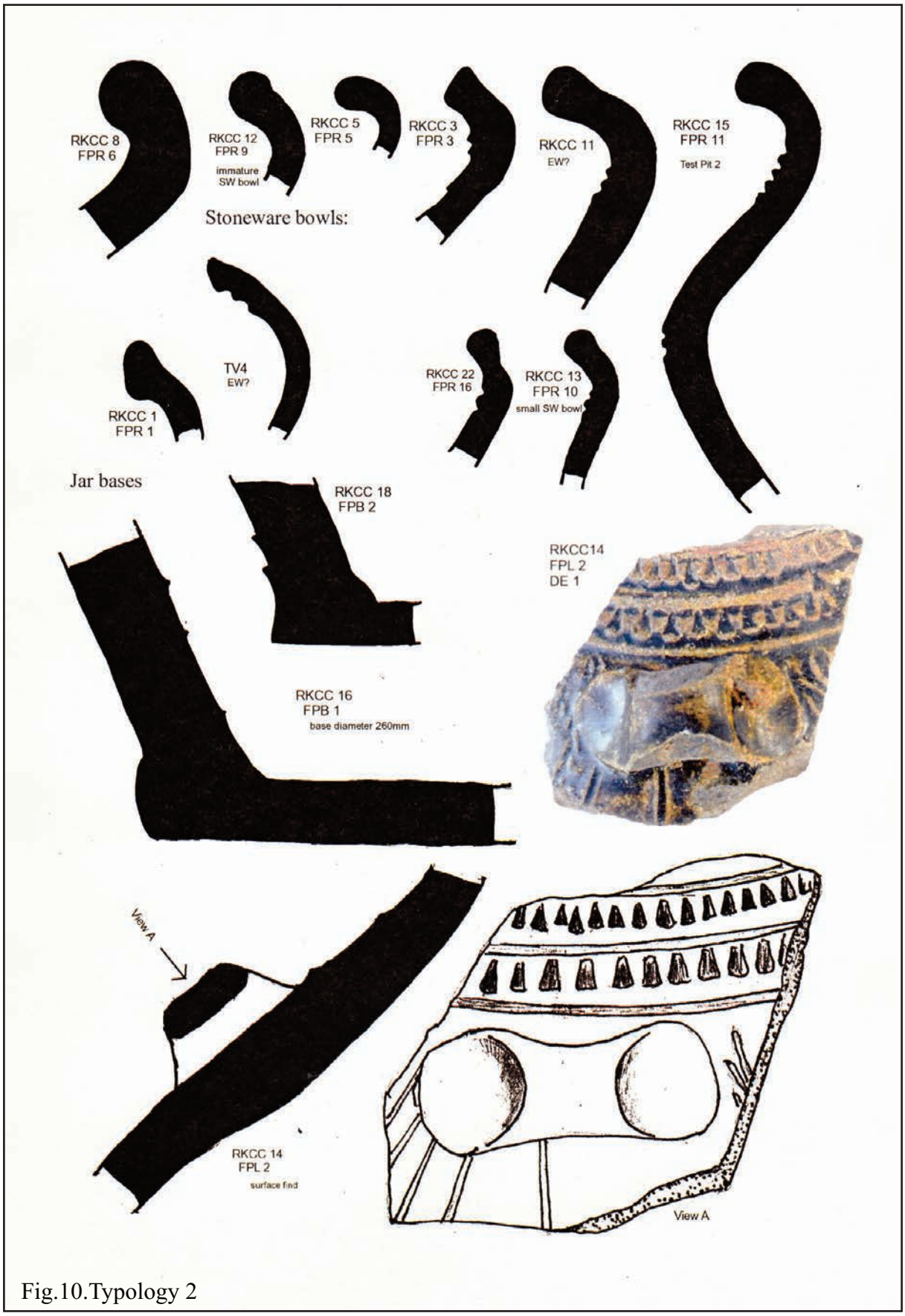


Fig.10.Typology 2

domestic pottery. These were generally thin-walled with a blackened surface on the inside or outside, indicating bonfire firing or use as a cooking pot. It is unlikely that earthenware was fired in the kiln, and the presence of such shards is probably due to bringing pots of food or water to the site and discarding broken ones there. Few of the shards showed signs of marking with cord or decorated paddle. No flat base shards of earthenware form types were among the finds, indicating all pottery was round-bottomed. Most had abraded edges due to erosion.

The only finds of material foreign to the site were a few small pieces of Chinese trade wares, including several of porcelain with underglaze cobalt decoration ("blue and white") and one shard of a white lid with vertical grooves. Except for those intrusive pieces, it may be assumed that all of the Angkorean stoneware finds were produced in that kiln. Although rather crudely modeled animal forms, possibly made by workers as a pastime activity, are often found at kiln sites, none were found at Chong Samrong. Nor were any firing supports (setters), including broken jar shards commonly found to have been used to level jars on a sloping firing chamber floor (recognized by shadowing or circular scars matching the base of supported jars). The absence of setters may be explained by the lack of need for them when firing a limited number of standardized ware forms and the use of the simple stacking (setting) method of placing one object on another.

No attempt was made to reconstruct any particular form, since virtually no related shards of any individual object were found (another consequence of disturbance due to looting).

Kiln Rubble. By far the most common find by number and weight was of kiln rubble resulting from the collapse of the kiln walls and dome.[19] (See Appendix 2) The rubble was documented in three sizes: small, medium, and large. The quantity of each group by size and weight was greatest for the smallest size. No piece was larger than 15cm diameter. Some of the larger pieces had striations on the inner surface (the hotface), showing that the kiln had been made by manipulating moist clay over a framework covered with reed-like grass.[20]

Although care was taken to observe any rubble with a curved surface that could relate to a firing port in the kiln, none was found.

Slag. A small amount of the rubble was associated with slag (clay melted to a vitrified or glassy state), which formed at the highest temperatures in some parts of the kiln, particularly on or near the firewall. In a few cases lumps of slag were found adhered to the kiln floor, apparently from something having melted and dripped downwards.

Roof-supporting columns. A few pieces of columns were identified among the rubble, recognized by curved surfaces and in some cases by a hole (or part of a hole), which resulted from the technique of forming the column around a stick for support (in the first firing the stick burnt out, leaving the hole). For stability the columns were spread wide at the base and curved inwards toward the

[19] Not that the collapse itself caused the formation of rubble. From the time of the first firing the clay walls of the kiln would have begun to fracture from differential expansion and contraction as the kiln heated and cooled. By the end of its operational life the walls of the kiln would be severely fractured, remaining tenuously in position until the end. This factor represents the greatest disadvantage of the manipulated clay construction method compared to that of brick. A solid clay wall mass must fracture in use due to expansion and contraction during the heating and cooling of the kiln but the separated nature of brick allows movement without damage to the brick itself.

[20] After the completed kiln was dry the framework was probably burnt out.

Prof. Sugiyama and team (Photo by Toni)

Helen Jessup of FOKCI (Photo byThu Ya)

Dr. Darith informs students (Photo by Toni)

Visitors at lunch 1 (Photo by Thu Ya)

Visitors at lunch 2 (Photo by Thu Ya)

H. E. Khuon Khun Neay inspects site (Photo by Yawen)

Further inspection (Photo by Toni)

Database explained (Photo by Thu Ya)

Fig. 11. Visitors to the Site

top (although only about one quarter of the estimated column height was extant).

Overall, the amount of finds was less than commonly found. When a kiln is finally abandoned it is common that the failed or broken wares are left inside the kiln. That such remains were lacking also indicated some kind of interference.

11. INTERPRETATION OF CHONG SAMRONG AND ITS RELATION TO TORP CHEY

Initial interpretation. As noted in the introduction, during the workshop excavation interpretation was initially inhibited by the uncertainty whether the arbitrarily imposed center line did in fact represent the actual center line of the kiln. After the exposure of part of what was assumed to be the firebox, it was realized that the center line, which was based first on small opposite sections of wall that had been subjected over time to distortion by large trees, was probably not accurate. To conform more closely to the estimated middle of the firebox, the position of the northern end of the line was then adjusted by moving it westward 25cm at the junction of the N5 and P5 squares. As both locations of the center line were arbitrary judgments, it was understood that its allocated location may not be correct.

An early assumption was that the Chong Samrong kiln would be similar to those of nearby Torp Chey and have a firebox that narrowed to little more than the width of the single stokehole, or else the firebox would be wide like those of Angkorean kilns elsewhere in Cambodia.

Interpretation after the supplementary excavation. Although the excavation results resolved the question of the firebox, the matter was complicated by differences between the kilns at the two sites. One distinctionwas that the Chong Samrong kiln had only one secondary fire trench, which was located close to the vent end of the kiln. That means the primary fire box had to be large enough to provide the heat energy for most of the firing chamber. Furthermore, before reaching the secondary fire trench, the greater part of the firing chamber would need to decrease in height incrementally to match the reduction in the volume of the draft as the temperature reduced, due to loss of heat to the kiln and wares being fired.[21] The single secondary fire trench would seem likely to represent an early developmental stage of side-stoke technology, perhaps as a test of its efficacy without risking a whole kiln load of wares. Perhaps the potters, on learning about side stoking, first interpreted it as a means of adding heat to the vent end of the firing chamber, the area which normally provided the lowest temperature and commonly failed to reach stoneware temperature.

