# Brief report on archaeological survey at the western causeway of Angkor Wat: 2015-2017

Sophia Asia Center for Research and Human Development and
APSARA Authority

## I INTRODUCTION

The second phase of the Angkor Wat Western Causeway Restoration project has challenged to keeping an original form of the laterite wall which was recommended by the International Coordinating Committee for the Safeguarding and Development of the Historic Site of Angkor, ICC-Angkor. To reply to ICC-Angkor, the work team conducted several campaigns of excavation to understand the internal structure of laterite wall and its foundation. Excavations at the moat-side of the foundation of laterite wall (test trench 2015 DEC.), and on the causeway (test trench 01 and test trench 02) were carried out between 2015 and 2017 by Sophia Asia center for Research and Human Development and the Department of Conservation of Monument in Angkor Park and Preventive Archaeology, DCMA, APSARA Authority (Fig. 1; Photo 1, 2). This is a brief report on these surveys focused mainly on two test trenches of trench 01 and trench 02.

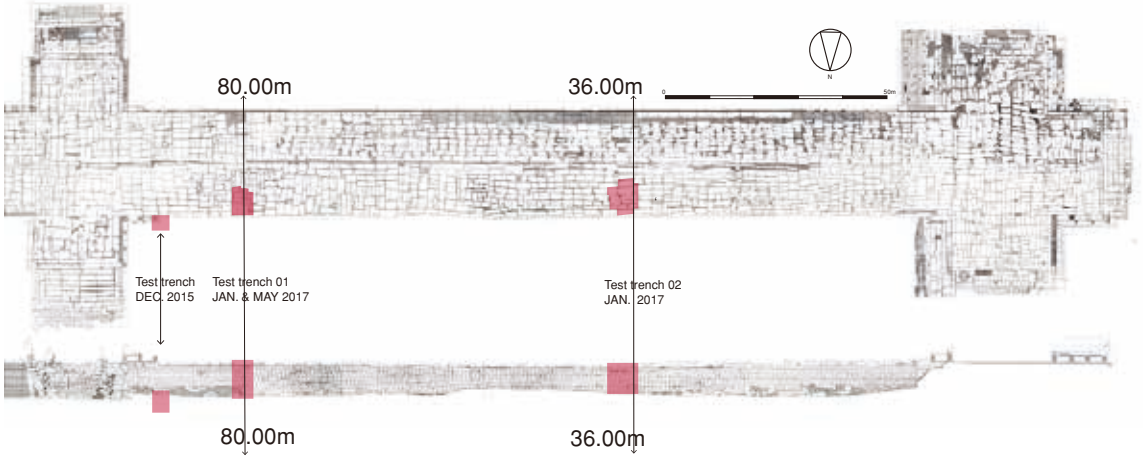


Fig. 1 Location of test trenches, December 2015, January and May 2017

Ph. 1 Western Causeway, Angkor Wat:
View from North-West (January 2, 2017)

Ph. 2 Western Causeway, Angkor Wat:
View from South-West (January 2, 2017)

## 1. Investigation Area

Two test trenches including following 2 areas on the western causeway, Angkor Wat which covering total 32 square meters.

Trench 01: grid 80 area (between grid 79-82/D-H): 12 square meters, excavated in January 2017 and May 2017

Trench 02: grid 36 area (between grid 35-39/C-H): 20 square meters, excavated in January 2017

## 2. Members

APSARA Authority:

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- Chhun Sambor /Archaeology, DCMA
- Ourn Sinang /Archaeology, DCMA
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- MIWA, Satoru /Architecture, Sophia Asia Center for Research and Human Development
- Nhim, Sotheavin /Archaeology, Sophia Asia Center for Research and Human Development
- Choeun Vuthy /Staff, Sophia Asia Center for Research and Human Development

## 3. Purpose and Process of Investigation

For coming restoration project of 2nd phase, main purpose of the first survey in January 2017 is to clear current condition of internal structures of the western causeway based on the results of test trenches by archaeological survey and auger borings. At the grid 80 area, test trench 01, laterite wall seems keeping good condition as original structure, however sandstone floor is in unstable which to be spread in rescue (Fig. 2; Photo 3, 4). At the grid 36 area, test trench 02, laterite wall seems keeping condition as once restored, then sandstone floor is also in unstable (Fig. 6; Photo 9, 10). Through excavation at these areas, it would be expected to understand that actual internal structure of causeway and find trace with any restoration activities historically.

