

National Authority for Preah Vihear

April 2025

Kingdom of Cambodia
Nation Religion King

U.S. EMBASSY PHNOM PENH
NAPV-AFCP

ANNEXURES:
Documents from All Phases

Conservation and Restoration of the Northern Ancient Staircase Preah Vihear Temple (Phases I-IV: 2018-2024)

Funded by
Ambassadors Fund for Cultural Preservation (AFCP)

Implemented by
National Authority for Preah Vihear (NAPV)

PREAH VIHEAR

April 2025

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Thomcheat Village, Sra Em Commune, Choam Ksant District, Preah Vihear Province

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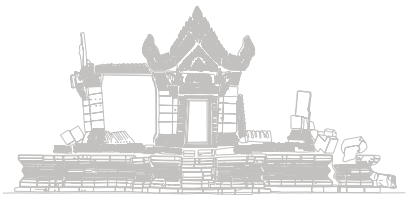
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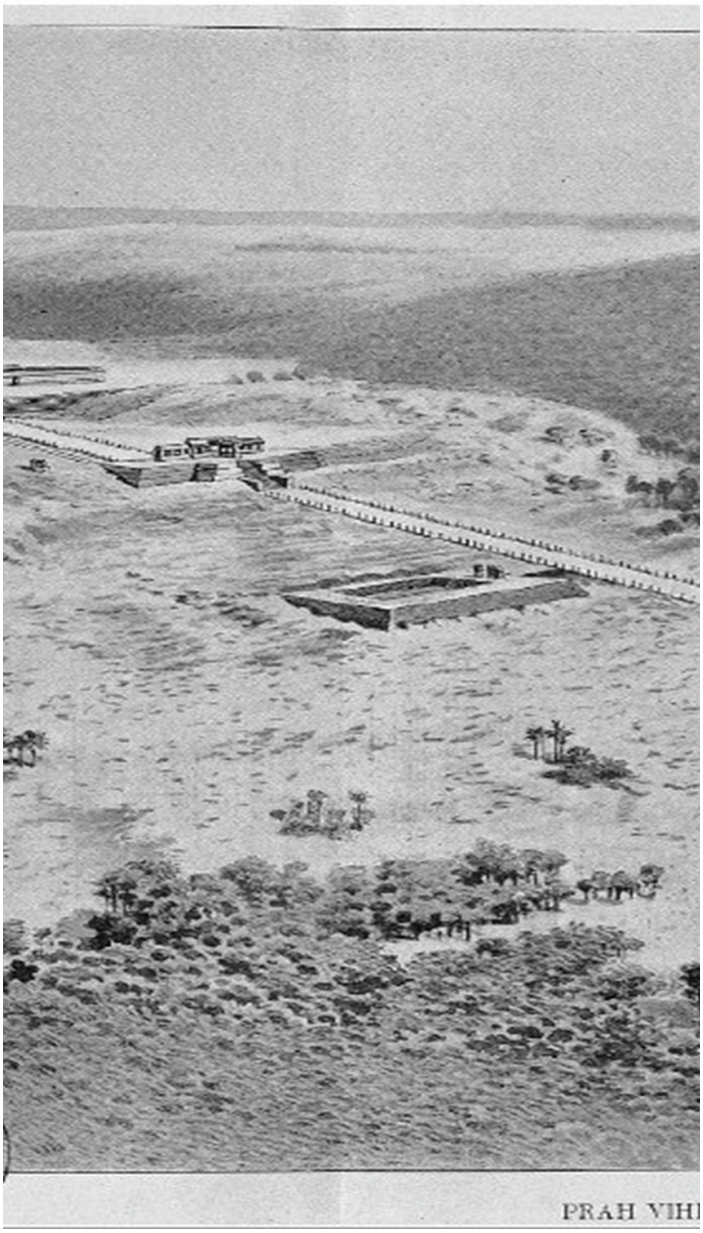
April 2025

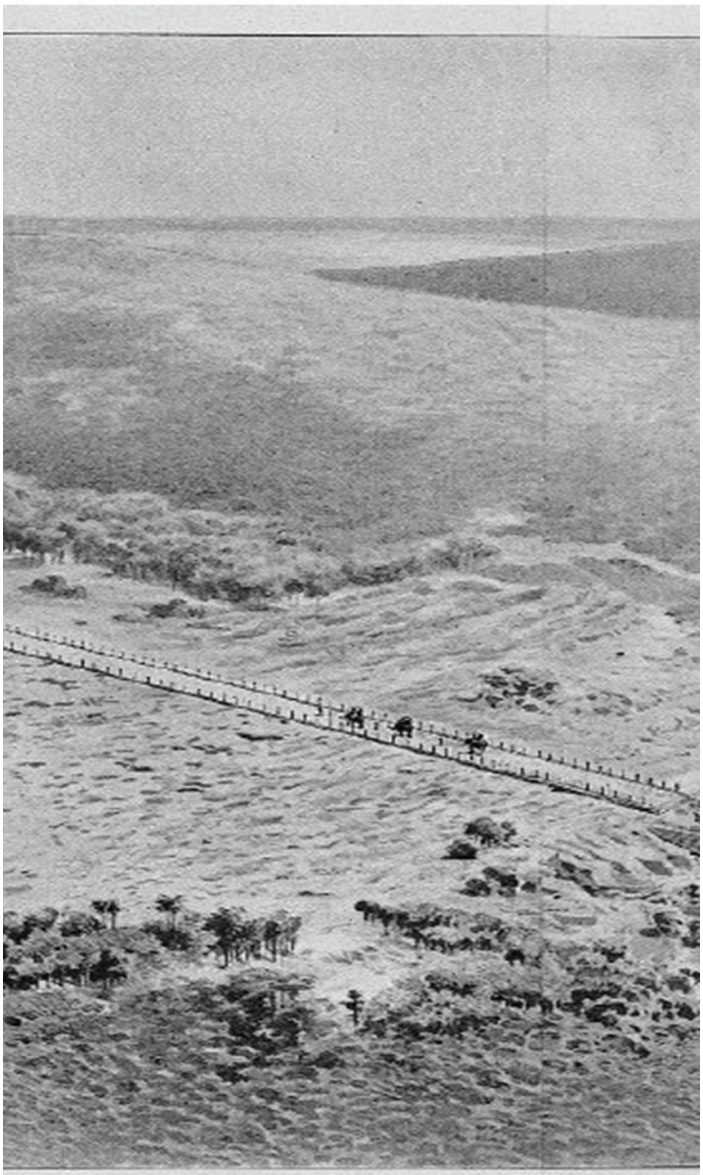


Preah Vihear Temple

A historical reconstruction of Preah Vihear Temple by the EFEO in the early 20th century, showing its stunning layout along the edge of the Dangrek Mountains.

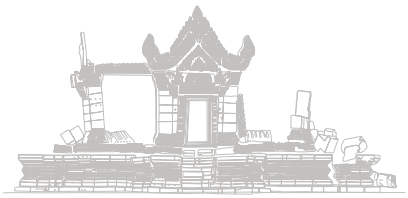






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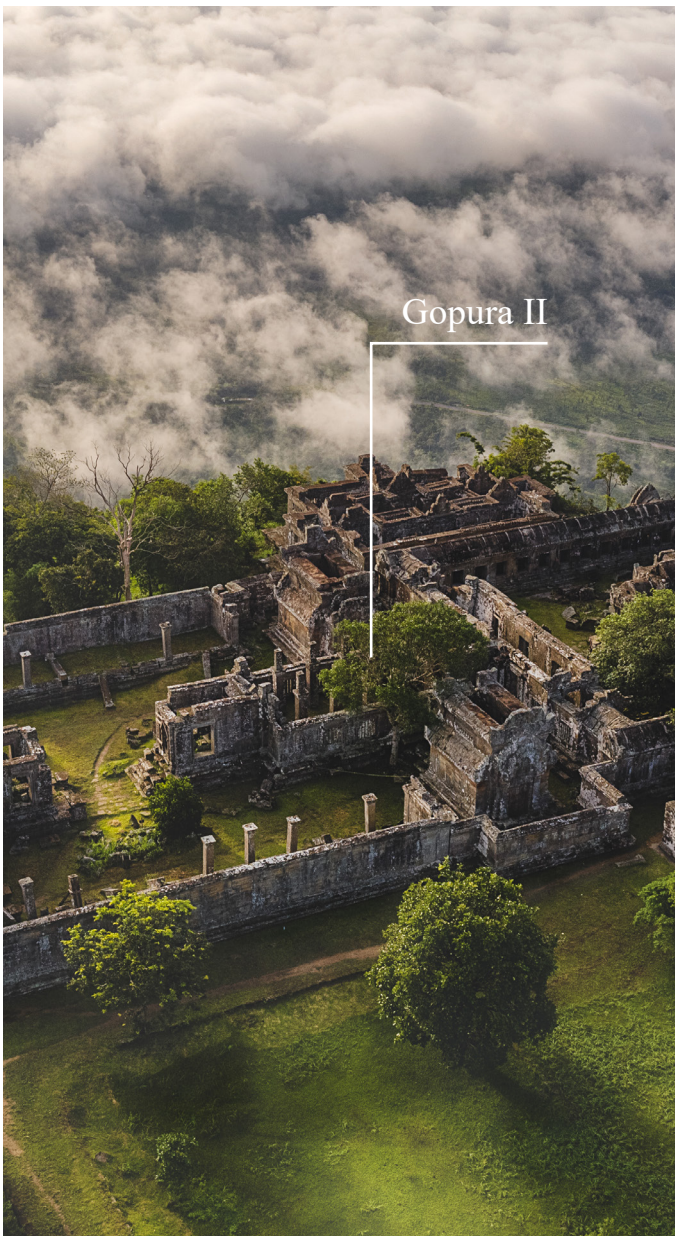




Preah Vihear Temple

Aerial view of Preah Vihear Temple in 2021, perched atop the Dangrek Mountains in sanctuary overlooking the plains, with a clear view extending from Gopura I to Gopura III.