Another factor relates to the width of the Chong Samrong kiln. The inside width measurement of the uppermost kiln at the secondary fire trench was 3.1m. Coupled to its assumed length of about 18m, this meant that the kiln was shorter and wider than Torp Chey, which internally was

[21] To achieve this, Angkorean kilns tend to maintain width (tending to be rectangular in plan) but reduce the height of the firing chamber toward the vents, whereas the kilns of Myanmar, Laos and Thailand reduce width laterally forming their classic ovoid shape.

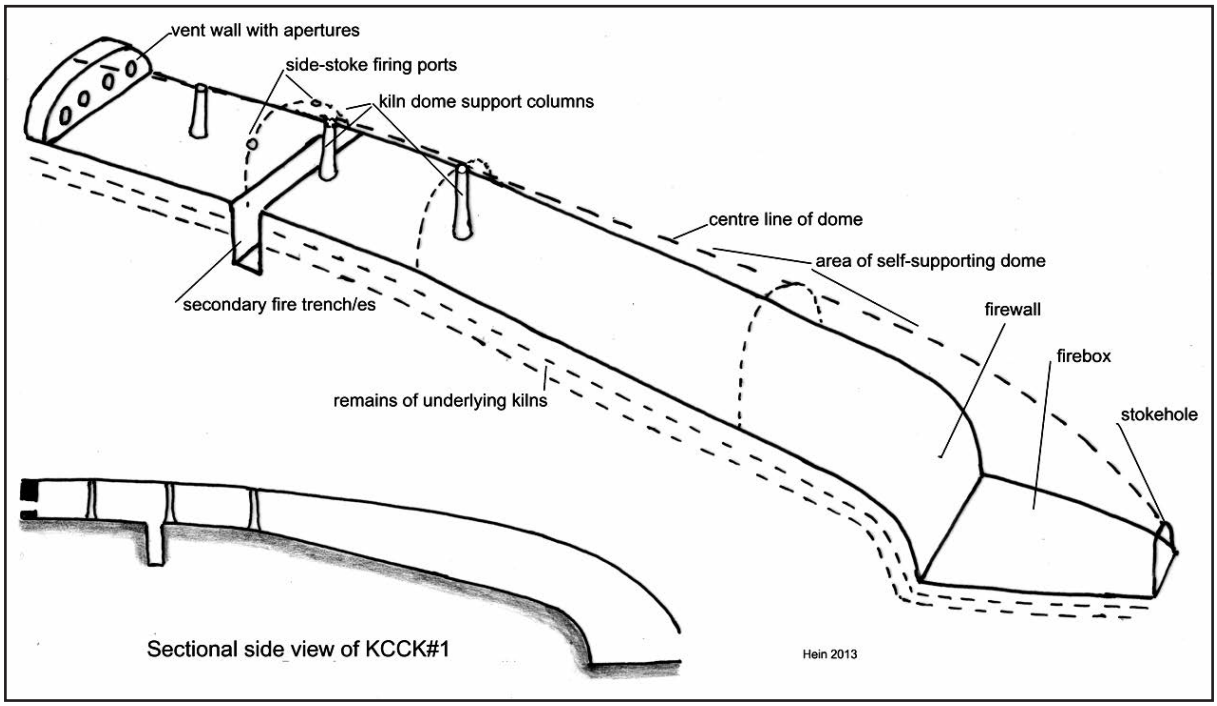


Fig. 12. Pictorial view of Kiln KCCK#1

2.8m wideby 21.45m long—that is, longer and narrower. Therefore, the Chong Samrong kiln appears to retain elements of the earlier form of Angkorean period kilns, as represented in the kilns for green-glazed and unglazed stoneware excavated to date. It would seem that some influence on the construction of the kiln was traditional, and this, in turn, suggests that Chong Samrong was intermediate in the sequence of development from the common Angkorean kiln type to that of Torp Chey. Furthermore, there was a curious difference between the two sites in that the firewalls of the two upper kilns at Chong Samrong were markedly curved (fig. 7) compared to the fairly straight and angular configuration of the only observable firewall at Torp Chey.

The question of influence. Compared to the Chong Samrong kiln, the kilns of Torp Chey display much more adaptation of the southern Chinese model of the elongated, side-stoked kiln. Unfortunately, the excavation at Torp Chey did not expose the lowest kiln in the mound, so it is not known whether it had secondary fire trenches or not. If not, then it might be assumed that the influence of side-stoke technology had not yet reached that site (although it may have existed at Chong Samrong). The second kiln in the Torp Chey mound had secondary fire trenches of a size and shape similar to that at Chong Samrong. However, the secondary fire trenches of the uppermost kiln at Torp Cheywere much narrower, and perhaps were on their way to disappearing altogether. This development, linked to the fact that the Torp Chey kilns were longer and narrower, suggests they were moving along the sequence of development long established by southern Chinese models.

Side-stoke firing of kilns had been in use for a millenniumin southern China,where the kilns are known as ‘dragon’ (*long*) or ‘hill’ kilns. Built on the slope of rising ground to take advantage of the incline to create draft, such kilns have a number of variant forms, most commonly one long firing chamber or a series of connected ‘stepped’ chambers. The common factor is that firing ports, each with a closing plug, are arranged in opposite pairs on both sides of the firing chamber.

The primary firebox at the lower end is used to raise the temperature to above 1100°C. Then, with the stokehole partially closed, fuel of small size is fed into the first set of firing ports until maturation temperature is reached. At that stage the first ports are closed with plugs and the next set opened. This continues along the length of the kiln to complete the firing. The major advantages of the system are that the kiln can be of any length and that heat generated is carried upward through the remaining length of the kiln. This Chinese side-stoke process was used by the Khmer potters at Torp Chey and Chong Samrong, except for one major distinction. To understand that difference it is relevant to speculate how side-stoke technology may have found its way to Cambodia.

The date of Torp Chey is estimated at the late twelfth–early thirteenth century. At that time such technology was not yet known in Korea or Japan, where development of kiln technology depended extensively on successive introductions from China.The most likely source of influence on the kilns in the Angkorean kingdom, given existing patterns of geography, diplomacy, and trade, is southern China. While attempts were probably made by kiln managers at ceramic manufacturing centers to limit the loss of commercial secrets and the movement of potters, events of transfer did occasionally occur. In this case, however, it is highly unlikely that a Chinese potter was involved. As has been argued (Hein 2008), if a Chinese potter did move from his home place to a new site to build a kiln, that kiln would be identical to the type he had previously used, one that he was confident would function satisfactorily using the methods he had previously practiced. Potters tend to be extremely conservative and successful practice is maintained, as failure was commercially catastrophic.

The most likely agent of influence was someone who was aware of dragon kilns in southern China, perhaps to the point of watching them work, but not familiar with the kiln's internal design. Such a person, perhaps a trader or merchant, on visiting a working Angkorean kiln could have informed the local potters of the side-stoke method used in China and the greater possible length of a kiln employing that method. On the basis of what is found in Cambodia so far, it seems likely that the information was limited to verbal description.

The potters of Chong Samrong and Torp Chey (and probably elsewhere) had to interpret the information they received. Apparently the external details—such as the location of the firing ports, their size of about 20cm diameter, and their interval along the kiln— were transferred, but it is highly unlikely that detail of what happened inside the kiln was included in the information package. Therefore, if the local Khmer potters were to adopt the theoretical system of side-stoke firing, they were obliged to consider whether internal structural changes to their existing kilns were needed to make the concept work. Based on their understanding of the role of the primary firebox as a source of heat, they apparently thought that each set of side-stoke firing ports would likewise require some kind of firebox to contain the burning fuel. This may have led them to invent a transverse trench across the full width of the firing chamber directly under each pair of secondary fire ports, a solution indicating the Khmer potters did not know that Chinese dragon kilns (as far as is known from excavations of surviving kilns) did not have any such feature and did not need one.

The main interest of the Khmer potters was probably to solve the problem that all crossdraft kilns tend to have, of diminishing temperature at the upper end of their kiln. They may have understood that an additional advantage of the side-stoke system was that kilns could be made longer to

increase economic efficiency. The Chong Samrong kiln is the earlier trial of the new idea known through archaeological excavations to date. It would seem prudent that the kiln was made with a moderate increase in length and only one secondary fire trench (and one set of side-stoke ports). The main part of the kiln should still work as before and ensure that the firing of the majority of the setting would still be successful. The Chong Samrong kiln displays both aspects of such a cautious approach.

The circumstance at Torp Chey of additional construction to the walls of the secondary fire trenches that indicated each of the three kilns employed the same trenches was also true for the one trench at Chong Samrong. Several other factors regarding the design of the kilns modified for side-stoke firing at Torp Chey and perhaps at Chong Samrong are noteworthy. First, the ground plan is some what trapezoidal and the firebox is particularly narrow, with only one stokehole, while most of the Angkorean kilns excavated elsewhere is Cambodia (which in most cases predate Torp Chey and Chong Samrong) have a more rectangular shape with a wide firebox containing two stokeholes. In this, the Torp Chey firebox anticipates the existence of the secondary fire trench. It would be valuable to know if any of the underlying kilns at either site showed development from the usual wide firebox to a narrower one.