In the first survey of the trench 01, it was excavated to the depth of 225cm from surface of sandstone-floor, it means 19.500m (sea level, SL). It corresponds with the middle of 6th laterite wall from top (Fig. 3-1). We observed inner condition of the deposited soil and laterite wall. The soil under 19.500 m (SL) was investigated by hand auger coring, because the groundwater level at the time obstructed us to continue a trench survey (Fig. 3-2). The report was submitted to twenty-seventy Technical Session of ICC-Angkor, January 24, 2017. The committee evaluated the result and observation of our first campaign, then made recommendation to excavate again for observation digging down to the basement of the laterite walls. Due to comply with the recommendation, APSARA and Sophia decided to excavate again as second campaign in May 2017.


Plan of test trench 01:
Grid 79-82/D-H, grid 80 area,
12 square meters

Floor of sandstones colored red were removed,
then excavation was conducted.
The plan was prepared for last restoration project
of phase 1.

Fig. 2 Test trench 01

Ph. 3 Floor of sandstones, before removal

Ph. 4 Wall of laterite blocks at the area of trench 01: Grid 79-82, view from north, moat side)

## II RESULTS OF INVESTIGATION

### 1. Outline of Investigation Result

In January 2017, it started to remove floor stones at both areas of trench 01 and 02, then dig down inside. In summarize of survey, the mission confirmed that trench 01, T1 and trench 02, T02 show various traces of activities to be restored which are completely different with the sedimentary soil observed in phase 1. Detail of observation with each trench is proposing following chapters.

As mentioned above in the INTRODUCTION, the 2nd campaign focuses to observe inner condition at the bottom of laterite wall by excavation. There is no previous research reported for this, therefore the observation of T01 was expected to provide an important information with the internal structure of the causeway and contribute to build a plan of restoration.

### 2. Groundwater level

On the 2nd January, 2017 (dry season), the groundwater level was 250cm below the surface sandstone of the western causeway (sea level 19.361m), which limited the range of this excavation.

On the May 1, 2017 (beginning of rainy season), the groundwater level was 296cm below the surface sandstone of the causeway (sea level 18.900m). For safely and efficiently survey in test

trench, lower the water in the moat was a top immediate priority. Reinforcing work of embankment at the area of investigation started for the beginning, then water in the moat was pumped, and finally a drainage work lowered it to 17.960m which showed less equal height with the 11th laterite wall.

### 3. Trench 01: grid 80 area (Fig. 2, 3, 4, 5)

After removal of sandstone floor (01, Fig. 3) of causeway in January 2017, instead of laterite surface, a layer mixed with a huge number of mountain stones sized from small to middle (02, Fig. 3) laid under sandstone floor, then big blocks of laterite stones (04, Fig. 3) subsiding deeper were observed. Then a lot of mountain stones sized from middle to big (05a, Fig. 3) and sandy soil (05b, Fig. 3) are just under laterite stones. The story once happened between layer 03-05 seems that sandy soil of 05 flowed out gradually, then only mountain stones remains there, finally laterite stones were subsided. There is a high possibility these laterite stones were laid horizontally just under sandstone floor originally. The soil under 19.500 m (SL) was investigated by hand auger coring, because the groundwater level at the time obstructed us to continue a trench survey. Due to the above reasons, it could not be denied that observation soils were limited.

In the second campaign in May 2017, trench 01 was dug down again to the level of 11th laterite wall in the end. At the bottom of the trench, it heights 17.968m (north-west corner of the trench). However drainage work lowered the level of water, at the bottom of trench water flows constantly from bottom and side. Under 11th laterite wall, next basement of laterite, 12th laterite, set in vertical direction packed with fine sand layer was observed by looking. It is so obvious that digging more into sand layer offers little stability of whole construction of the wall, then investigation decided to stop at this stage. 13th laterite has not been observed.