Gopura I



Preah Vihear Temple

Conservation and Restoration of the Northern Ancient Staircase, World Cultural Heritage Site







The Northern Ancient Staircase: *Spanning 111 meters in length, 11 meters in width, and 39 meters in height, the Northern Ancient Staircase consists of 26 sections with 165 steps. Built in the 11th century, it follows the natural mountain slope along the Naga causeway, serving as a vital access route to Preah Vihear Temple and historically facilitating pilgrimage and material transport.*







Signing Ceremony for Phase III of the Northern Ancient Staircase Restoration at Preah Vihear Temple, funded by the U.S. Ambassadors Fund for Cultural Preservation (2022) – December 8, 2021







NAPV Technical Colleagues and RUFA Students Documenting the Northern Ancient Staircase Through Sketching and Structural Analysis

Forward

Preah Vihear Temple comprises numerous structures, in which include five Gopuras connected by causeways of varying lengths, a northern staircase, an eastern staircase, a western causeway, ancient ponds, and an embankment system in the west designed to divert rainwater away from the temple. In addition, ancient stone quarries are abundant across the hilltop. The National Authority for Preah Vihear (NAPV) was established in 2006 to manage the Preah Vihear temple and its surrounding area of archaeological significance in collaboration with concerned stakeholders and international partners to assure its sustainability. With its outstanding masterpieces in terms of plan and decoration, the temple was inscribed on the World Heritage List by the UNESCO World Heritage Committee on 07 July 2008.

Due to centuries of abandonment without maintenance, civil unrest, environmental factors, and looting, the structures of Preah Vihear Temple have suffered varying degrees of damage, including settlement, partial collapse, and breakage. The northern staircase and its associated structure, a key attribute of the Preah Vihear temple serving a key entrance from the north to the hilltop, was in severe condition in the form of partial collapse, loss of ancient stone blocks and stone slabs, settlement of soil-compacted foundation, deposited soil along the ancient drainage system and tree roots damaging the foundation.

Under the framework of the International Coordinating Committee for Preah Vihear (ICC-PV), the United States of America, as one of its members, provided funding to NAPV for the conservation and restoration of the northern ancient staircase through large grant of the Ambassadors Fund for Cultural Preservation (AFCP) program since 2018. With funding support in the four consecutive phases from 2018 to 2024, a total of 10 sections of the staircase, around 329 m long ancient drainage system, and five lion sculptures have been restored, and their condition have turned to original state. The restoration of the entire staircase is expected to be completed within the next three to four years. This staircase will stand strong and refunction as a pathway for the next generation. In addition, the project organized 5 times of exchange visits for project staff, outreach program to 226 local students and teachers, and internship program to 11 students from the Royal University of Fine Arts.

This document wishes to present a series of conservation and restoration activities from the start of the project Phase 1 in 2018 to the end of Phase 4 in 2024. With all the results recorded in this report, I would like to highlight the role of international community and the invaluable long-standing support of the United State of America in the cultural preservation of this World Heritage site. In this spirit, I hope that this report will be an important archive for future conservation works and will inspire concerned stakeholders, international community and individuals to recognize the value of conservation and restoration of the ancient temple for humankind, and join force to preserve our cultural property for the next generation.



KONG Puthikar
Project Director, AFCP Funded Project
Director General, National Authority for Preah VIhear

Acknowledgement

The successful conservation and restoration of the northern ancient staircase achieved so far is financially supported by large grant of the Ambassadors Fund for Cultural Preservation (AFCP), with the generous coordination of the U.S. Embassy in Phnom Penh. I wish to extend my gratitude to the government of the United State of America for such invaluable support to make this project happened at the Preah Vihear World Heritage Site. I am especially grateful to Patricia A. Carrada (Grants Officer, U.S. Department of State), and staff of the U.S. Embassy Phnom Penh, with particular thanks to Katherine M Diop, Amparo Garcia, Norn Soreimeas and Sy Sokuntheary invaluable support across the four phases. I also extend thanks to previous U.S. Embassy staff: Linnette Franco and Arend Zwartjes for their support at the beginning.

NAPV ad-hoc experts regularly visited the site to check the restoration methodology and performance, provide technical advice to solve technical issues, and provide recommendation to reinforce the restoration quality. These invaluable contributions are gratefully acknowledged, with particular thanks to Divay Gupta (Ad-hoc expert for Conservation and Restoration, Principle Director, Architectural Heritage Division, Indian National Trust for Art and Cultural Heritage) and his friend Dr. Sachchidanand Sahai (Researcher, India), Koenraad Van Balen (Ad-hoc expert for Conservation and Restoration, Director of R. Lemaire International Center for Conservation, Belgium), Hans Leisen (Ad-hoc expert for Conservation and Restoration, University of Cologne, Germany) and his wife, Dr. Esther von Plehwe-Leisen (Geologist, Cologne Institute of Conservation Sciences), and Maria Gravari-Barbas (Ad-hoc expert for Culture, Tourism and Development).

My sincerest thanks are extended to World Monument Fund (WMF), JASA, APSARA National Authority, Sophia University, Nara Institute and Institute of Technology of Cambodia (ITC) and individual advisors for sharing their knowledge, experiences and technical assistance on conservation and restoration of the ancient temples during the exchange visit. I also wish to express my sincere gratitude to the project staff, as well as the skilled and unskilled laborers, for their dedication and tireless efforts in the conservation and restoration of the northern ancient staircase.

Finally, gratitude is owed to Her Excellency Madam Minister of Culture and fine Arts, ICC-PV secretariat, and ICC-PV member states for their invaluable spiritual support to this project.

Summary of Project Accomplishment

The northern ancient staircase, built in 11th century on natural slope of mountain from south to north, is located at the northern section of Naga causeway measuring approximately 111 m long, 11 m wide, and 39 m high. It is divided into 26 sections with 165 steps. The conservation and restoration of this staircase began in 2018 and made a significant accomplishment from phase to phase since 2018 to 2024. As highlighted below, the project started with the comprehensive survey of existing condition of the entire staircase structure, made analysis of risk typology, development of holistic restoration plan, restoration of ancient drainage system which is part of the staircase, and staircase structure. The other associated activities and outputs of the project include exchange program of project staff, outreach program for local students, and internship training program for students from Royal University of Fine Arts (RUFA).

Phase I (US$200,000.00; 25 September 2018 to 25 August 2019)

A signing ceremony was organized on November 6, 2018 at the National Museum of Cambodia, Phnom Penh. The event was presided over by H.E. Mr. William A. Heidt, U.S. Ambassador to Kingdom of Cambodia; H.E. Dr. Phoeurng Sackona, Minister of the Ministry of Culture and Fine Arts; H.E. Dr. Kim Sedara, former president of NAPV, H.E. Mr. Kong Puthikar, Director General of NAPV, and staff from the U.S. Embassy, Ministry of Culture and Fine Arts, NAPV and the National Museum of Cambodia. This phase focused on survey of the existing staircase condition and development of holistic restoration plan which is the foundation step in the conservation and restoration process. Key activities and accomplishment of this phase included:

- Completed the photogrammetry of the whole staircase,
- Excavated 6 trenches and 2 test pits in the archaeological survey,
- Completed the architectural drawing of the staircase, encompassing design, elevation, and stone measurement of the entire staircase, risk analysis, risk intervention and design the restoration plans,
- Surveyed drainage system and made analysis of its impact on the staircase,
- Completed trial conservation and restoration of section 5,
- Organized exchange visit for the project staff to acquire experiences in method application for conservation and restoration of ancient temples at Angkor archaeological site, and
- Organized two times of outreach programs for a total of 70 local school students and community.

Phase II (US$120,000.00; September 2020 to August 2021)

The official signing ceremony was jointly organized with World Monument Fund (WMF) at Bakheng temple on January 16, 2021.The event was presided over by H.E. Dr. Phoeurng Sackona, Minister of Culture and Fine Arts and H. E. Mr. W. Patrick Murphy, U.S ambassador to Kingdom of Cambodia, and attended by staff from the U.S. Embassy to Phnom Penh, Ministry of Culture and Fine Arts, NAPV and WMF. Key activities and accomplishment of this phase included:

- Developed formular for lime mortar and tested seven sample of lime mortar for their durability,
- Conducted archaeological survey including surface investigation, excavation of 3 trenches and one test pit,
- Completed the conservation and restoration of sections 2 to 4,
- Completed the restoration of ancient drainage system along the staircase,

- Completed the restoration of a section of the western causeway of 9 m long connecting to section 2 of the northern ancient staircase, and
- Completed restoration of a lion sculpture and a Gaja Sinha sculpture.

Phase III (US$86,664; 2021 to 2022)

The official signing ceremony was organized at the Nagar courtyard of the Preah Vihear temple on December 08, 2021. The event was presided over by H.E. Dr. Phoeurng Sackona, Minister of Culture and Fine Arts and H.E. Mr. W. Patrick Murphy, U.S ambassador to Kingdom of Cambodia, and attended by staff from the U.S. Embassy to Phnom Penh, Ministry of Culture and Fine Arts, provincial governor, NAPV, local stakeholders and local authority. Key activities and accomplishment of this project included:

- Conducted archaeological excavation of four trenches – two at section 6 and two at section 7,
- Completed the conservation and restoration of one lion sculpture,
- Completed the conservation and restoration of sections 6-7,
- Maintained the ancient drainage system along the staircase and created new channel on surface of stair step at section 7 and section 9 to reduce run off pressure downwards, and
- Organized two times of outreach program for a total of 60 local students and 5 teachers.

Phase IV (US$360,804; 2022 to 2024)

Key activities and outputs being achieved in this phase included:

- Excavated four archaeological trenches – one at section 13, two at section 14, one at section 12,
- Completed reinforcement and restoration of two lion sculptures,
- Completed the maintenance of drainage system along the staircase,
- Completed conservation and restoration of sections 11-14,
- Organized four exchange programs for project staff to gain knowledge and experiences of stone cutting technique and restoration of ancient structure used of different materials
- Organized four awareness programs, engaging a total of 80 local students and 11 teachers, and
- Organized two internship programs for a total of 11 students from the Royal University of Fine Arts in conservation and restoration method of ancient temple.