Another distinction between the two sites is the greater width of the Chong Samrong kiln, at 3.1m compared to 2.8m of the uppermost kiln at Torp Chey. Side stoking works best when the kiln body is narrow, allowing the burning side-stoke fuel to affect the whole width of the firing chamber, whereas a wider firing chamber would tend to have a colder area in the middle (between the two fire ports). It might be argued that the single secondary fire trench of the Chong Samrong kiln and the kiln's lesser length indicate an earlier stage of development of side-stoke kilns than Torp Chey.

Another consequence that may have affected the efficacy of secondary fire trenches was the loss of floor space for ware setting. While one trench at Chong Samrong may not have made much difference, the three trenches at Torp Chey resulted in a loss of about 1m of firing chamber length—an extra 1m of non-productive space requiring energy to heat.

The angle of incline of the kiln is another pertinent point. Chinese kilns of the type developed over centuries through a series of changes regarding the incline of the kiln, finally settling on an angle of about twenty degrees from the firewall over the greater part of the firing chamber, decreasing to about ten degrees for the final few meters before reaching the exhaust vents (Kerr and Wood 2004:355). The Torp Chey kilns had a floor incline of fourteen degrees and that of Chong Samrong was estimated at about the same. Those floor angles are low compared to the kilns of other Angkorean kilns such as Tani (Aoyagi and Sasaki 2007: 210) and Thnal Mrech (Miksic et. al. 2009:7). The rate of draft through the kiln is determined by the vertical distance from the top of the vents (or chimney) to the firehole, and is a measure of the difference in pressure between the colder denser air entering the stokehole and of that existing at the exhaust vent. In this condition there is a relationship of the degree of floor angle and the operating temperature of the kiln, such that a lower floor angle would result in a lower maximum temperature. The lack of fusion to the walls of the Chong Samrong and Torp Chey kilns and the fired state of the wares and glazes indicates a relatively low firing temperature, perhaps in the order of 1200^{o}C.

To accommodate the standard inclined Angkorean kiln, a natural slope such as a hillside or dike was exploited whenever possible; whereas on horizontal ground a constructed mound was

employed. Both strategies are found, although the latter is more common at the sites excavated to date throughout the plains of northwestern Cambodia, including at Chong Samrong and Torp Chey.[22] Whereas in southern China side-stoke kilns are often found in undulating landscape allowing kilns dozens of meters in length to be built, in Cambodia such kilns have only been found on artificial mounds built on level ground. Due to the practical limit of mound size, this limited the possible length of the kilns that could be built on them.

The secondary fire trench may have seemed sensible to the Khmer potters, but in fact it was a mistake. Timber fuel falling into an enclosed trench does not burn efficiently due to the lack of oxygen, and incomplete burning produces large amounts of charcoal, which represents lost energy. Efficient side-stoke firing depends on the rapid ignition of small-size fuel fed in sequence through the ports when the kiln is already at high temperature. Ideally the fuel should burn fiercely, almost explosively, producing a large amount of heat energy and leaving little residue to fall onto the floor. To judge by the amount of charcoal found in the trenches at Torp Chey and its size range, the potters at that site used timber of significant size, resulting in accumulation of charcoal. The lack of charcoal found in the secondary fire trench at Chong Samrong is confounding, unless its absence can be ascribed to looting activity, because as the previous reasoning implies it should be present.

Of the three kilns in mound No. 2 at Torp Chey, the upper two had secondary fire trenches[23] and showed signs of development from wider to narrower trenches, while at Chong Samrong the wide form of the trench was used without change for all of the kilns. It appears that the Chong Samrong potters did not consider any design change necessary and were not influenced to do so.

One distinction between the two sites may be the existence of a loading door, which was found in kiln No. 2 at Torp Chey, about halfway along the northern (righthand) firing chamber wall.[24] As only the lefthand (eastern) half of the Chong Samrong kiln was excavated, the kiln might have had a loading door on the righthand side.[25] Loading wares into small Angkorean kilns was done through the firebox, probably by several individuals passing wares hand to hand. This method was probably used for the Chong Samrong kiln because of its lesser length. As the kilns at Torp Chey increased in length to over 21m, the distance to handle wares along that length during the loading of the kiln, including passing over the trenches, would have been arduous.[26] That apparently led, for the first recorded occasion in Angkorean-period Cambodia, to the introduction of a loading door.

The Chong Samrong kiln mound was one of only two at the site (compared to twelve in the Torp Chey group), suggesting a family-managed industry with relatively low levels of production. However, the three sequential kilns on the Chong Samrong mound indicate a fairly long term of

[22] Another prominent case of constructed mounds is evident in the Angkorean kiln complex in Buriram Povince, Thailand, which did not employ side-stoking.

[23] The excavation did not proceed sufficiently to determine whether the lowest one had them.

[24] Not on the southern wall as the preliminary report states; see Ea Darith 2012a:22.

[25] The loading door would have faced the area where the workshop was located, which at Chong Samrong would have been the unexcavated (western) side. The existence of the clay pit on the other side would have inhibited workshop location there.

[26] Caution is needed. The loading door may have been used mainly to set wares between the loading door and vents, and for the lower section wares were probably still passed through the stokehole. For practical reasons it is easier to set wares from the top of a slope downwards.

operation, so the adopted system must have functioned satisfactorily. The model of a few kilns forming a small production nucleus to meet the needs of local communities is common to the Angkorean period, a point illustrated by the scatter of such sites along the Beng Mealea–Bagan road,[27] where finds of predominately medium size jars or roof tiles suggest an output for domestic and architectural ware, although the possibility of contribution by Chong Samrong to long distance trade cannot be discounted. In the case of Chong Samrong the certainty of that assumption is tempered by the fact that the wasters recovered from the kiln excavation or test pits represented very few forms, limited to utilitarian wares. Further fieldwork would be needed to discover the location of waste deposits, which could be anywhere close to the firebox end of the kiln or even in abandoned spaces of clay pits.[28]

12. CONCLUSIONS

In terms of its aims as a training exercise, the excavation of Chong Samrong was successful. Seventeen professional archaeologists, most of whom had very little experience in the field, gained knowledge and practice in the specialized research of ceramic kilns.The course introduced methodologies and systems not currently in use in Cambodia, thereby promoting individual maturity and better understanding of the profession. Emphasis was given to the importance of exercising control of the excavation processes so that the recorded information would accurately reflect the order and nature of the source. Emphasis was also given to the serious attention demanded for successful execution of the task.

Excavation on historically important monuments, where the team is composed of a high ratio of students, must be undertaken with care lest insufficient expertise is applied to the processes of excavation and observation. This point was particularly pertinent in regard to the Chong Samrong training excavation, where an extremely compacted and disturbed matrix existed. Perhaps no more than three students to each instructor would constitute a responsible ratio. The time required for instruction is several times that required for a fully trained team to achieve the same results. As some team members had very little experience in field archaeology, and most had not previously participated in the excavation of a kiln, the need for instruction slowed the rate of work.

In such circumstances, one month of excavation time is too little to produce satisfactory results in the excavation of a large kiln, even exploiting the half longitudinal excavation strategy. A short duration creates pressure to rush work and tends to leave insufficient time to contemplate the meaning and significance of features that appear. The duration of an excavation is usually confined by start and end dates, and this can be a problem if the work cannot be finished in time. Either the work must be rushed, employing short cuts, or it must be left incomplete. Flexible

[27] The kiln sites include one a km or so to the east (fig. 2) tentatively named after the discoverer Muong Chan-reaksmey (nickname Smey) as the 'Smey Group' and the nearby Veal Svay site, where excavation by a Japanese team began in June 2013.

[28] Archaeological experience shows that potters used any convenient slope or depression to contain their ceramic rubbish rather than dumping on level ground which was probably needed for production infrastructure.

encompassing dates are highly preferable, especially the end date, even if it means work must be continued by a reduced team. In the case of the initial excavation of Chong Samrong, the ability to continue the work for a few more days would have avoided the four-month hiatus and a supplementary dig in wet-season conditions.

Excavations should be open activities during which visitors, including fellow professionals, politicians, teachers, students, the public and local residents, are encouraged to attend. Excavators should be confident that their work meets public interest and professional scrutiny. In fact it is by this process that support at the political, professional, and wider public levels for such work increases and the reputation of the excavators, and consequently of their institutions, grows. Exercise of this policy resulted in many visitors of all levels during the Chong Samrong excavation, to the enjoyment and advancement of all.

Throughout the excavation important insights into brown-glazed ceramics produced by side-stoke kilns were gained. The excavation of the Chong Samrong kiln demonstrated that the technology was more widespread than previously known and that it was applied to the local ceramic industry as a production strategy over a substantial period of time. However, more research is needed to further define this matter, at both Chong Samrong and Torp Chey and at other sites along the ancient Beng Mealea–Bakan road. It is important to know if other mounds contain further evidence of the evolution of side-stoke technology in Cambodia. What seems evident is that the technology was not fundamental to stoneware production in the Angkorean kingdom, but was a process introduced to an existing industry in an effort to improve its efficiency.