Two sections (east and west) were observed as following details:

#### 3-1. East section (Fig. 3-1):

- 01 : Sandstone floor
- 02 : 5YR5/6 bright reddish brown: silty fine sand, mountain stone chips (dia.4cm-), some small sandstone chips
- 03 : 5YR4/6 reddish brown: silty fine sand, big (dia.13cm-) and small sandstone chips, some pieces of laterite chips
- 04 : laterite blocks
- 05a : 5YR5/8 bright reddish brown: silty fine sand, big mountain stone chips (dia.13cm-), some laterite chips
- 05b : 5YR6/8 orange-7/4 dull orange: silty fine sand, laterite gravel, manganese
- 06a : 5YR5/6 bright reddish brown: silty fine sand, some laterite chips
- 06b : 5YR4/6 reddish brown: sandy fine sand, some laterite chips, some small sandstone chips, a few mountain stones
- 07a : 7.5YR6/8 orange-5/8 bright brown: sandy clay, a lot of laterite chips and fear pieces of sandstone chips
- 07b : 7.5YR6/8 orange-7/1 light brown gray: sandy clay, some laterite chips, a few pieces of sandstone chips

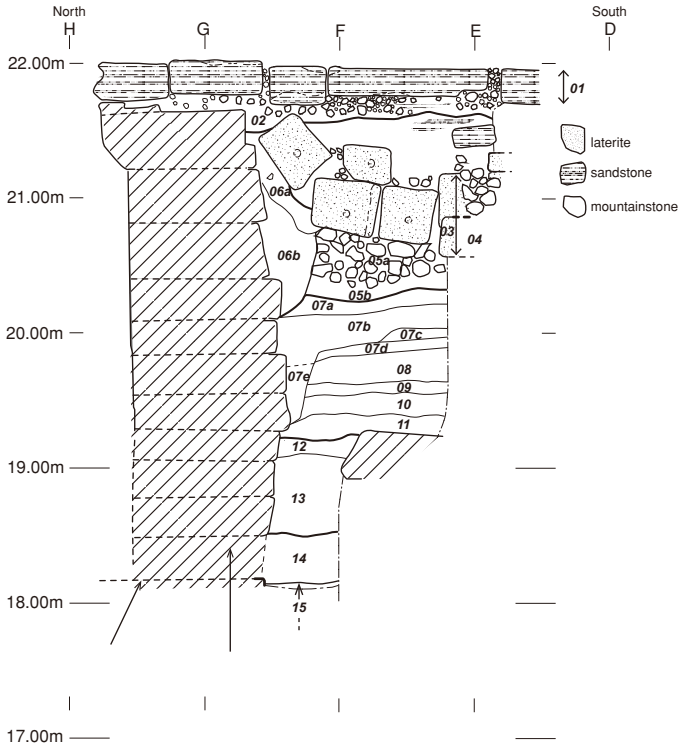



Fig. 3-1 East section, grid line: 81m, test trench 01 May 2017

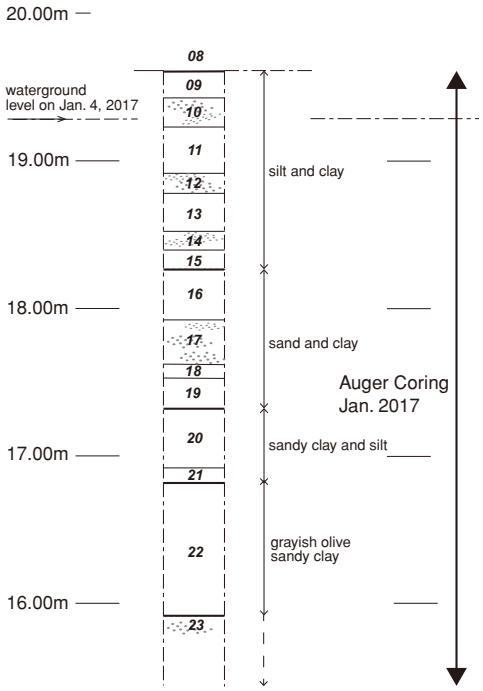



Fig. 3-2 Auger Coring, East section, grid line: 81m, test trench 01 Jan. 2017

- 07c : 5YR5/8 bright reddish brown: silty fine sand, little pieces of laterite chips
- 07d : 7.5YR6/8 orange-5/8 bright brown: sandy clay, a lot of laterite chips
- 07e : 7.5YR5/8 bright brown: silty fine to medium sand, sandy clay
- 08 : 10YR5/8 yellow orange: clay block, silty fine to medium sand
- 09 : 10YR5/8 Yellowish brown: clay block, fine sand to medium sand
- 10 : 7.5YR5/6 bright brown: clay block, silty fine to medium sand
- 11 : 7.5YR5/6 bright brown: fine to medium sandy clay
- 12 : 5YR4/8 reddish brown: fine to medium sandy clay, laterite chips
- 13 : 7.5YR 5/6 bright brown: fine to medium sandy clay, silty medium sand
- 14 : 7.5YR 5/8 bright brown: clay block, silty fine sand
- 15 : 5YR 5/6 bright reddish brown: fine sand