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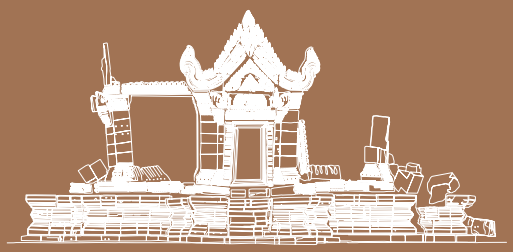
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Phase I : 2018-2019

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ANNEX – PHASE 1

Annex 1: Restoration plan

Activity	Phase I (1 year): September 2018 to August 2019	Phase II (2 years): September 2020 to August 2022	Phase III: September 2022 to August 2025	Phase IV: September 2025 to August 2027
	Documentation and trial restoration	**Restoration of drainage system along both sides of staircase, 6 lion sculptures, staircases from section 1 to section 9 (34.74 meters)**	**Restoration of staircase from section 10 to section 18, which is the most sever sections (42.32 meters)**	**Restoration of staircase from section 19 to section 26 (36.44 meters)**
1. Preparation stage				
Building teamwork and orientation				
Site preparation (installing project's information board, prohibition sign, working area, etc.)				
Set up warehouse, and conservation and exhibition building				
2. Survey of existing conditions				
Drainage system,				
Building structure, inventory and				
Lion sculptures				
3. Archeological survey focusing				
Archaeological research,				
Foundation, and				
Chronological construction.				
4. Extended activities of phase I project				
Pilot conservation and restoration of section 5				
Pilot restoration of one ornamental lion sculptures				
1. Project commencement				
Building project team				
Launching project				
2. Site Preparation				
Preparing stone storage ground				
Installing rail along the staircase to move stone from upper part to restoration site				

Constructing temporary bypass trail for visitors				
Safeguarding the restoration site				
3. Drainage system restoration and rehabilitation				
Diverting rainwater to the western causeway on the upper section (dig canal)				
Removing sediment along the ancient canals				
Conserving and restoring ancient canal to refunction and prevent foundation from water infiltration				
Constructing new hydraulic system to divert rainwater from staircase into ancient canals, alongside with staircase restoration				
Constructing new canal to bring water to the northwards				
Maintenance of drainage system				
Documenting after completed restoration work				
4. Archaeological work				
Excavating foundation where restoration is undertaken				
Documenting and providing recommendation for restoration				
5. Conservation and restoration				
Restoring 6 lion sculptures				
Dismantling stone slabs and moving to storage ground				
Repairing broken stones				
Repairing staircase foundation				
Assembling stone slabs to the original place				
Replacing broken stones with new ones, and filling missing stones with new stones				
Applying lime concrete mortar at gap area				
Documenting the restoration process (prior, during and posterior restoration activities)				
6. Outreach program				

Delivering awareness raising to local school students and community				
Providing internship program for university students in skill of restoration and conservation				
Organizing exchange program				

Annex 2: Budget requirement for completing conservation and restoration of the northern ancient staircase and associated ancient infrastructure for 8 years action plan

Description	Budget by project phase			
	2018-2019	2020-2022	2022-2025	2025-2027
Personnel	$69,200	$ 244,400.00	$366,600	$228,400
Fringe Benefits - insurance	$800	$ 6,000.00	$9,000	$6,000
Travel (including Per Diem)	$12,700	$ 9,000.00	$12,400	$9,000
Equipment and Service	$79,600	$ 82,597.00	$64,900	$38,900
Supplies	$25,300	$ 35,572.00	$27,296	$20,264
Other Direct Costs	$12,400	$ 9,280.00	$9,780	$9,280
Total	**$200,000**	**$ 386,849.00**	**$489,976**	**$311,844**

Annex 3: List of equipment and materials

No.	CODE	OBJECT/ DESCRIPTION	SERAIL NUMBER	OTHER
	E. ELECTRONICAL EQUIPMENT			
1	NAPV-AFCP 2018 E-001	COMPUTER (MONITER HP ZR2440W)	H1712-012-0249	
2	NAPV-AFCP 2018 E-002	COMPUTER (CASE HPZ820 WORKSTATION)	2UA5242X5B	
3	NAPV-AFCP 2018 E-003	COMPUTER (KEYBOARD)	BDBRN0CGA8L1LI	
4	NAPV-AFCP 2018 E-004	COMPUTER (UPS APC 1100)	BX1100LI-MS	
5	NAPV-AFCP 2018 E-005	EXTERNAL HARD DISK (TRANSCEND /TS4TSJ35T3)	D86727-0001	
6	NAPV-AFCP 2018 E-006	PRINTER (EPSON L1455)	X2SK013548	
7	NAPV-AFCP 2018 E-007	ICOM (PROFESSIONNAL FM TRANSCEIVER)	JT150059568	

8	NAPV-AFCP 2018 E-008	ICOM (PROFESSIONNAL FM TRANSCEIVER)	JT150059566	
9	NAPV-AFCP 2018 E-009	ICOM (PROFESSIONNAL FM TRANSCEIVER)	JT150056955	
10	NAPV-AFCP 2018 E-010	ELECTRONICAL DRILLING (MAKITA),1 set	HP330D	
11	NAPV-AFCP 2018 E-011	ELECTRONICAL SHARPING ø100MM (MAKITA), 1 set	171786P	
	C.CAMERA EQUIPMENT			
12	NAPV-AFCP 2018 C-001	CAMERA (CANON EOS 80D), 1 set		
13	NAPV-AFCP 2018 C-002	CAMERA (CANON EOS 80D), 1 set	1263C003(AA)	
14	NAPV-AFCP 2018 C-003	CAMERA VIDEO (SONY PXW-X70)	S01-1628826-J	
15	NAPV-AFCP 2018 C-004	TRIPOD OF CAMERA (JINFOTO VT-2000)		
16	NAPV-AFCP 2018 C-005	TRIPOD OF CAMERA (JINFOTO VT-2000)		
17	NAPV-AFCP 2018 C-006	TRIPOD OF CAMERA (JINFOTO VT-2000)		
18	NAPV-AFCP 2018 C-007	PRO LED VIDEO LIGHT (YN300 III)	82912587	
	SM.SURVEY AND MEASURE EQUIPMENT			
19	NAPV-AFCP 2018 SM-001	AUTO LEVEL (SOKKIA B40A), 1 set	WS081589	
20	NAPV-AFCP 2018 SM-002	STAFF (5M)		
21	NAPV-AFCP 2018 SM-003	STAFF (5M)		
22	NAPV-AFCP 2018 SM-004	TRIPOD OF AUTO LEVEL (MY ZOX)		
23	NAPV-AFCP 2018 SM-005	TOTAL STATION (SOKKIA FX 101), 1 set	CE 1 7 8 9	
24	NAPV-AFCP 2018 SM-006	BIG PRISM FOR BACKSIGHT (SOKKIA OFFSET-30MM), 1 set		
25	NAPV-AFCP 2018 SM-007	MEDIUM PRISM, 1set		

26	NAPV-AFCP 2018 SM-008	MINI PRISM, 1set		
27	NAPV-AFCP 2018 SM-009	TRIPOD FOR PRISM		
28	NAPV-AFCP 2018 SM-010	PRISM HANDLE (2m)		
29	NAPV-AFCP 2018 SM-011	PRISM HANDLE (2m)		
30	NAPV-AFCP 2018 SM-012 to SM-013	Water Level Measure (0.5M)		
31	NAPV-AFCP 2018 SM-014 to SM-015	Water Level Measure (0.8M)		
32	NAPV-AFCP 2018 SM-016 to SM-019	Tape Measure (5m)		
33	NAPV-AFCP 2018 SM-020 to SM-021	Tape Measure (7.5m)		
34	NAPV-AFCP 2018 SM-022 to SM-023	Measure (100m)		
35	NAPV-AFCP 2018 SM-024 to SM-027	Steel Ruler (1m)		
36	NAPV-AFCP 2018 SM-028 to SM-029	Angle Measure		
37	NAPV-AFCP 2018 SM-030 to SM-035	Drawing Board A3		
38	NAPV-AFCP 2018 SM-036 to SM-038	Drawing Board A4		
	S.SITE EQUIPMENT			
39	NAPV-AFCP 2018 S-001	First Aid Box, 1set		
40	NAPV-AFCP 2018 S-002	Equipment Case (Small size), 1 set		
41	NAPV-AFCP 2018 S-003	Equipment Case (Small size), 1 set		
42	NAPV-AFCP 2018 S-004	Iron Equipment Case (Large Size)		
43	NAPV-AFCP 2018 S-005	Iron Equipment Case (Large Size)		
44	NAPV-AFCP 2018 S-006 to S-007	Pliers		

45	NAPV-AFCP 2018 S-008 to S-009	Hoc		
46	NAPV-AFCP 2018 S-010 to S-011	Hammer		
47	NAPV-AFCP 2018 S-012 to S-013	Axe		
48	NAPV-AFCP 2018 S-014 to S-015	Big Umbrella		
49	NAPV-AFCP 2018 S-016 to S-020	Dust Tool		
50	NAPV-AFCP 2018 S-021 to S-030	Plastic Canteen		
51	NAPV-AFCP 2018 S-031 to S-040	Ciment Spoon		
52	NAPV-AFCP 2018 S-041 to S-050	Dust Basket		
53	NAPV-AFCP 2018 S-051	Water Tank 3000L		
54	NAPV-AFCP 2018 S-052	Construction Helmet		
55	NAPV-AFCP 2018 S-053	Construction Helmet		
56	NAPV-AFCP 2018 S-054	Construction Helmet		
57	NAPV-AFCP 2018 S-055	Construction Helmet		
58	NAPV-AFCP 2018 S-056	Construction Helmet		
59	NAPV-AFCP 2018 S-057	Construction Helmet		
60	NAPV-AFCP 2018 S-058	Construction Helmet		
61	NAPV-AFCP 2018 S-059	Construction Helmet		
62	NAPV-AFCP 2018 S-060	Construction Helmet		
63	NAPV-AFCP 2018 S-061	Construction Helmet		
64	NAPV-AFCP 2018 S-062	Construction Helmet		