For several reasons further excavation should be done on Kiln #1 at Chong Samrong. It is necessary for the firebox to be fully exposed to allow complete recording of the kiln, something essential to the complete understanding of the kiln and to allowing accurate comparison to be made with other kilns of the type. Also, a sondage to examine the mound on which the kiln was built would determine the supposition that it was composed of overburden from the nearby clay pit.

On present knowledge, the influence of the technology represented at Chong Samrong seems to have been limited to a local area. Unless the side-stoke technology is found elsewhere in Cambodia, it may imply that its implementation was not entirely successful. To date there has been no sign that such influence exists at the late Angkorean period kilns of Ban Sawai and Khun Yuam at Ban Kruat or at other kiln sites in Buriram Province, Thailand.

The training excavation exposed certain deficiencies in existing methodologies. For example, the principle of half excavation of a kiln depends upon being able to access the location of the center line. In the case of short, wide, ovoid historical kilns such as those in Thailand, Burma, and Laos, this can be accurately judged from observation of the chimney and upper part of the firing chamber (the part often found exposed), but in regard to the longer, narrower kilns such as those found at Torp Chey and Chong Samrong it is now realized that an adjustment to the process is required. Instead of one cross trench to locate opposite walls, two trenches at different points along the kiln appear to be necessary to establish the center line.

No data was obtained that helped establish the dating of the Chong Samrong kiln site. Presumably, it operated in the twelfth century, a date commensurate with epigraphic records for monuments in the area, a circumstance that established the date for the Torp Chey kilns. No suitable carbon able artifact was among the finds. It is important to the research of Angkorean stoneware ceramic

production to know the chronological sequence of kiln sites, and thereby the series of ware types can be firmly established.

Finally, archaeologists must persist in sufficient study of a site prior to publication. Incomplete or, worse still, inaccurate description is unacceptable, a position we narrowly avoided. In addition to exposing a group of young professional archaeologists to the special demands of excavating and interpreting a historical kiln site, the workshop (especially the practice of living on site for the duration of the excavation) fostered the creation of a group of colleagues with shared interest spanning a number of cultures. The project managers and the workshop sponsors hope that the participants will become key contributors to the planning and execution of future kiln site excavations across mainland Southeast Asia, and that those projects will be occasions for members of the 2013 workshop group to reconvene and work together again.

Fig.13. Team with qualifying certificates (Photo by Hannah Arnhold)

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APPENDIX 1

QUESTIONS ON A FIREBOX ERROR

Given the purpose of the training excavation, the mistaken identification of a firewall at the junction of P5-Q5 squares should be questioned.

In the latter part of the excavation a small area of distorted and fused jars was uncovered, looking very much like the kind of material commonly found on the top of a firewall. The fused material lay at an angle to the kiln axis, a condition thought to have resulted from the collapse of the firewall in the final firing.

As it was in the position expected to be the location of the firewall it was treated as such with the excavation continuing down layer by layer toward where the firebox floor should be. The feature was interpreted as a firewall belonging to the uppermost kiln in the mound. However, no face to the 'firewall' was found, only rubble. That rubble showed no sign of the floors of the earlier kilns known to have existed and which should have been observable. Excavation by (horizontal) layer continued until slight signs indicated the location of the stokehole area at about the expected position from the 'firewall' (2.5m). At the time there was no evidence of the firebox floor.

In compliance with the schedule the excavation was concluded.

During the excavation very little of the structure and stratigraphy of the site was as intact as normally found and it was realized that something had caused abnormal disturbance. Post-excavation discussion among senior members of the field team expressed some unease with the validity of the results, and supplementary fieldwork was recommended. That occurred in August 2013 (four months after the initial excavation). A small team of three persons on a four-day schedule opened a 2x1m pit (named RT4) which overlapped the junction of T5 and V5 squares by 50cm. The purpose was to uncover the stokehole end of the firebox, expected at that point.

It was a surprise to find not the stokehole but the actual firebox represented by remnants of side walls and top of the firewall in a position about 80cm below that of the previously declared 'firebox'. Part of the firewall of the second kiln could also be seen. The firebox(es) continued, presumably for another two meters. (see fig. 7) As time did not allow for additional excavation and ground water prevented finding the firebox floor, the work was stopped.

The lesson for the archaeologist is to be cautious before declaring a find on insufficient evidence. At the time there was sufficient sign that should have caused the excavators to reconsider—what should have been there was not (no firewall face, no evidence of other kilns known to exist, and no firebox floor). What was there was the evidence of disturbance by looting, something already considered earlier in the dig, and something that should have been a major factor in the interpretation

of the initial excavation. The fused jars may even have been a secondary deposit from looting as, on closer inspection, no certain conjunction between the fused material and the kiln walls could be established.

The supplementary excavation revealed the true condition of the site; that it had been subject to disturbance of a kind that indicated as the looters proceeded they deposited displaced material into already dug spaces. That resulted in no intact firing chamber floors, or charcoal in the secondary fire trench, and confused evidence of a firebox.

In effect, the excavators made something that looked like a firebox, then (temporarily) interpreted it as one.

The irony is that had the initial excavation of the 'stokehole' continued one more level the side face of the real firebox would have been found.

Fig. 14. View of initial excavation assumed firebox
(Photo by Thu Ya)

Fig. 15. View of assumed firewall
(Photo by Wang Yawen)

APPENDIX 2

SUMMARY OF FINDS AND RELATED DATA

General. Only a summary is offered due to the low number of finds and the concern that, because of disturbance of the site due to looting, the quantum of finds may not provide meaningful information on the representation of the finds, A system of codes is used in the CCS database to document and record finds. The codes that relate to the form, fabric, and color of finds and are distinguished by a unique initial letter, e.g. all form codes begin with F, fabric codes with B, color with C, etc. Most results are expressed as quantity and weight (recorded in grams but generally expressed in this report as kilograms).

Total Finds. The total of **29, 492** individual finds weighing **714.369 kilograms** were recovered from the initial excavation, test pits, and surface collection; nearly all (99%) from the excavation.

Kiln Rubble and Slag. Of the finds the largest category was kiln rubble and kiln slag, which are tallied together because of their relationship (slag usually being material broken from the inner wall face of kiln rubble). The total quantity of rubble and slag was **24,428** and weight **664.948 kilograms**, representing 83% by quantity and 93% by weight of all finds.

Ceramic. The total of ceramic finds was **1,898** with a total weight of **27.448** kilograms. Although the average individual weight was just over 14.461 grams, about a half of ceramic finds were very small and weighed less than 5 grams. Due to the difficulty in discriminating between earthenware as pottery and earthenware as immature stoneware, no attempt was made to define the issue although the vast majority of earthenware under the category of fabric was of objects judged to be intended as stoneware. Only five pieces of porcelain weighing a total of eleven grams were found, and all were identified as Chinese.

In respect of form, the greater part of ceramic finds was ‘unidentified’ (meaning the form of the object could not be determined). Those **1,379** shards weighed **8.874** kilograms and amounted to 74% of the total ceramic finds, but only represented about one third of the total weight (meaning that unidentified shards tended to be smaller in size and weight).

Stone. The total of objects made of stone was **2,854** with a weight of **21.333** kilograms. This class of fabric consisted of 2,090 small pieces of laterite, 139 small rounded river stones, 4 pebbles, 2 pieces of sandstone, and other miscellaneous bits of stone.

TV4 Excavation. Finds from the supplementary excavation (finds not included on the database). A total of 154 finds were recovered from Square TV4 (and none from Square B4). All were of a small size and only a few as large as 100mm across. Except for two pieces that may have been earthenware pottery, all belonged jars with stoneware, or immature stoneware, fabric.

A few shards had mature brown glaze and twenty had immature glaze (appearing whitish). Three of the shards had a thickness greater than 17mm with one at 21mm.

The fabric of most shards was orange earthenware, but had the characteristics of stoneware and was assumed to be intended as stoneware (not pottery).

Two pieces were of bases from medium size jars. Thirteen shards were of rims from jars or bowls.

Seven finds were kiln wall rubble and ten were rounded river stones. One snail shell and an iron nail 50mm long with square section in a rusted condition were among the finds. The finding of a small (approximately 150mm square) clear plastic bag in the rubble at 1m depth provided certainty that the site had been disturbed by looting. The significance of the supplementary excavation is explained in Appendix 1. Finds from the supplementary excavation are not included in the data.