## 3-2. West section (Fig. 4):

*Layer no.1 – no.8 are same with East section.

- 08 : 7.5YR5/8 bright brown: fine to medium sandy clay, silty fine to medium sand
- 09 : 10YR5/6 Yellowish brown: clay block, silty fine to medium sand
- 10 : 7.5YR5/6 bright brown: fine to medium sandy clay
- 11 : 7.5YR5/6 bright brown: fine to medium sandy clay
- 12 : 7.5YR5/6 bright brown: silty medium sand, medium sandy clay, clay block
- 13 : 7.5YR 5/6 bright brown: silty fine to medium sand, fine sandy clay

- 14 : 7.5YR 5/8 bright brown: silty fine sand, clay to silt block
- 15 : 5YR 5/6 bright reddish brown: fine sand

### 3-3. Construction of layers in Trench 01 (Fig. 3, 4, 5)

Sedimentary layers are explained as following construction: Basement construction (12th laterite and under, layer no.15, fine sand) is clear through excavation that 12th laterite, top of the basement, was set in vertical direction with 11th laterite, the lowest laterite of the wall. This is new observation to understand inner structure of laterite wall and its basement. The 12th laterite, top of basement, accompanies fine sand layer without any other inclusion. It is supposed that fine sand was deposited inside of basement. Fine sand layer seems to be well drained in a closed space, but cannot stay once it has made a little route of outflow of water or sand.

Laterite wall construction, 11th laterite and upper: layer no.14-no.07

The soil deposited with laterite walls upper 11th shows mainly sandy clay including clay or silt- blocks, or laterite chips. Among layers, by components, following three groups are proposed:
-Layer no.14: silty fined sand layer including clay blocks and small gravels
-Layer no.13 and no.12: sandy silt including small laterite chips
-Layer no.11-no.7: clay and sand layers are alternately stacked

Uneven settlement: layer no. 06-no.03

Laterite wall is well conserved which is supposed to be keeping position constructed, on the other hand both sections of east and west, big blocks of laterite subsiding deeper to the south were observed. These blocks of laterite were originally covered surface of soil at the same level with the top of laterite wall, then blocks of sandstone were set over laterites. The story once happened sandy soil of layer no.05 flowed out gradually, then only mountain stones remains there, finally laterite stones were subsided, however laterite wall itself has not been damaged at all.

### 3-4. Internal condition of laterite wall

General profile of the wall (Fig. 5; Photo 5, 6, 7, 8, 9)

Laterite wall shows 11 blocks piled up, and as a basement 6 more laterite blocks were installed which were observed from moat-side in December 2015. Blocks of laterite wall Through excavation, 12th laterite, top of the basement, was installed in vertical direction with 11th laterite, and under 12th laterite cannot be touched in this campaign.

By measuring cross section of laterite wall at the grid 80m, it doesn't show inclination, and each block is well preserved except 11th laterite. Internal surface of 11th laterite was so weak that it was difficult to identify outline of block.

## 4. Trench 02: grid 36 area (Fig. 6, 7; Photo 10, 11, 12, 13)

At the grid 36 area, it also shows a trace of past restoration works. Under sandstone floor (01), a lot of small size of stones: mountain-stones, sandstone chips, and laterite chips were observed in a layer (02), then in deeper position a huge amount of sandstones with carving such as a pilaster, a pediment, a part of building were found (03). These stones indicate to be buried as an internal soil for restoration. Layer 03 is therefore lacking stability, and easy to slide down.