65	NAPV-AFCP 2018 S-063	Construction Helmet		
66	NAPV-AFCP 2018 S-064	Construction Helmet		
67	NAPV-AFCP 2018 S-065	Construction Helmet		
68	NAPV-AFCP 2018 S-066	Construction Helmet		
69	NAPV-AFCP 2018 S-067	Construction Helmet		
70	NAPV-AFCP 2018 S-068	Construction Helmet		
71	NAPV-AFCP 2018 S-069	Construction Helmet		
72	NAPV-AFCP 2018 S-070	Construction Helmet		
73	NAPV-AFCP 2018 S-071	Construction Helmet		
	A. ARCHAEOLOGICAL EQUIPMENT			
74	NAPV-AFCP 2018 A-072	Manual chain hoist		
75	NAPV-AFCP 2018 A-073 to A-077	Shovel		
76	NAPV-AFCP 2018 A-078 to A-082	Spade		
77	NAPV-AFCP 2018 A-083	Pruning shears (Large scissors)		
78	NAPV-AFCP 2018 A-084 to A-086	Pruner (Small scissors)		
79	NAPV-AFCP 2018 A-087 to A-090	Pickaxe		
80	NAPV-AFCP 2018 A-091to A-095	Trowel		
81	NAPV-AFCP 2018 A-096 to A-097	Basket for store artifect		
	R- RESTORATION EQUIPMENT			
82	NAPV-AFCP 2018 R-001	Engine Generator - AIRMAN-SDG 25 (No. 3)	C1900993	

83	NAPV-AFCP 2018 R-002	Electrical Driller (Moil & Point) (1Set)	HR2631FX1	
84	NAPV-AFCP 2018 R-003	Impact Drill Set (Ø13MM/600W) (1Set=101Pcs)	P800209-BMC	
85	NAPV-AFCP 2018 R-004	200MM-Bench Grinder (350W) (1Set)	P805435	
86	NAPV-AFCP 2018 R-005	235MM-Circular Saw (2300W) (1Set)	P800601	
87	NAPV-AFCP 2018 R-006	Electronic Compact Scale (7000g X1g) (1Set)	2 0 0 6 (Barcode)	
88	NAPV-AFCP 2018 R-007	Cable Reel (L=30M, Size=3x2.5mm2) (1Set)	6150B-1	
89	NAPV-AFCP 2018 R-008	Cable Reel (L=30M, Size=3x2.5mm2) (1Set)		
90	NAPV-AFCP 2018 R-009	230MM-Angle Grinder (2400W) (1Set)	P800412	
91	NAPV-AFCP 2018 R-010	Wet & Dry Vacuum Cleaner (40L,1200W) (1Set)	P805540	
92	NAPV-AFCP 2018 R-011	Claw Hummer with forge head (BYT-U.S.A.PAT-2000g)	DIN 6475 2000	
93	NAPV-AFCP 2018 R-012	Claw Hummer with forge head (BYT-U.S.A.PAT-1500g)	DIN 6475 1500	
94	NAPV-AFCP 2018 R-013	Claw Hummer with forge head (BYT-U.S.A.PAT-1500g)	DIN 6475 1500	
95	NAPV-AFCP 2018 R-014 to R-018	Safety Goggle (Type 1)	435104	
96	NAPV-AFCP 2018 R-019 to R-028	Safety Goggle (Type 2)	435101	
97	NAPV-AFCP 2018 R-029 to R-040	Flat Brush (Width=75MM)		
98	NAPV-AFCP 2018 R-041 to R-046	Scrubbing Brush		
99	NAPV-AFCP 2018 R-047 to R-050	Air Craft Cable tie		
100	NAPV-AFCP 2018 R-051 to R-052	Nylon Lifting Sling certificate (3T, 2M, L2)		
101	NAPV-AFCP 2018 R-053 to R-056	Nylon Lifting Sling certificate (2T, 3M, L2)		
102	NAPV-AFCP 2018 R-057	Nylon Lifting Sling certificate (3T, 3M, L2)		

103	NAPV-AFCP 2018 R-058	Nylon Lifting Sling certificate (5T, 3M, 2L2)		
104	NAPV-AFCP 2018 R-059 to R-062	Plastic tent (6 x 8m)		
105	NAPV-AFCP 2018 R-063	Chain Block -VITAL-(Model No.:VL5) (5T)	T-10 180514	
106	NAPV-AFCP 2018 R-064	Chain Block -TOEO-(Model No.:HSZ-V) (Lift=3m, 3T)	19020352	
107	NAPV-AFCP 2018 R-065	Iron Equipment Case (0.9 x 0.6 x 0.5m)		
108	NAPV-AFCP 2018 R-066	Iron Equipment Case (0.9 x 0.6 x 0.5m)		
109	NAPV-AFCP 2018 R-067	Air Compressor Machine (HIKARI MASTER, Model: 020-50)	20-32-12-18	
110	NAPV-AFCP 2018 R-068 to R-077	Metal ladder		
111	NAPV-AFCP 2018 R-078 to R-087	Steel pipe (2x0.3x600)		
112	NAPV-AFCP 2018 R-088 to R-117	Scaffolding Board		
113	NAPV-AFCP 2018 R-118 to R-517	Scaffolding (L=6M, Ø49 x 0.3)		
114	NAPV-AFCP 2018 R-518 to R-617	Scaffold (L=6M, Ø49 x 0.1)		
115	NAPV-AFCP 2018 R-618 to R-717	Support Scaffold		
116	NAPV-AFCP 2018 R-718 to R-3717	Clump		
117	NAPV-AFCP 2018 R-3718to R-3719	Plain Trolley (VSS_2Ton_Beam range 100 - 150mm)		
118	NAPV-AFCP 2018 R-3720 to R-3721	I-Steel Beam support plain trolley		
119	NAPV-AFCP 2018 R-3722	Welding machine (MillTec, TIG-200, AC 220V)	H020190411127	

Annex 4: Events and activities at the start of project



Signing ceremony at the National Museum between the Ministry of culture and fine arts and the U.S. embassy in Phnom Penh on November 6, 2018, for a $200,000 grant under Ambassadors Fund for Cultural Preservation (AFCP) to the National Authority for Preah Vihear (NAPV) for restoration of the Northern ancient staircase of Preah Vihear temple.