KILN RUBBLE AND SLAG

Square	Level	Quantity	Weight
B5	6	411	53690
B5	7	4	100
C4	3	6	5
C5	3	180	1700
C5	4	590	11720
C5	5	78	10850
C5	6	203	10380
C5	7	776	34276
C6	3	36	390
D3	3	34	105
D5	4	33	510
D5	5	233	7100
D5	6	339	28050
D5	7	3	2
D5	20	38	800
D6	3	37	400
E3	3	150	2350
E3	4	440	12430
E4	3	20	165
E4	4	150	3040
E5	3	15	60
E5	4	200	4900
E5	5	98	5200
E5	6	118	7490
E5	7	168	3795
E5	9	41	3500
E5	11	122	3530
E5	12	76	8190
E5	13	131	2400
E6	3	56	700
E6	4	60	1720
F3	3	135	1850
F4	3	245	2120
F5	3	63	520
F5	4	287	11140
F5	5	208	3600
F5	6	342	17960
F5	7	25	480
F6	3	103	1220
G3	3	128	1530
G4	3	130	2200
G5	3	129	3000
G5	4	538	28730
G5	5	503	22360
G5	6	85	1798
G5	7	71	3695
G6	3	46	530
H3	3	8	60
H4	3	23	260
H5	4	30	1380
H5	5	143	4350
H5	6	71	4780
H5	7	825	16403
H5	9	132	14070
H6	3	12	40
J5	6	37	1380
J5	7	329	25954
J5	8	121	1780
J5	9	153	9590
K5	5	5	800
K5	7	41	1220
K5	8	192	2035
K5	9	191	6590
K5	10	347	7690
K5	11	101	1720
K5	12	119	2350
L5	7	17	115
L5	8	25	200
L5	9	198	3040
L5	10	208	8610
L5	11	207	5890
L5	12	76	3730
M5	8	3	10
M5	10	21	1200
M5	11	32	2880
M5	12	76	3850
M5	13	200	6130
M5	14	673	14950
N5	11	2	2
N5	12	9	2330
N5	13	26	500
N5	14	128	3820
N5	15	14	460
P5	12	1	2
P5	14	98	1300
P5	15	23	180
P5	16	187	1800
P5	18	45	1020
Q5	14	19	145
Q5	16	23	200
Q5	17	40	260
Q5	18	18	80
Q5	19	648	6910
Q5	20	1482	35520
Q5	21	151	1870
Q5	22	703	19000
Q5	23	137	2400
R5	14	2	10
R5	15	8	120
R5	16	39	300
R5	17	33	300
R5	18	20	100
R5	19	217	2290
R5	20	183	4780
R5	21	386	8140
R5	22	621	8430
R5	23	153	2100
T5	14	2	2
T5	16	7	60
T5	17	30	220
T5	18	7	30
T5	19	53	300
T5	20	111	1250
T5	21	182	4440
T5	22	607	14390
T5	23	8	60
V5	21	95	1600
V5	22	53	1180
LRS	KR	634	8932
LRS	KS	4438	48417
		24428	**664948**

Fig. 16. Roof rubble with striation
(Photo by Big Hà)

FABRIC TYPEFORM TYPE

Fabric	Qty	Form Type	Quantity	Weight
E (earthenware)	307	FPB (form-part-base)	1	40
EB (black earthenware)	5	FPB1 (form-part-base type 1)	1	840
EBB (v. black earthenware)	4	FPL1 (form-part-lug type 1)	1	10
EE (grey earthenware)	1	FPL2 (form-part-lug type 2)	1	220
EN (brown earthenware)	1	FPR (form-part-rim)	1	260
EO (orange earthenware)	599	FPR1(form-part-rim type 1)	1	15
ER (red earthenware)	5	FPR2 (form-part-rim type 2)	2	110
EY (yellow earthenware)	10	FPR4 (form-part-rim type 4)	1	30
EYO1 (yellow colour code)	1	FPR5 (form-part-rim type 5)	2	20
W (white fabric)	3	J (jar)	479	14237
S (stoneware)	205	JPB (jar-part-base)	8	890
S0 (orange stoneware)	157	JPL(jar-part-lug)	1	5
S02 (stoneware type code)	191	JPR (jar-part-rim)	4	35
S03 (stoneware type code)	78	JPR8 (jar-part-rim type 8)	1	5
S04 (stoneware type code)	235	JW (jar wide-mouth)	1	70
S06 (stoneware type code)	39	PA (entry error)	1	1
SO7 (stoneware type code)	9	B (bowl)	4	28
SE (grey fabric stoneware)	25	PB (part base)	12	582
SER (grey-red fabric stoneware)	1	PL1 (part-lug type 1)	1	2
SN (brown stoneware)	1	PR (part-rim)	79	1011
SB (black fabric stoneware)	2	PR1 (part-rim type 1)	5	37
SNO3 (colour code)	2	PR2 (part-rim type 2)	1	20
SOY (orange-yellow stoneware)		PR10 (part-rim type 10)	1	20
SGO1 (stoneware colour code)	3	PR12 (part-rim type 12)	2	100

SOB (orange-black stoneware)	3	PR5 (part-rim type 5)	2	15
SR (red stoneware)	5	PR6 (part-rim type 6)	1	100
SRB (red-black stoneware)	1	PR7 (part-rim type 7)	2	50
SRD (dark-red stoneware)	5	PR8 (part-rim type 8)	2	80
SYD (dark-yellow stoneware)	3	PR9 (part-rim type 9)	1	40
P (porcelain)	4	U (unidentified form)	1379	8874
A (stone)	762	W1 (wheel type 1)	1	40
AL (laterite)	2090	X (amorphous-irregular) clay	1	1
AS (sandstone)	2		**2000**	**27728**
B (metal)	2			
D (seed/pod)	9			
R (raw clay)	1			
X (bone)	12			
J (shell)	1			
K (charcoal)	211			
Z (plastic)	10			
C (unidentified ceramic)	67			

INITIAL EXCAVATION LEVEL RECORD SHEET NOTES BY LEVEL

MH means median (of height measurements within a square) distance below datum.

MOUND SURFACE. Ht. 0130.Dry sandy clay surface without ground cover vegetation (dry season), several medium size trees and fallen foliage. Some loose laterite lumps and kiln wall rubble. Parallel and contiguous firing chamber walls of three kilns in approximately north-south alignment belonging to the eastern (left hand) side of the kilns situated on the eastern side of the mound.

LEVEL 1. Squares (O) E4, E5, G4, G5. Median height (MH) 0140 (mm below temporary datum mark). Dark rich soil. No finds.

LEVEL 2. O: C3, C4, C5, C6, D3, D4, D5, D6, E3, E4, E5, E6, F3, F4, F5, F6, G3, G4, G5, G6. MH 0200. Kiln wall rubble, roots of trees and shrubs prolific including a large tree stump in C5. Several termite nests. Hardened (compacted) areas of fired clay.

LEVEL 3. O: C3, C4, C5, C6, D3, D4, D5, D6, E3, E4, E5, E6, F3, F4, F5, F6, G3, G4, G5, G6. MH 0330. Extended to 19 squares. Sediment characterized by very hard matrix of kiln wall rubble, sandy clay, tree roots, several tree stumps, and some charcoal probably from field burning practices (judged not suitable for testing). Several brown glazed jar shards found.

LEVEL 4. C5, D5, E3, E4, E5, E6, F5, G5, H5. MH 0450. As the left hand firing chamber wall of the uppermost kiln were in plain view this level was primarily focused on squares E3, E4, E5, and E6 in an attempt to locate the corresponding opposite wall. The western walls were found in E3. A circular clay feature thought to be a roof supporting column found on the junction of E5 and F5. When this was done further excavation was limited to a single line of squares from C5 to H5 with the center line as the western boundary and the eastern kiln wall as the eastern boundary.

LEVEL 5. B5, C5, E5, F5, G5, H5. MH 0550. Very hard compacted sediment in B5 to F5. Dark soil in G5 and H5. More ceramic finds of brown glazed jars in D5, to F5. Some small roof tile shards in G5.

LEVEL 6. B5, C5, E5, F5, G5, H5, J5. MH 0700. A secondary fire trench (SFT) feature first recognized in E5. Jar bases some with brown glaze found in F5 along with rim and body shards. Also some earthenware (EW) in F5.Signs of a floor in G5 and H5. The exhaust vent system becomes clearer in B5.

LEVEL 7. B5, C5, D5, E5, F5, G5, H5, J5, K5, L5. MH (not recorded). Excavation of B5 was continued to further expose the vents. Work continued on the SFT in E5 to a final depth of 1110 BDM. Sign of another column in G5. Clearer evidence of a lower kiln floor in F5 and G5. Exposure of western (LH) kiln walls to L5 Finds include EW and SW.

LEVEL 8. E5, J5, K5, L5, M5. MH 1000. A scatter of brown-glazed jar shards, bowl rims, earthenware pottery, and a Chinese B&W small bowl shard in lower squares.

LEVEL 9. E5, H5, J5, K5, L5, M5. MH 1200.Walls gradually narrowing toward center line. Many EW shards of cooking pots and bowls in K5 and L5. Some brown-glazed SW jar shards. Some charcoal but considered unreliable.

LEVEL 10. E5, J5, K5, L5, M5. MH 1275. More brown glazed jar shards and EW pottery in lower squares. Patches of firing chamber floor in K5 and L5.

LEVEL 11. E5, K5, L5, M5, N5. MH 1380. SW and EW in K5 and L5. Small SW and EW shards in SFT.