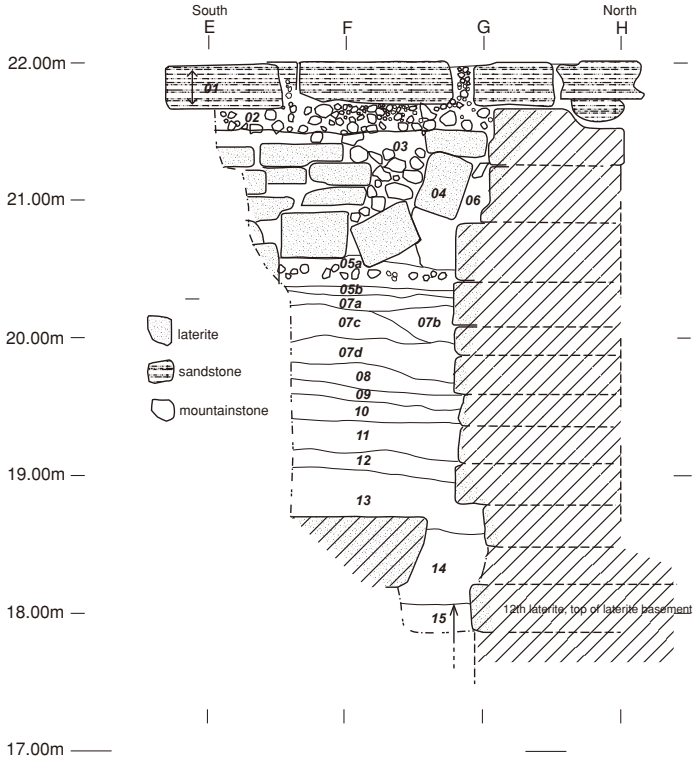



Fig. 4 West section, test trench 01 May 2017

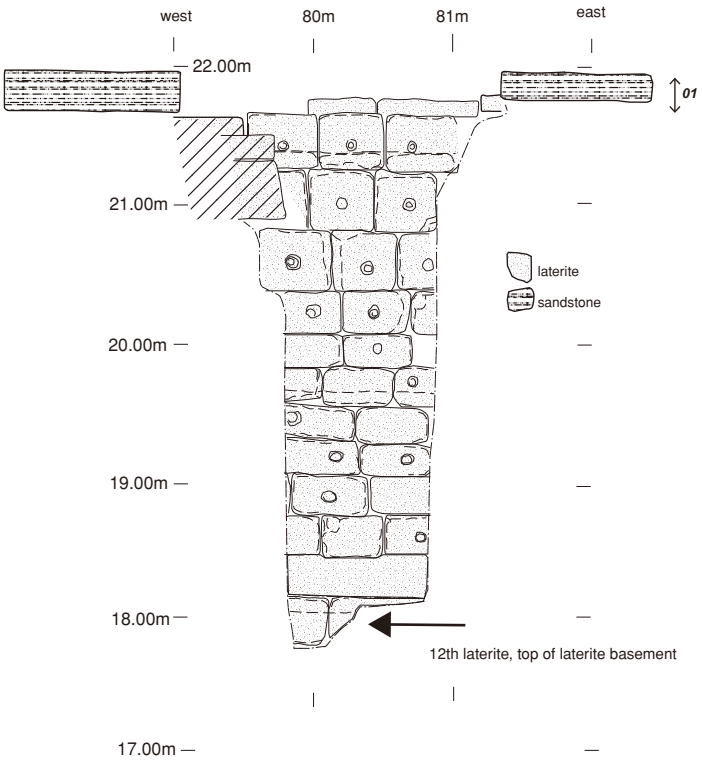



Fig. 5 Profile of laterite wall, inner condition of T01 May 2017

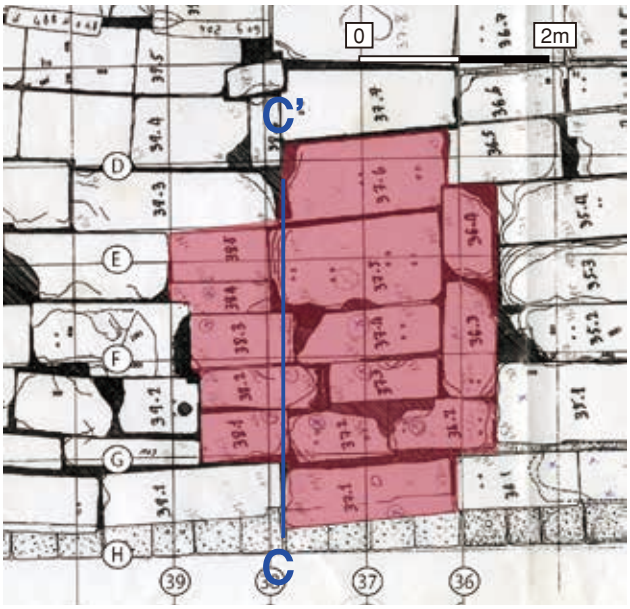
Ph. 5 Test trench 01, view from west

Ph. 6 Test trench 01, view from south-west

Ph. 7 Test trench 01, view from north-west

Ph. 8 Test trench 01, view from east


Ph. 9 Profile of laterite wall, bottom of test trench 01




Plan of test trench 02:
Grid 35-39/C-H, grid 36 area,
20 square meters

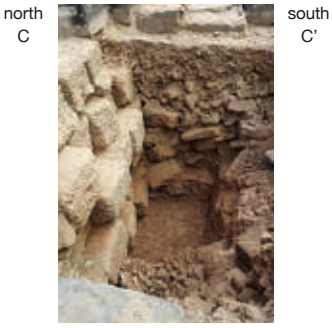
Floor of sandstones colored red were removed, then excavation was conducted. The plan was prepared for last restoration project of phase 1.

Fig. 6 Test trench 02

Ph. 10 Floor of sandstones, before removal

Ph. 11 Wall of laterite blocks at the area of trench 02: Grid 35-39, view from north, moat side