Ceremony to start the project



Cleaning the staircase surface



Demining activities at the vicinity of the northern staircase

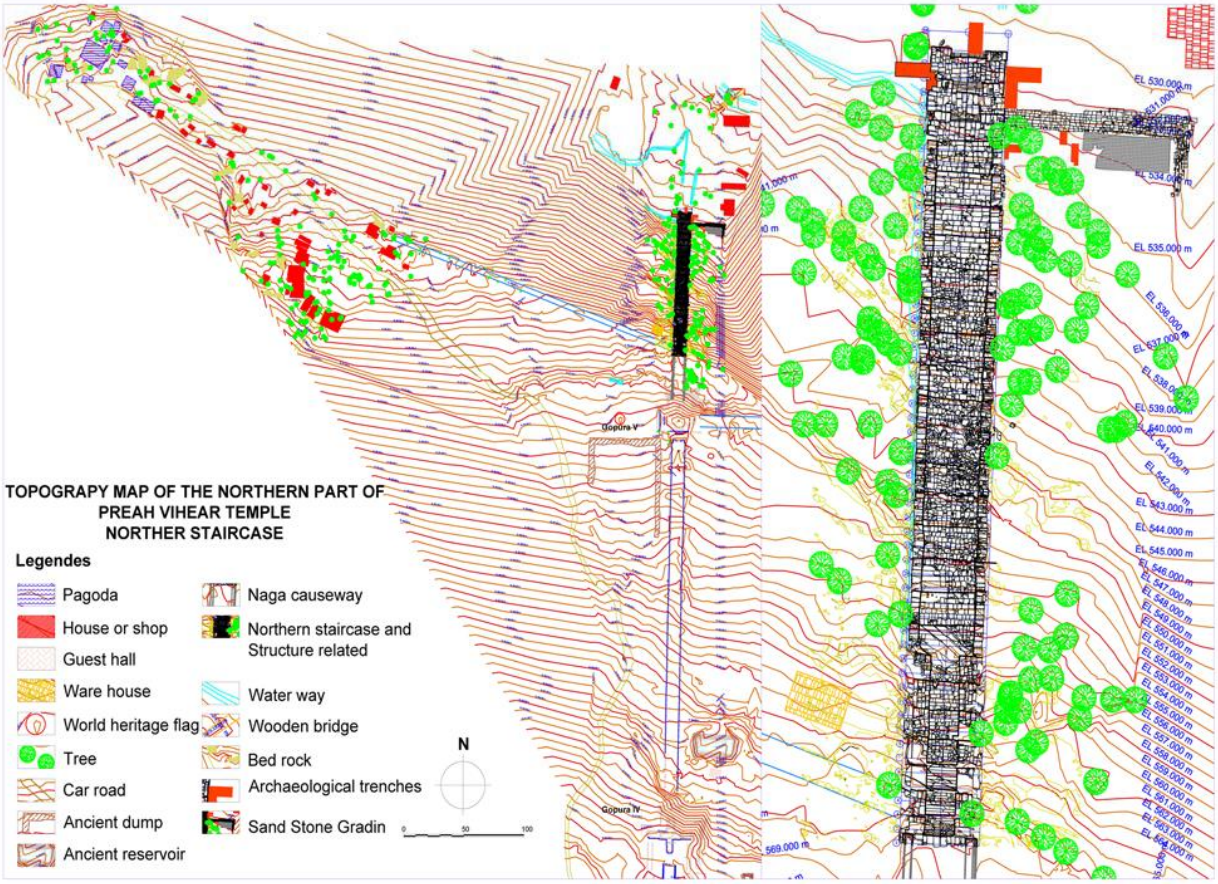


Installing project information board

Annex 5: Topographical survey



The activities of topographical survey at the northern staircase



Topography Map (Contour Map) with import drawing of Northern Ancient Staircase

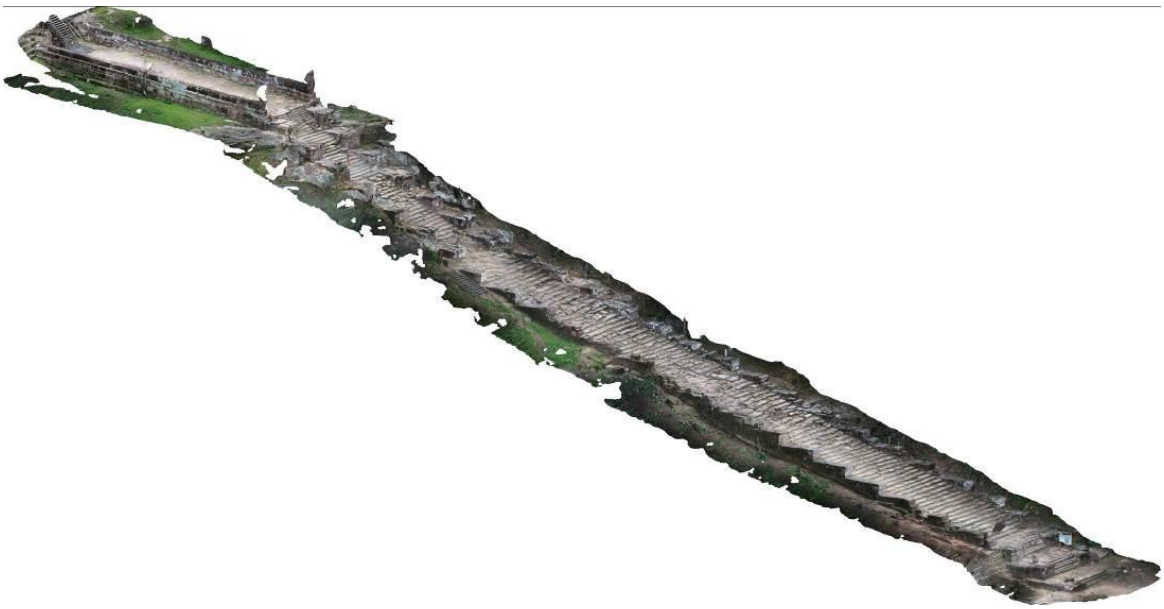
Annex 6: Photogrammetry



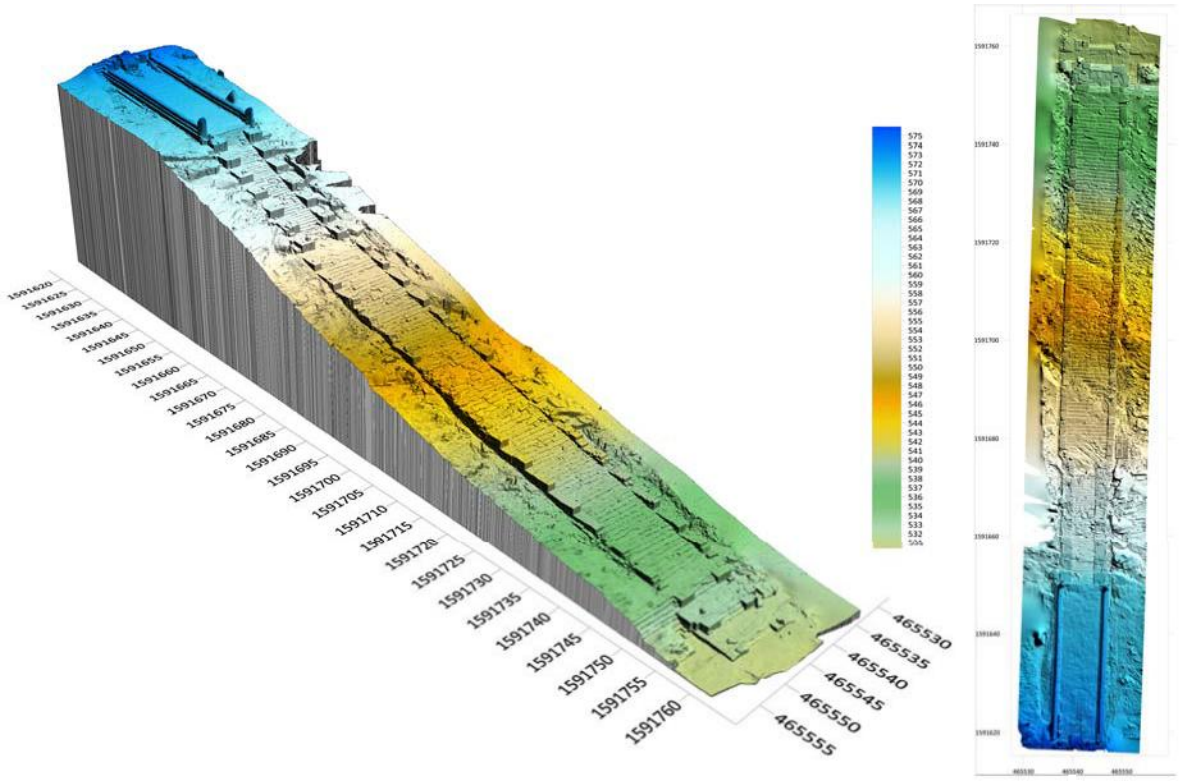
Drone flight for Photogrammetry work on the Northern Staircase



Aerial Photo of the Northern Staircase Model by Agisoft Metashape Professional



Perspective View of the Northern Staircase Model by Agisoft Metashape Professional

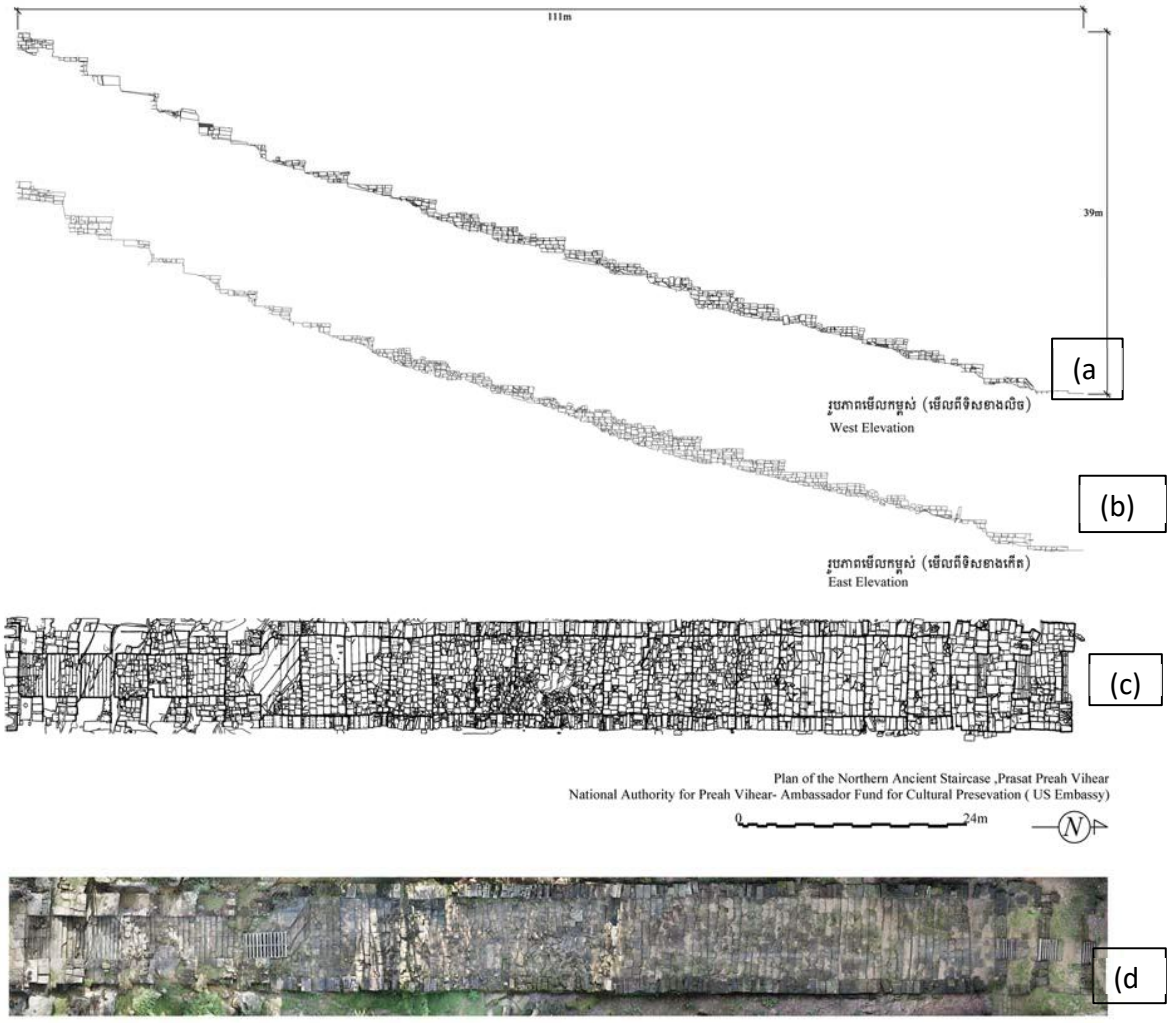


Digital Elevation Model (DEM), Model by Agisoft Metashape Professional

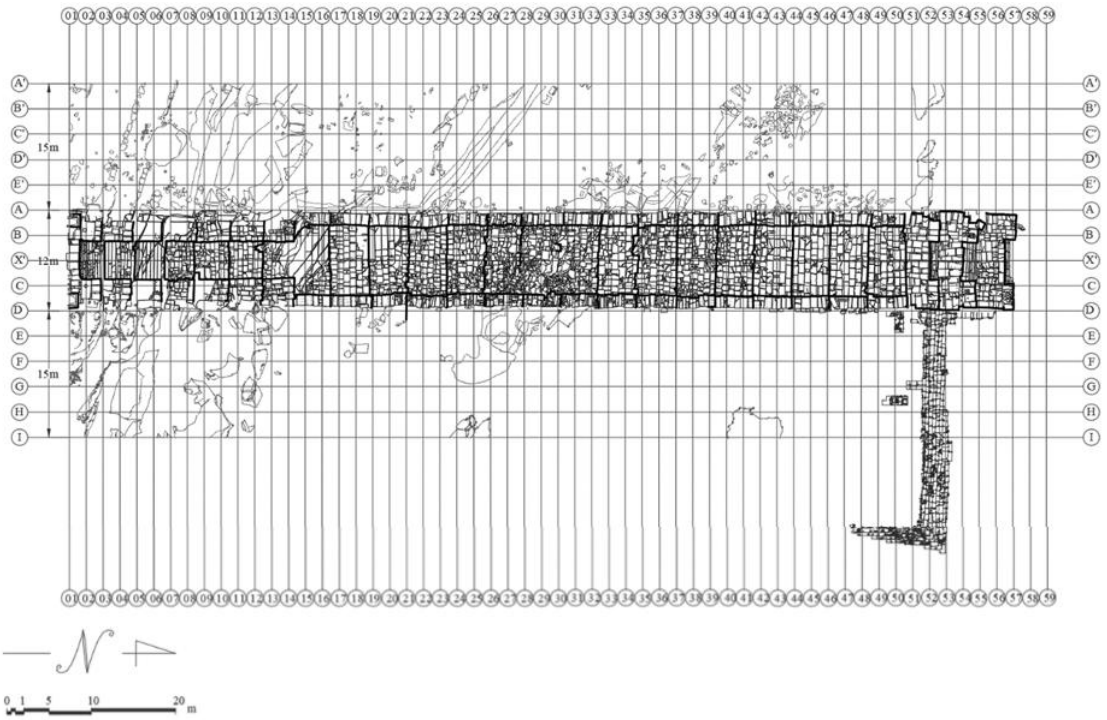
Annex 7-1: Architectural survey of the northern staircase