LEVEL 12. E5, K5, L5, M5, N5, P5, Q5. MH 1550. Light grey ash found in the SFT of E5. Shards and rubble in K5. Kiln rubble and brown glazed jar shards in L5 and M5.

LEVEL 13. E5, K5, L5, M5, N5, P5, Q5. MH 1650. Kiln rubble, SW shards, brown-glazed jar shards in N5. SFT discontinued due to difficulty of access.

LEVEL 14. M5, N5, P5, Q5, R5, T5. MH 1950. Two eastern walls still evident (third not certain). Some ash deposit in P5. Hard compacted sediment in N5.

LEVEL 15. M5, N5, P5, Q5, R5, T5. MH (not recorded). No notes.

LEVEL 16. N5, P5, Q5, R5, T5. MH 2050. Large shards of medium brown-glazed jars fused together and apparently to kiln firewall at junction of P5 and Q5.

LEVEL 17. Q5, R5, T5. MH 2450. Roof rubble.

LEVEL 18. P5, Q5, R5, T5. MH (not recorded). Charcoal in P5. Shards in T5. At this time the eastern wall was close to the center line leaving little access and it became clear that the assumed center line was not correct and was adjusted by 25cm at the junction of squares N5 and P5.

LEVEL 19. P5, Q5, R5, T5. MH 1920-2500. Ash in R5. Brown-glazed jar shards and much roof rubble in Q5, R5 and T5. Kiln firewall (KFW) clearly evident.

LEVEL 20. Q5, R5, T5, V5. MH 2600. Shards in T5 and V5.

LEVEL 21. Q5, R5, T5, V5. MH 2750. EW, soft sediment, and white-glazed shard in T5.

LEVEL 22. Q5, R5, T5, V5. MH 2900. Rubble, ash, and brown glazed SW found in soft sediment.

LEVEL 23. Q5, R5, T5, V5. MH 2950. The kiln firebox floor reached to find ash but no charcoal. Remnants of walling at the junction of T5 and V5 indicated the end of the firebox and a stokehole [both statements proved to be in error].

REGISTRATION LOG (R)

Finds are registered for typology or if they are of special interest, with the application of a code for the site and a serial number. R is the code for registration. K is the source code for Cambodia, C for Chong Samrong kiln site at Kambo Or Village in Khvav Commune, C for Chikreng District, Siem Reap Province.

Twenty-three finds were registered.

Codes are used to record forms.

FB means Form - Bowl.

FW means Form - Wheel.

FP means Form - Part, followed by e.g. R for mouthrim, L for lug, etc.

In this chart source is shown as Square and Level, and fabric by EW (earthenware), SW (stoneware), or P (porcelain).

RNO	CODE	SOURCE FABRIC		DESCRIPTION
RKCC1	FPR1	E6/L2	EW	rim - of cooking pot?
RKCC2	FPR2	G4/L3	EW	bowl rim
RKCC3	FPR3	F5/L4	EW	bowl rim
RKCC4	FPR4	F5/L4	SW	flared mouth jar
RKCC5	FPR5	G5/L6	EW	jar rim, matt green glaze both sides
RKCC6	FB	C5/L7	P	small piece of Chinese covered box lid, incised ribbing decoration on outside
RKCC7	FW1	F5/L7	SW	complete wheel, immature glaze both sides
RKCC8	FPR6	L5/L10	SW	large rolled neck of bowl, 480mm diam.
RKCC9	FPL1	K5/L11	SW	complete horizontal lug with immature glaze
RKCC10	FPR7	R5/L21	SW	bulbous rim of flared mouth jar
RKCC11	FPR8	R5/L21	EW?	rim of a flared mouth jar
RKCC12	FPR9	R5/L21	EW	rim of wide mouthed jar
RKCC13	FPR10	R5/L21	EW?	rim of a jar (or bowl)
RKCC14	FPL2	SC. 3.6m W.	SW	large complete lug on jar shard and decoration (DE1)
RKCC15	FPR11	Test Pit 2	SW	mouth of flared mouth jar, glazed both sides, colour/N03 260mm diam.
RKCC16	FPB1	Test Pit 1	SW	base of large immature coil built flared mouth jar 260mm diam.
RKCC17	FPR12	Test Pit 1	EW?	rim of immature flared mouth jar, orange fabric
RKCC18	FPB2	F5/L6	SW	large immature jar base, orange fabric
RKCC19	FPR13	F5/L3	EW	bowl rim, orange fabric
RKCC20	FPR14	H5/L9	SW	flared mouth jar rim with five ridges on upper-side
RKCC21	FPR15	M5/L14	SW	immature jar rim with ridge on outside, orange fabric
RKCC22	FPR16	R5/L22	SW	rim of jar with 3 ridges on upper-side
RKCC23	FPL3	surface find	SW	large jar shard with vestigial lug, brown glaze outside

APPENDIX 3

Archaeological Mapping Survey and 3D Model of Chong Samrong

KiM Samnang, GIS Specialist

Head of GIS and Database Unit,
Dept. of Technical Supports and Inter-sectoral Projects
APSARA AUTHORITY

Many recent collaborative research projects have revealed new information about the Angkorian highway network and its associated communities. The road connecting central Angkor to Beng Mealea and Bakan (Preah Khan Kompong Svay, also known as Plov Beng), is known to be an important road to the region east of the capitol through the presence of several significant ancient agglomerations and industrial workshops (eg.ceramic kilns and Iron-smelting sites) located along this road. In 2013, the Chong Samrong kiln site was identified along this road at Kambo Or village, Khvav commune, Chikreng district, Siem Reap province.

Before starting to excavate and to study in detail about the history of archaeological characteristics of the kiln site, the advanced technology of GIS and remote sensing was firstly initiated to do the field mapping survey at Chong Samrong area by using a handheld GPS and a total station.

GIS and RS Compatible Survey Equipments

- Global Positioning System (GPS): Garmin GPSMap 76s (accuracy +/- 5-10 meters);
- total station: Sokkia SEt30R and its peripherals;
- military manual compass and 50-meter tape measure.

Garmin GPSMap 76s

Total Station: Sokia Set30R

Archaeological Measurement and Survey Methodology

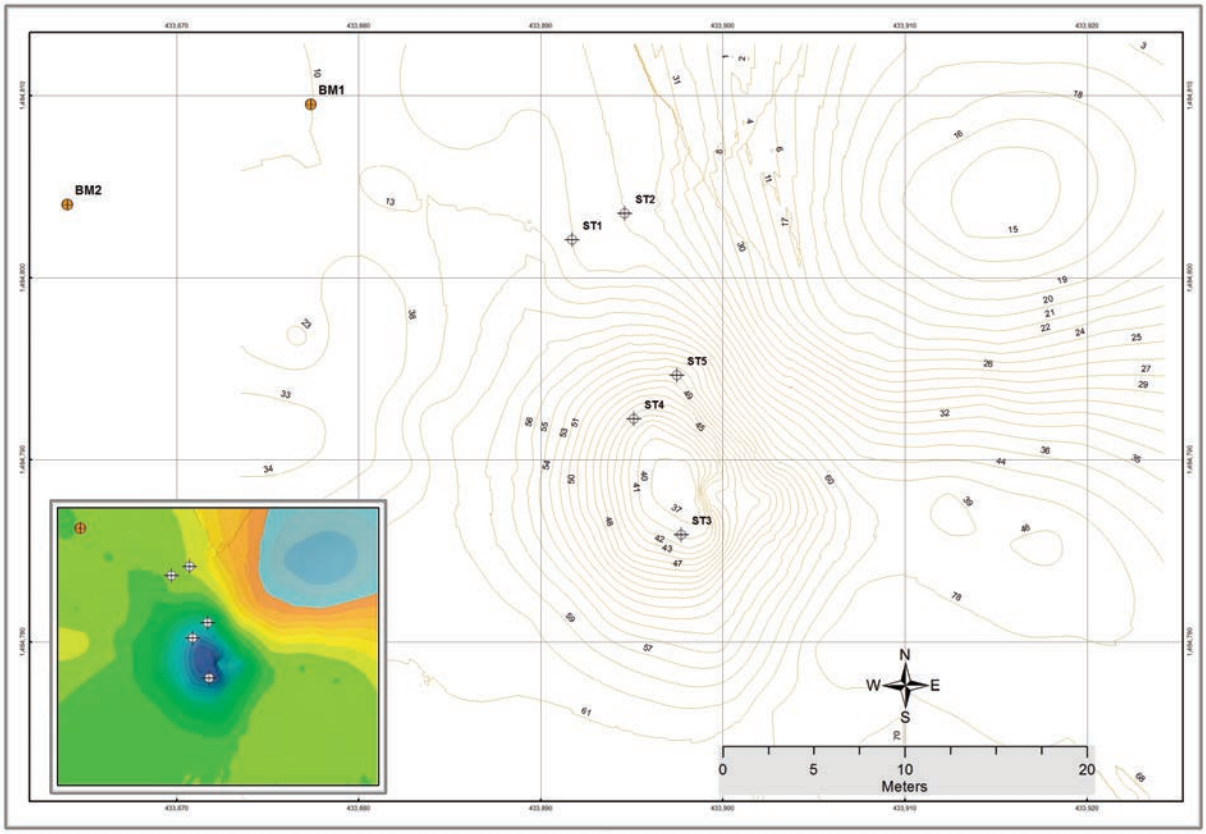
In this study, we conducted a general field survey in the vicinity of Chong Samrong using a Garmin handheld GPS and military compass and meter measurement tool to draw the archaeological site. We defined the common World Geographic Coordinate system so-called "Universal Transfer Mercator (UTM)", zone position 48 north and World Geodetic system 1984 (UTM_P48N_WGS84). After measurement and survey int the field, all of the collected data were plotted and re-drawn into the GIS and Rs applications. Those applications are ArcGIS Desktop 10.1, Arcscene 10 (3D) extension, Google Earth and Garmin Mapsource for interpreting and analyzing the general characteristic of the Chong Samrong kiln site.