Ph. 12 Test trench 02, view from west, January 2, 2017




Ph. 13 East section, test trench 02

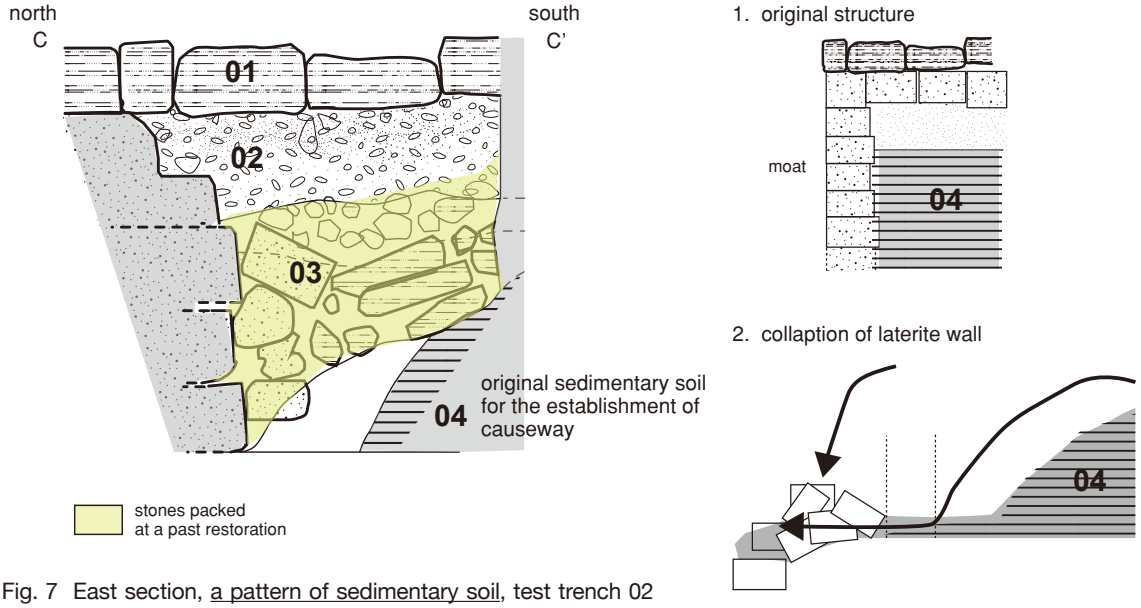



Fig. 7 East section, a pattern of sedimentary soil, test trench 02

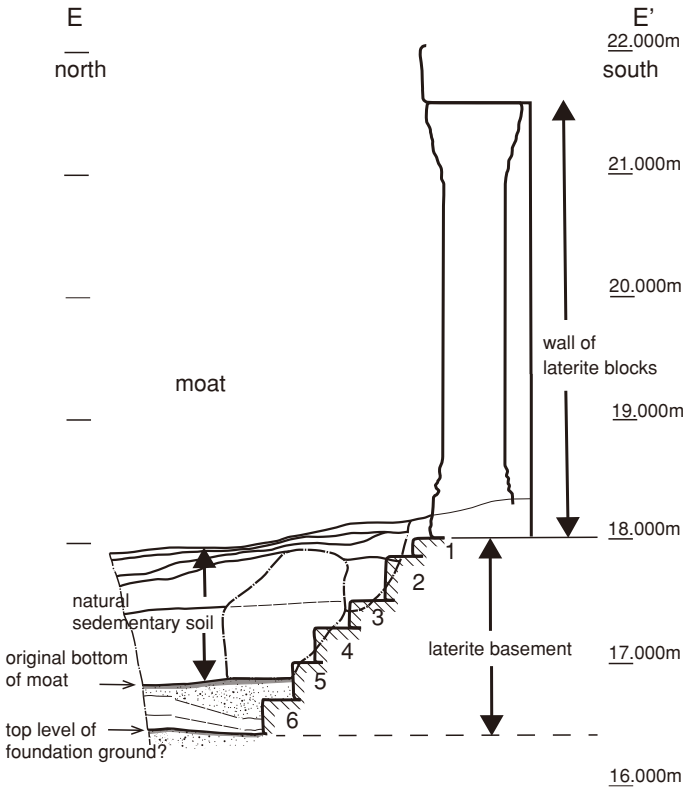



Fig. 8 East section, test trench 2015 December

Ph. 14 Test trench 2015 December, view from north

Ph. 15 Test trench 2015 December, view from north west

As a future research, it will be expected to study iconography and art history with carvings excavated from this trench.

**5. Investigation on December, 2015** (Fig. 8; Photo 14, 15)

In December 2015, the mission investigated at the moat side of the western causeway, Angkor Wat. 6 steps of laterite basement were observed, and it cleared that original bottom was hard and packed small laterite chips thickly to its maximum. The condition of basement stones of laterite in lower part: 5th and 6th basement, were conserved in good.