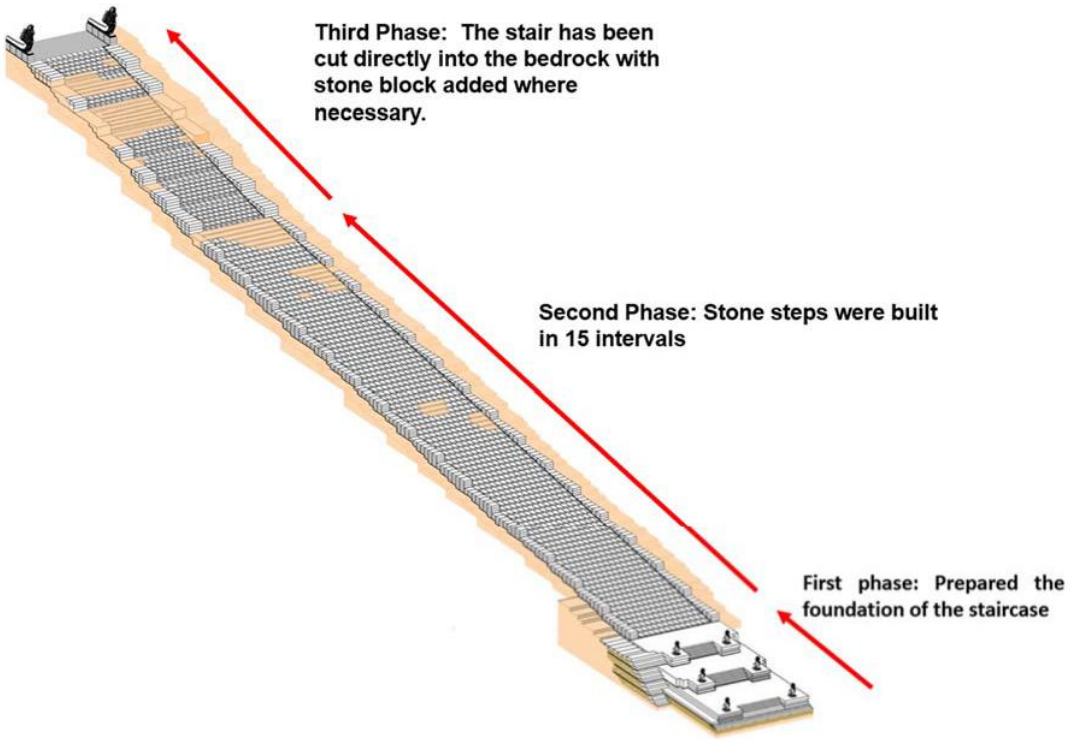
3D Modelling of the Northern staircase of Preah Vihear temple



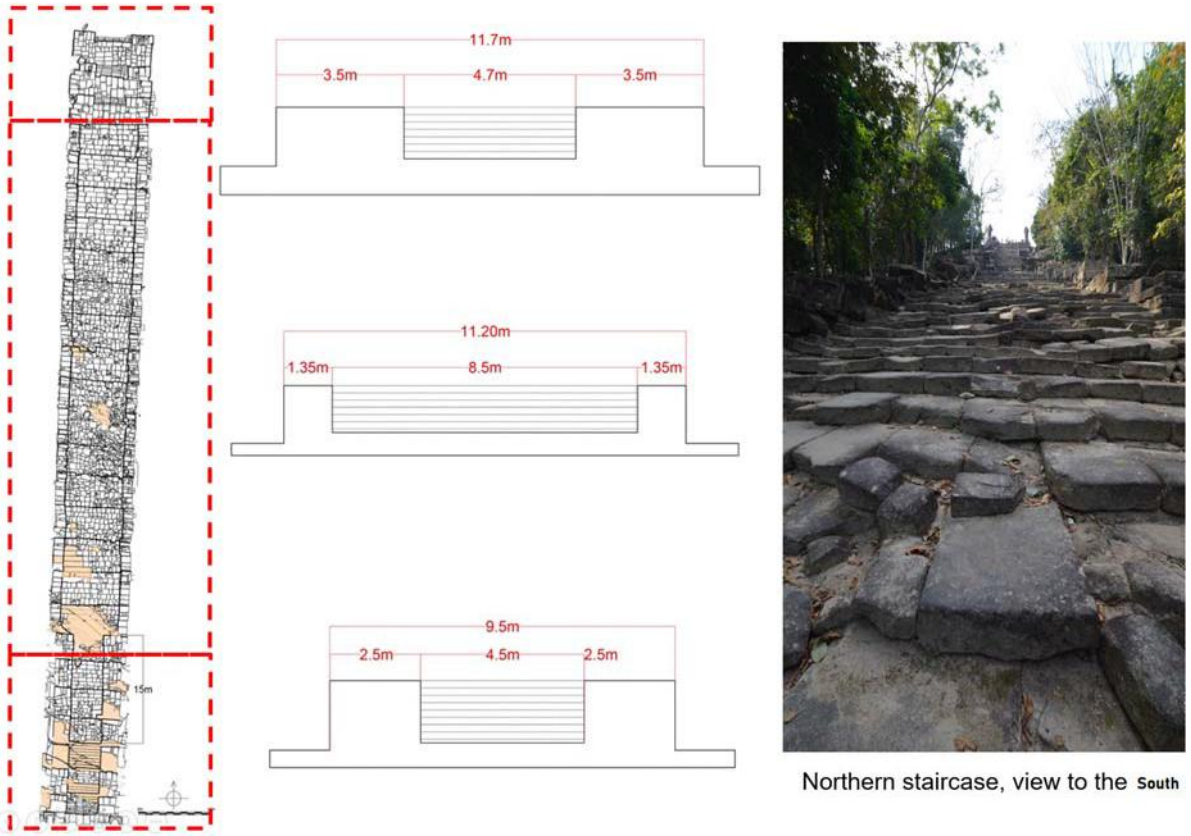
(a) West elevation, (b)East elevation, (c) Aerial plan and (d) Aerial photo of the Northern Staircase



Map showing holistic view of the northern staircase structure



Phase of construction of the Northern Staircase

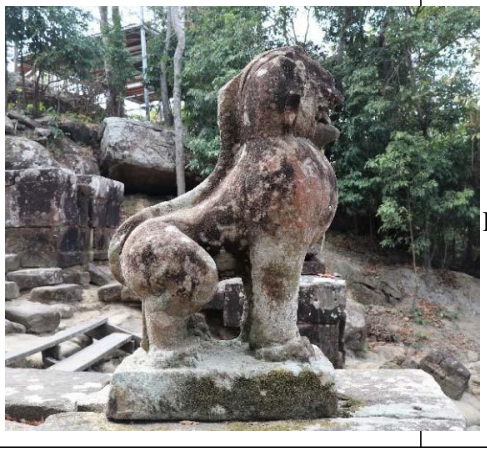


Cross section of Northern staircase variable in sizes from the lower part to upper part

Annex 7-1: Architectural survey of lion sculpture

1. Damage status of lion

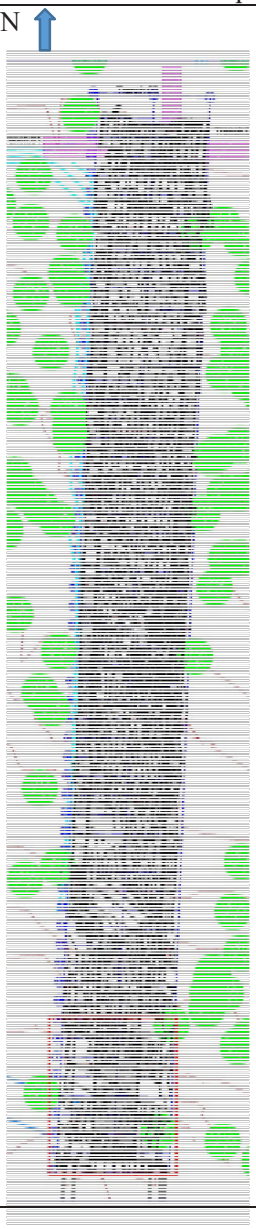
No.	Photos	Code	Name	Description
1		H2016-067	Singha	• Lost legs and pedestal • Intervention: Make new legs and pedestal
2		H2016-066	Singha	• Broken into 5 pieces, Lost front piece of head at upper molar • Intervention: Reassemble all broken pieces
3		H2016-065	Lion	• Broken into two pieces at ankle and lost front piece in the left side • Intervention: Restore and replace new ones at the loss parts