Establishment of Ground Control Points (GCP) using a Total Station

Many ground control points (GCPs) have been installed since the French colonial period to the present to serve as real ground location points (XYZ) in order to transform the ground field plan into a highly accurate paper plan for the purpose of the preservation and management of the monumental sites and urban planning projects at the Angkor parks and at Siem Reap town.

There were no GCPs nearby Chong Samrong because of the area's considerable distance from the Angkor capital. Therefore, due to the lack of GCPs and the time and cost limitation in this phase, we started to propose some GCPs which have more or less error tolerance (+/-) 5m of X,Y value and (+/-) 2-5 m of Z value by using the handheld GPS (Garmin GPSmap 62s) to read XYZ locations. Then we established two GCP permanent concrete markers nearby the kiln excavation site measured using total station Sokkia SET30R. Our purpose is to measure in detail the profile of the kiln site and to provide detailed survey work in the future, not only at the other nearby kiln sites but also at the other archaeological sites around that area. These two GCPs are BM01 (X: 1484809.521, Y: 433877.387, Z: 46.958) and APSARA BM02 (X: 1484804.01, Y: 433864.01, Z: 47.01).

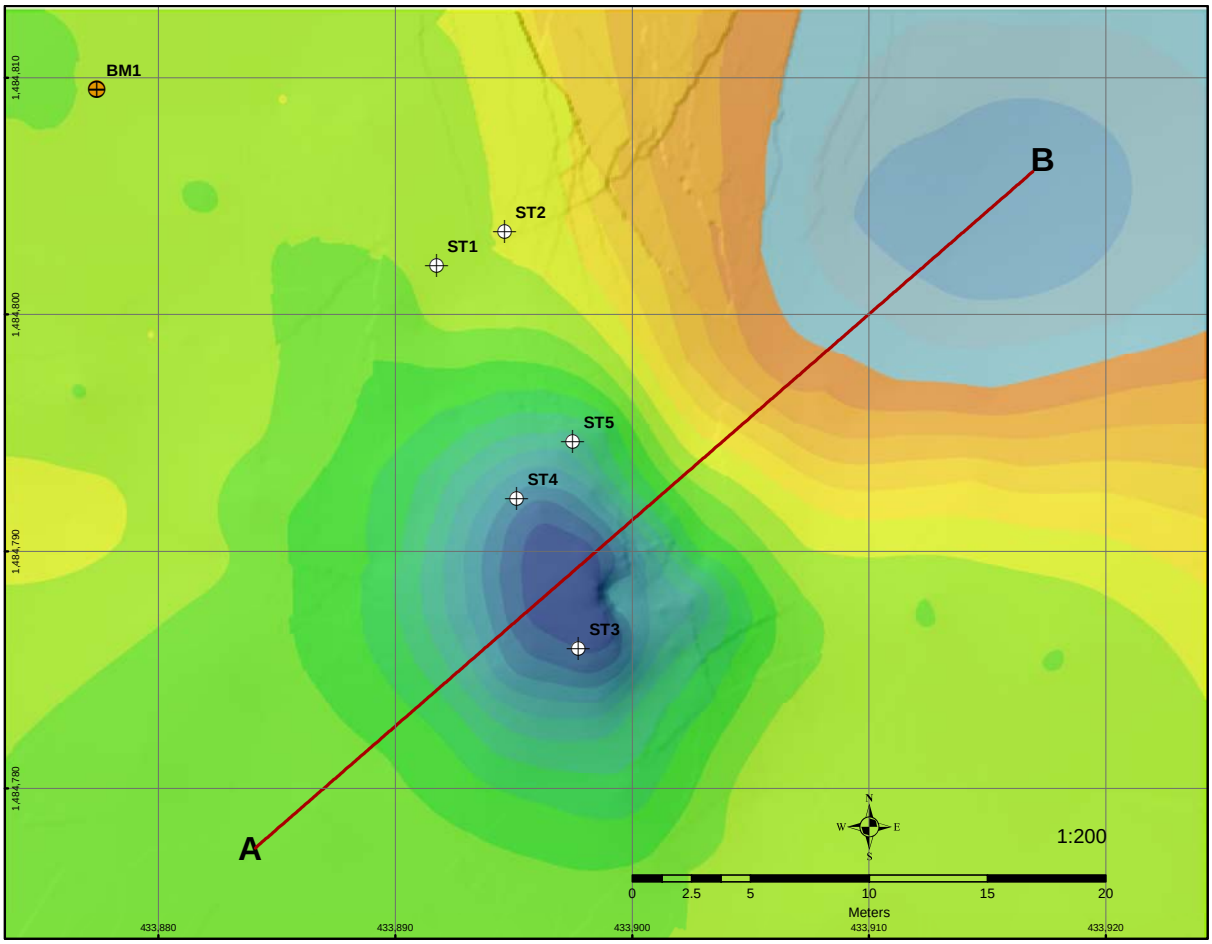
These GCPs could be adjusted to the absolute location of X,Y,Z with higher capacity of DGPs machine in the coming phase, when we are able to hire the DGPs service to derive the absolute location (XYZ).

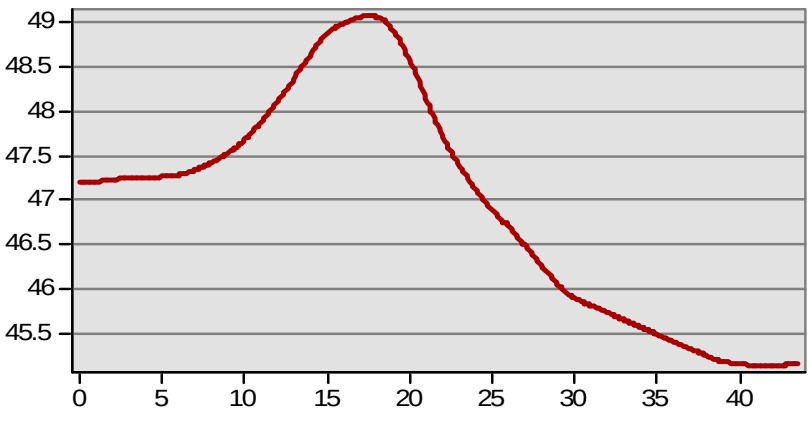


Setting up starting points (st), setting up the concrete benchmarks' values, reading the XYZ value (left to right). Chong Samrong kiln mound (below).

3D Model of Ceramic Kiln Site

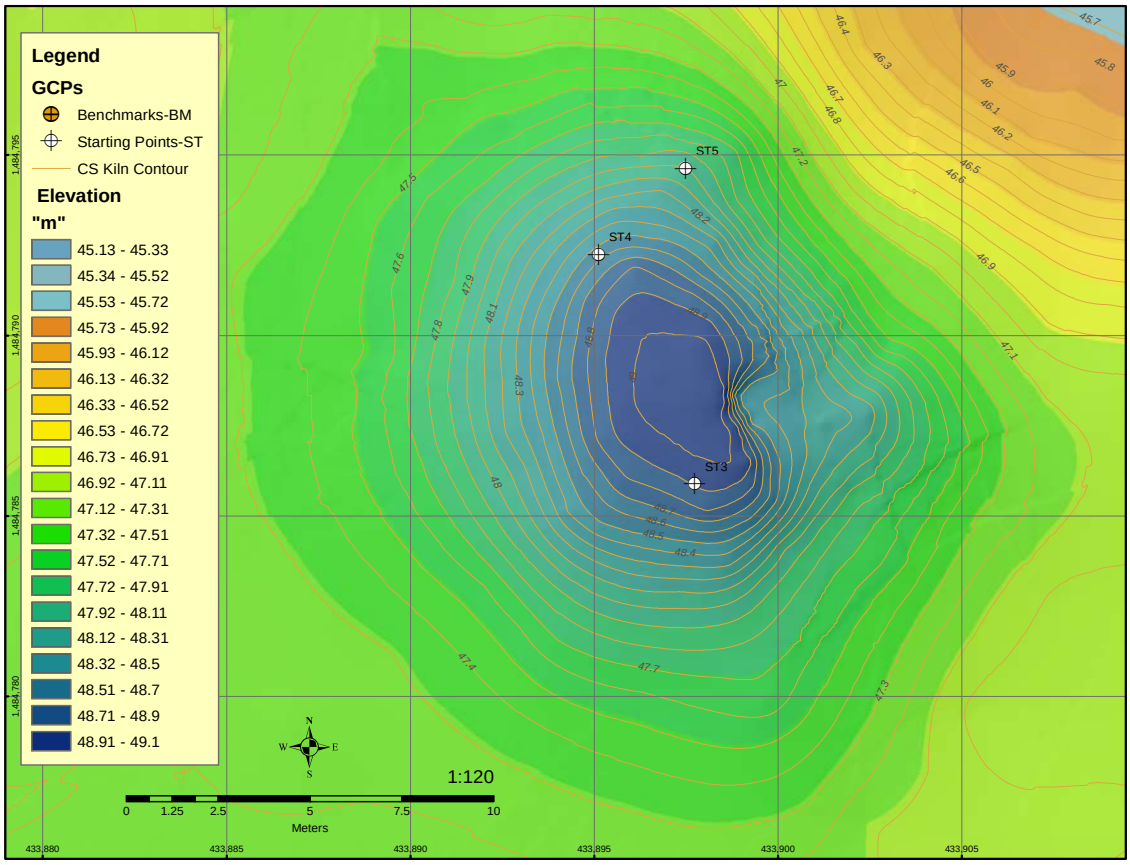
Referring to the two GCPs, the detailed measurement works was carried out by the total station specialists over the kiln mound and its surroundings. As a result, we completely obtained a hundreds of control points read by total station in order to understand the topographical map of the kiln mound and its characteristic and profile. Thus, through the collected control points, the 3D model, the general profile and its structures were developed utilizing the ArcGIS Desktop 10 and 3D analyst extension. Below are the examples of the output work of 3D model.