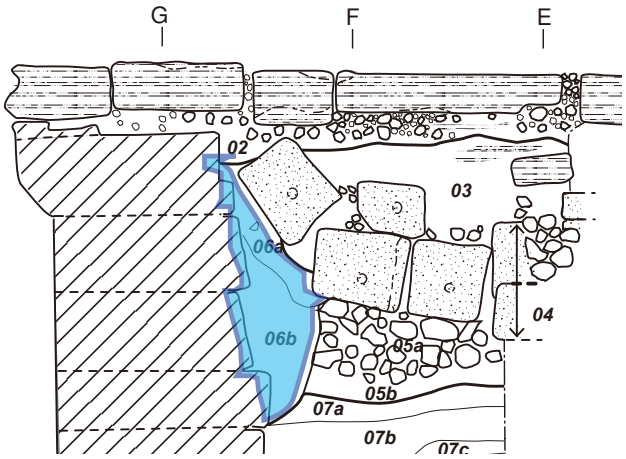
## III DISCUSSION AND RECOMMENDATION

Observation through test trenches shows various historical traces of collapse and following restoration works. They had not been recorded on the report by Conservation d'Angkor, CA and Indian Team in 1980's, however the mission found a few artifacts to be dated. From the view point of archaeology, these features excavated from both trenches indicate a very important historical development in a long "life" of the western causeway, Angkor Wat. They are traces of restoration works in a past. At this stage, the mission cannot say when these works had been done. Some pot sherds and ceramics were excavated. About the description and analysis for those artefacts will be reported in near future.

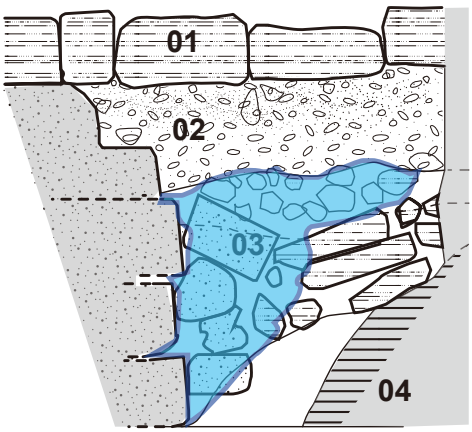
Lastly, archaeology team mentions following observation through trenches.