4		H2016-064	Lion	• Broken into two pieces - lost two front legs at below half and lost a rear leg in the right • Intervention: Restore with new stone replacement
5		H2016-063	Lion	• Broken into 5 pieces, broken front foot in the left • Intervention: Restore by reassembling and replacement of foot
6		H2016-062	Lion	• Broken into 8 pieces and partial degradation on the sculpture • Intervention: Strengthen stone, reassemble all broken pieces and add new stone at the loss parts
7		H2016-061	Lion	• In good condition, somewhat broken at mouth, and loss of the above molar • Intervention: Strengthen stone

8		Pedestal of lion	• Remain only piece of foots, broken foot, loss the body • Intervention: Searching the body and keep at the safe place
9		Lion	• Remain only pedestal with foots, lost body • Intervention: Searching the body and keep at safe place
10		Unknown	• Pieces of lion legs, cannot be identified and reassemble • Searching pieces of body and keep at safe place

2. Conservation and restoration methodology

2.1 Photos prior restoration taken place: The current status of a lion sculpture from four angle view

Northern staircase plan	lion code: PVH 2016-065
N 	 Back view  Front view  Left side view  Right side view

2.2 Reassembling pieces of lion: Reassemble pieces of lion sculpture at the found place, find pieces of the loss part and identify area to be reassemble



Condition of lion sculpture prior trial reassembling



The activities of trial reassembling of lion sculpture



The activities of trial reassembling of lion sculpture

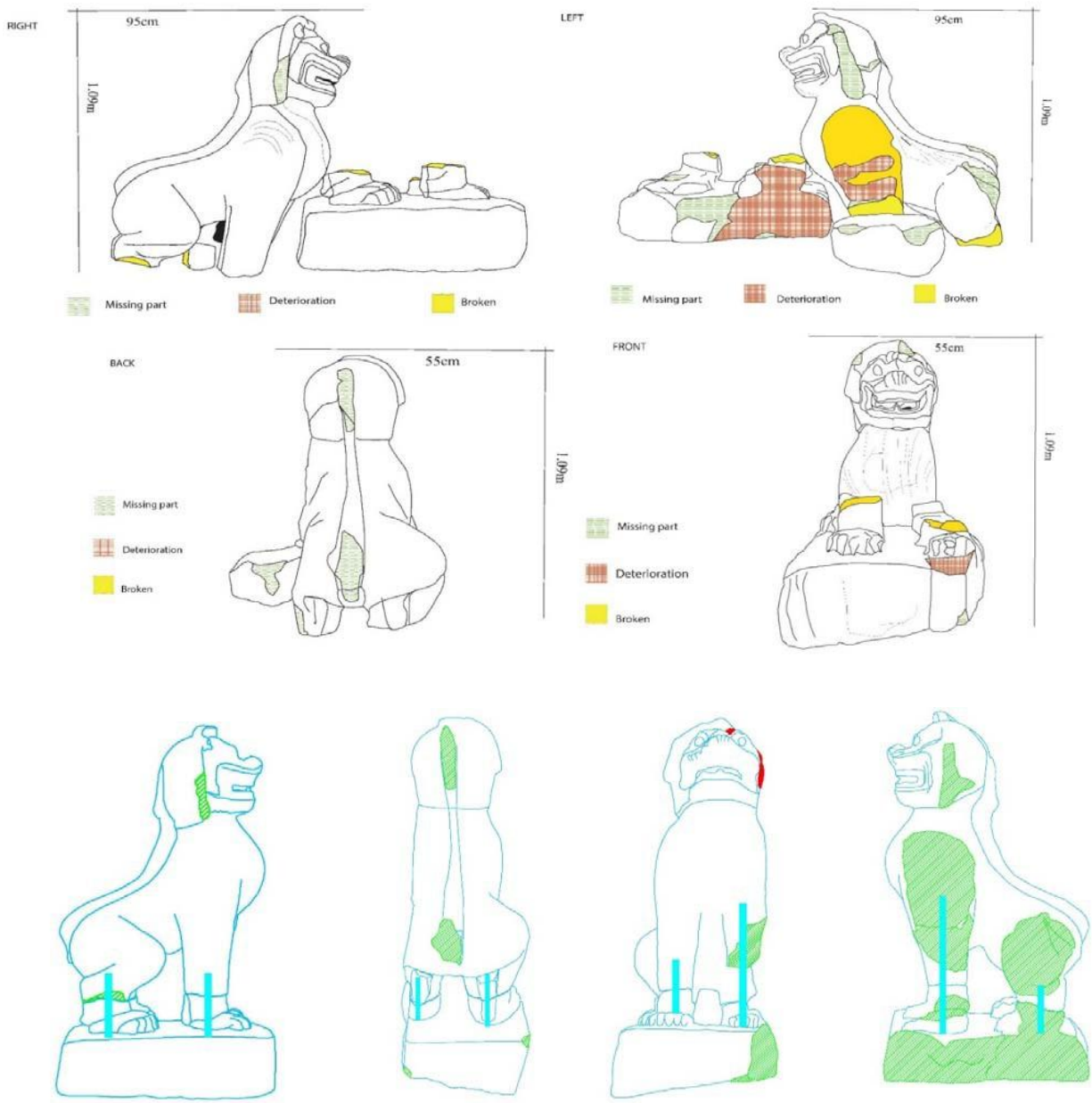


Condition of lion sculpture after reassembling

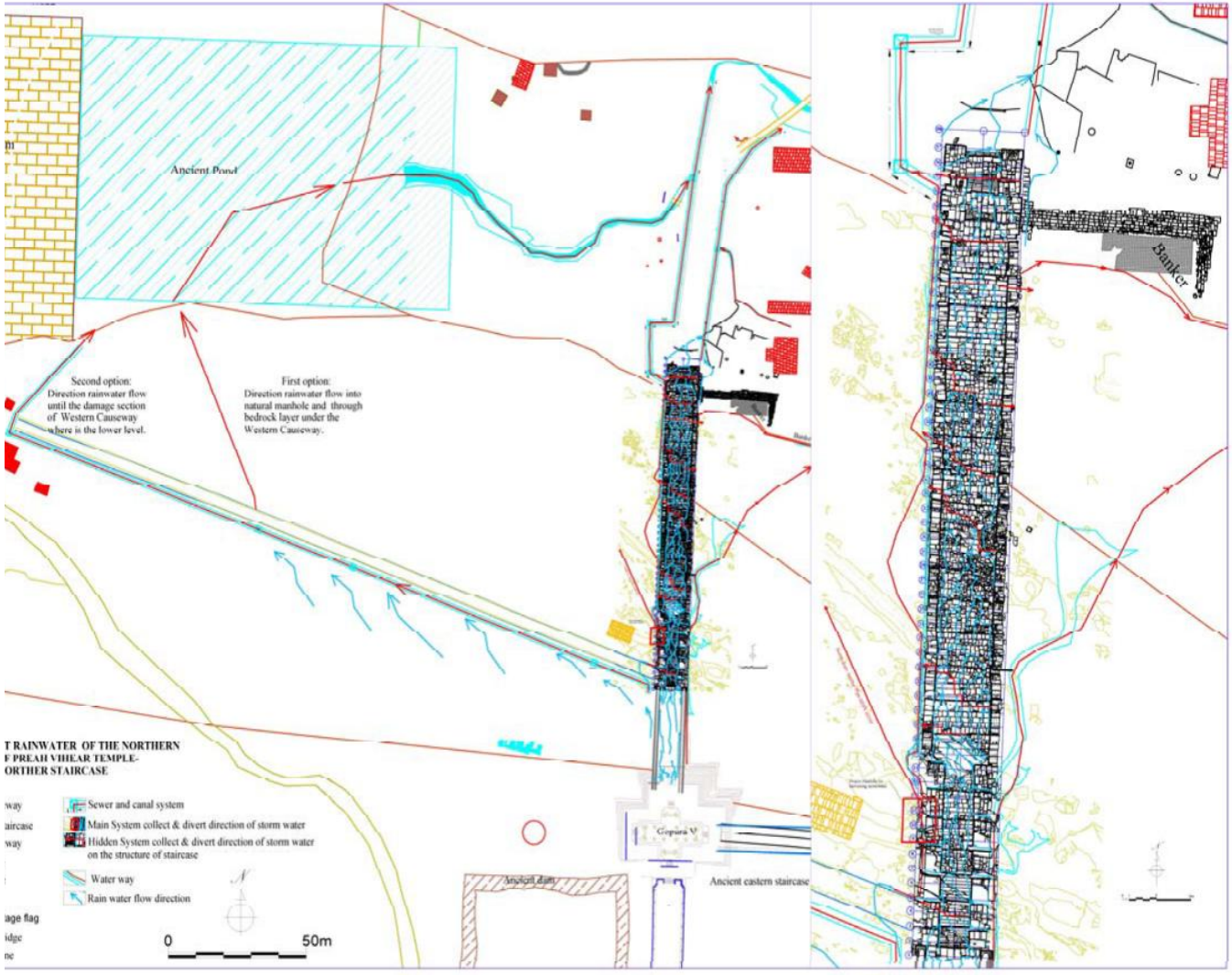
2.3 Map of damage area

Technical drawing illustrates the scope of damage, restoration part, general body, show product applied for lion sculpture. Moreover, technical drawing provides general information of the changing condition at any portion of the sculpture after restoration was done, which is useful data for restoration work in future.