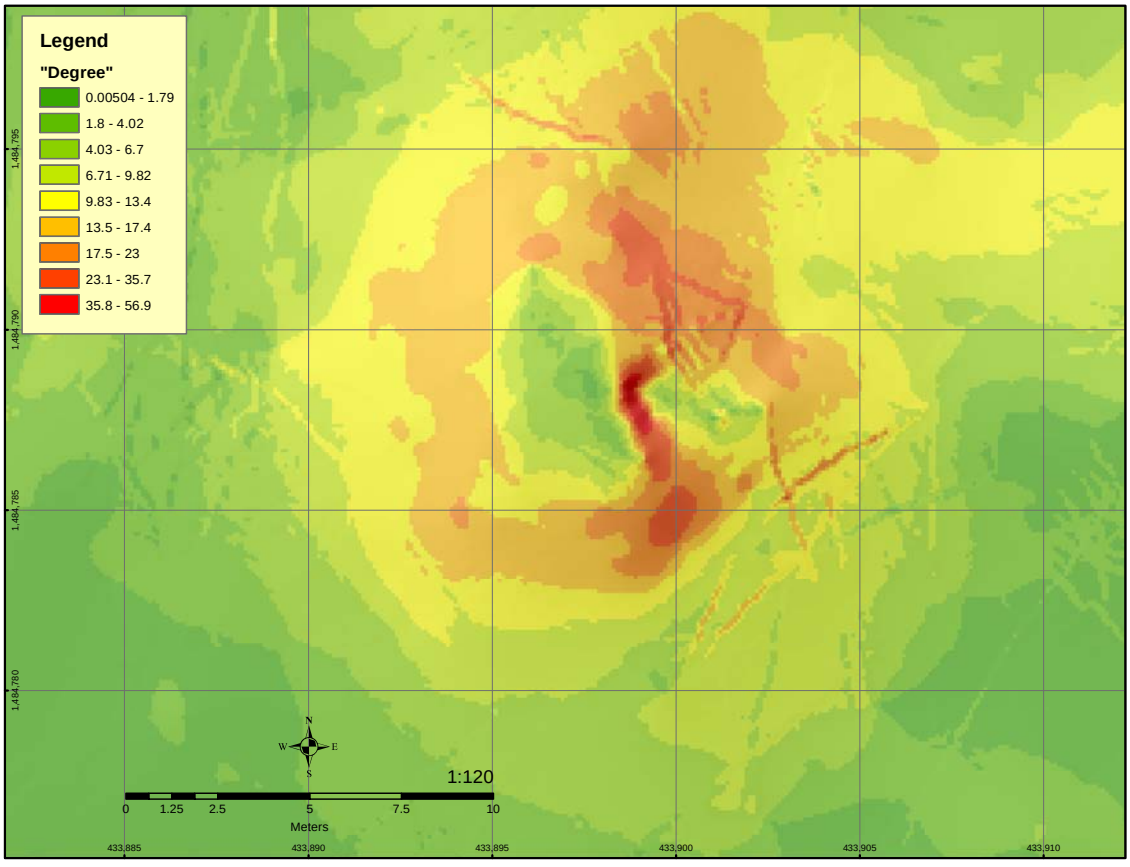


3D modelling and cross-section of Chong Samrong Kiln Site 01

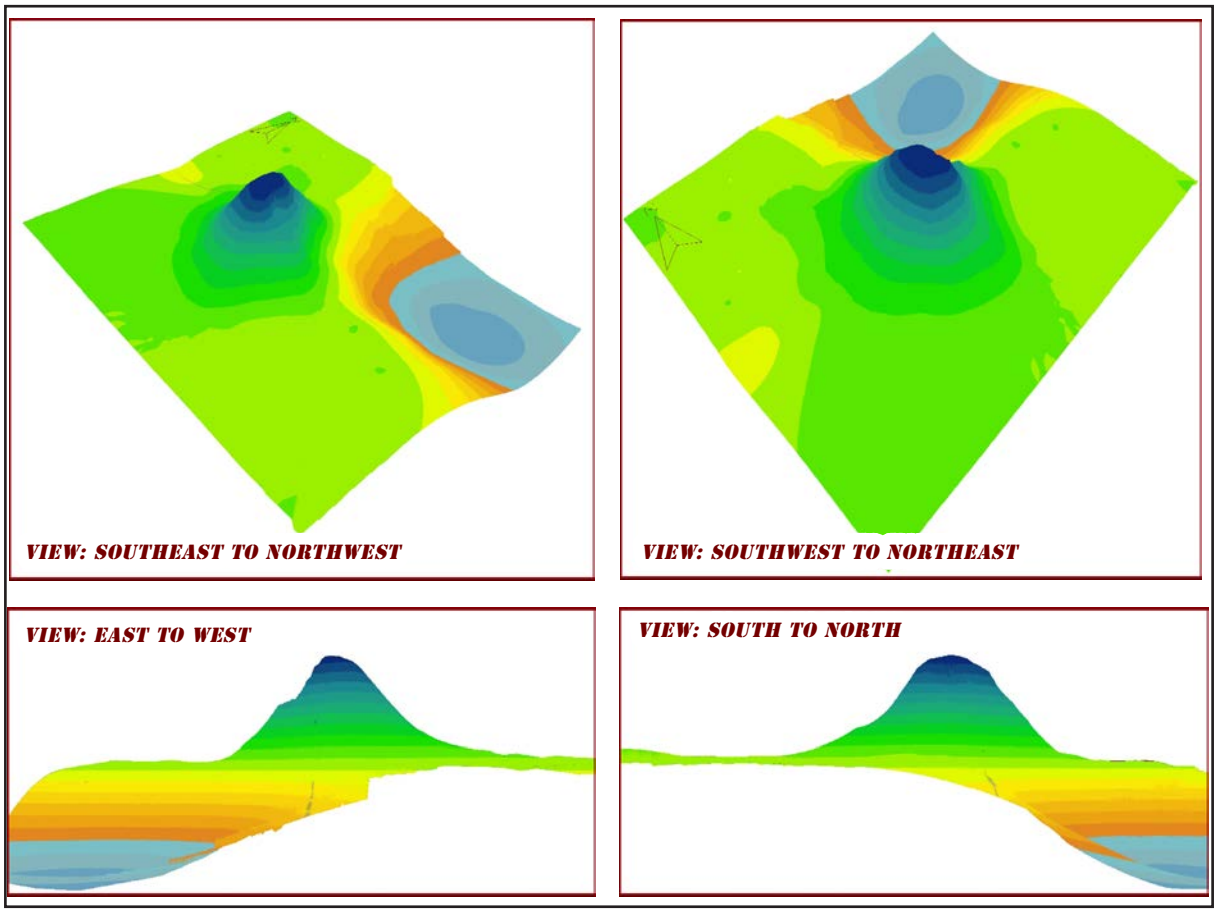
View: Southwest to Northeast (A-B)



Contour line and its 3D modelling of Chong Samrong Kiln Site 01



Slope view of Chong Samrong Kiln Site 01



3D modelling of Chong Samrong Kiln Site 01

Conclusion

The new tools of GIS and remote sensing play an important role in current archaeological research projects in the world. These tools provide researchers and archaeologists with interpretations in advance not only of the detailed excavation work but also of the general relationship of the site to its cultural landscape. Moreover the two concrete control points demarcated near Chong Samrong Kiln Site 01 will serve as main global referencing locations for future research around this area.

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