Some parts of layers, layer 06a and 06b in trench 01, and layer 03 in trench 02, have cracks and include rubbish such as plastics. It seems they are flowing in an east-west direction inside of causeway (Fig. 9). This observation is particularly worth noting to establish a restoration plan.

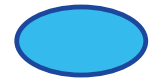
Investigation by test trench can clear small range of facts, and additionally the condition is very severe for digging down ground. Research team wants a groundwater level to be down more, to conduct an effective investigation and restoration works.



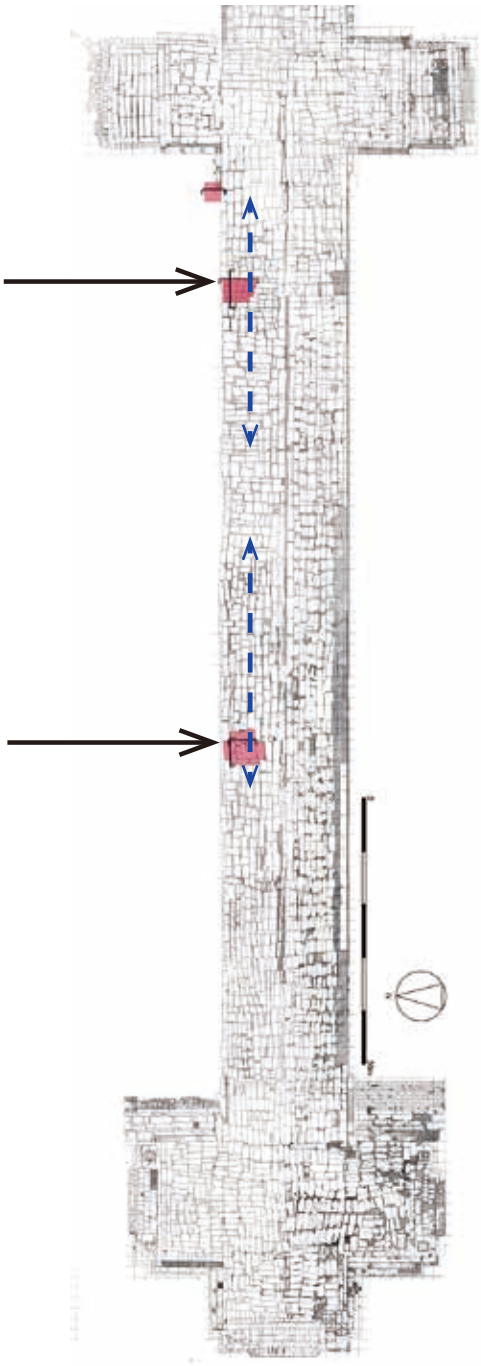

Test trench 01




Test trench 02







Plan of western causeway

Fig. 9 water, soil, and rubbish flow in an east-west directioninside of western causeway - hypothetical model

## Acknowledgement

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## Bibliography

Marui, M.

1999 Artifacts excavated from the Western causeway of Angkor Wat: investigation in the moat at the north corner of causeway, *Renaissance Culturelle du Cambodge (Kanbojia no bunka fukko)*, 16, Institute of Asian Cultures, Sophia University, pp.176-179. (in Japanese)

Marui, M., Miyamoto, Y., Miwa, S., Nhim Sotheavin

2016 Archaeological survey at the moat of the western causeway of Angkor Wat: campaign on December 2015, *Renaissance Culturelle du Cambodge (Kanbojia no bunka fukko)*, 29, Institute of Asian Cultures, Sophia University, pp.201-210. (in Japanese)

Sophia Asia Center for Research and Human Development

2011 *Report of the Conservation and Restoration of the Angkor Wat Western Causeway, Phase 1*, Sophia University, Tokyo.

Tsukawaki, S., Fujita, Y., and Kum Sorith

1995 Internal structure of the Western Causeway of Angkor Wat: investigation with a hand -auger coring, *Renaissance Culturelle du Cambodge (Kanbojia no bunka fukko)*, 11, Institute of Asian Cultures, Sophia University, pp.32-39. (in Japanese)