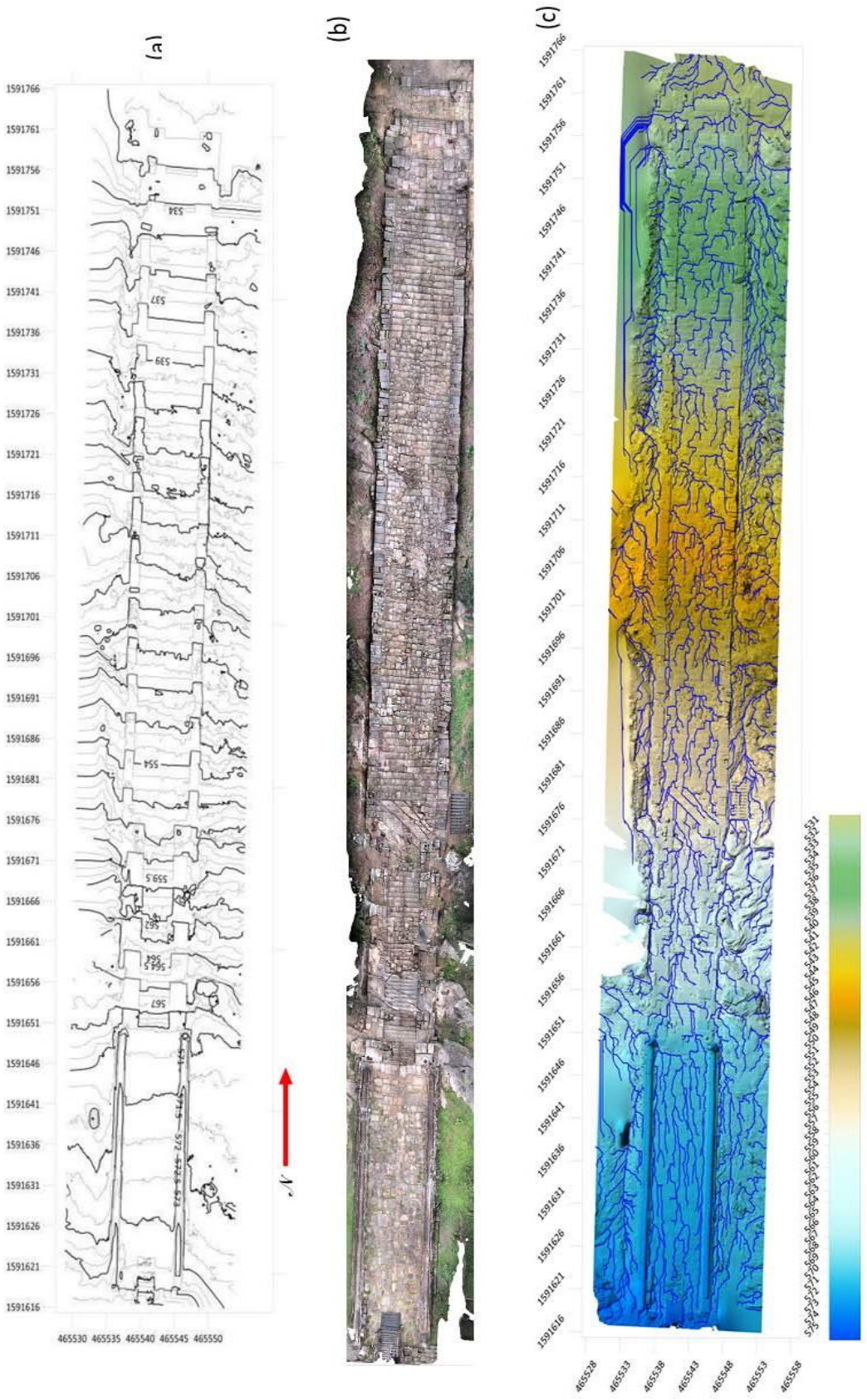
Drawing demonstrating the reassembling technique of lion sculpture



age system survey



Plan of rainwater diversion to avoid the effect on the Northern Staircase



The Northern staircase showing (a) Contour map, (b)Aerial Photo and (c) Digital Elevation Model (DEM) and flow direction of rainwater

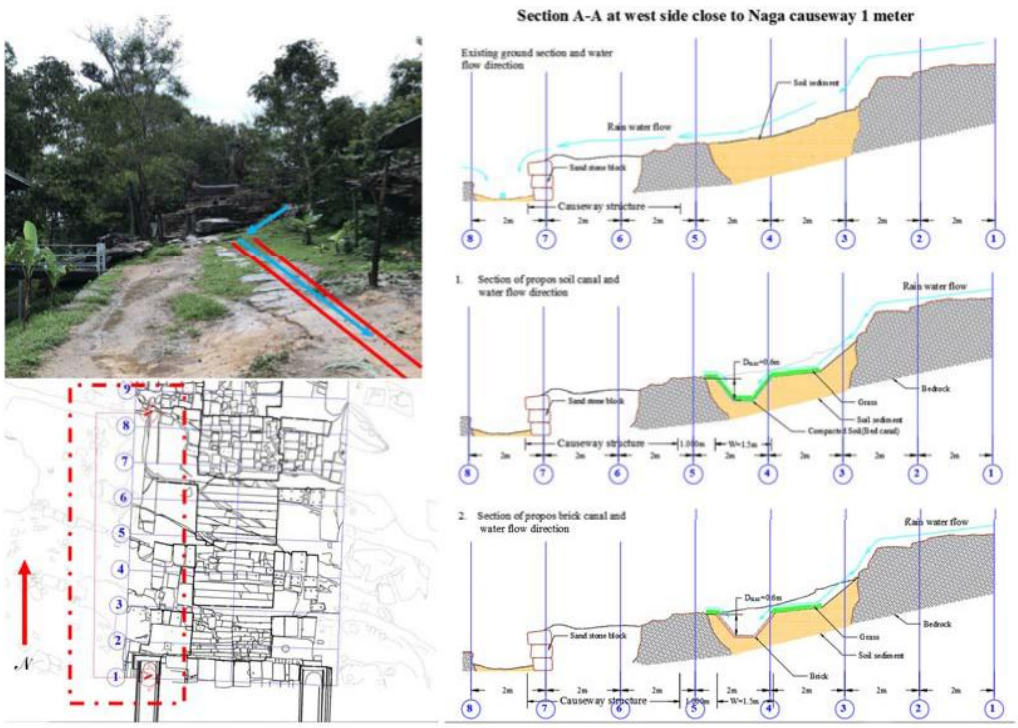
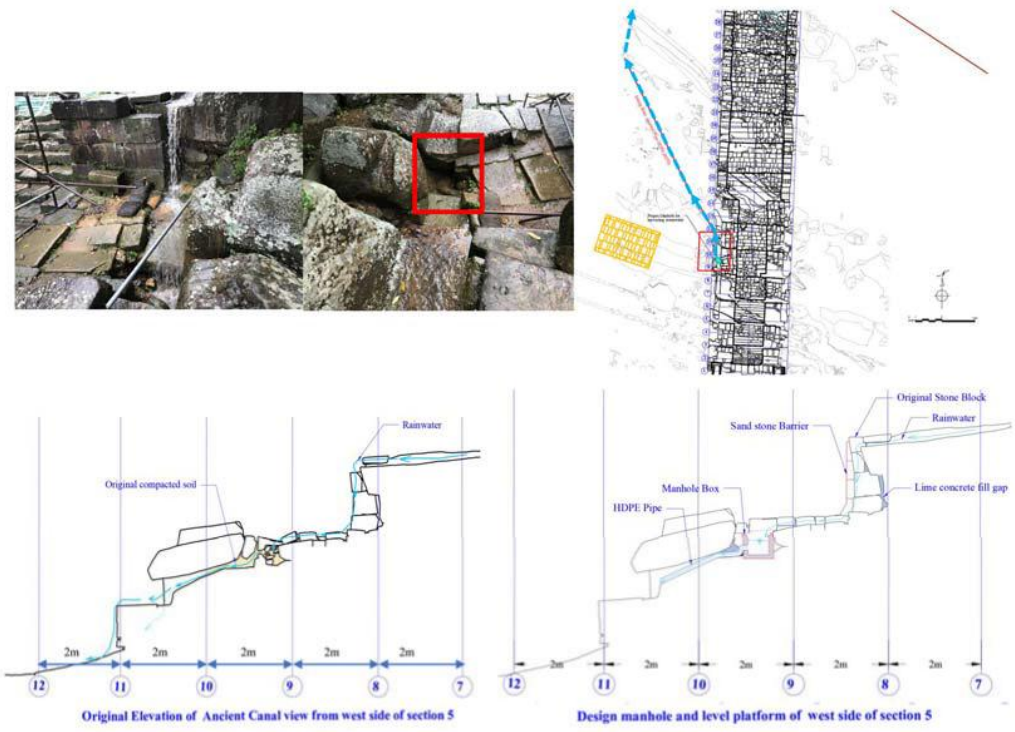
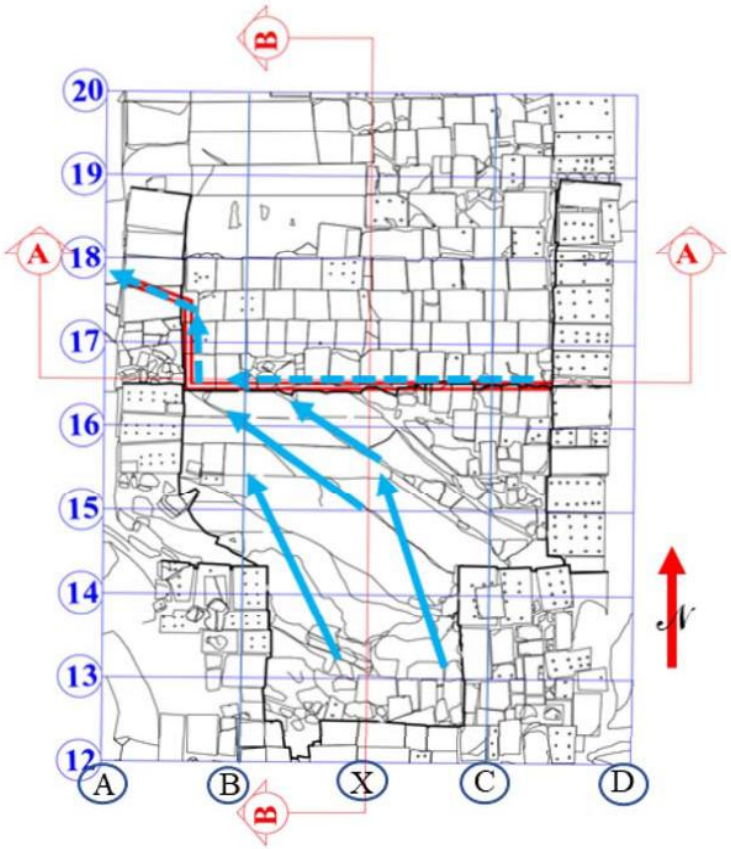


Figure : Proposed rainwater diversion plan along the Western Causeway

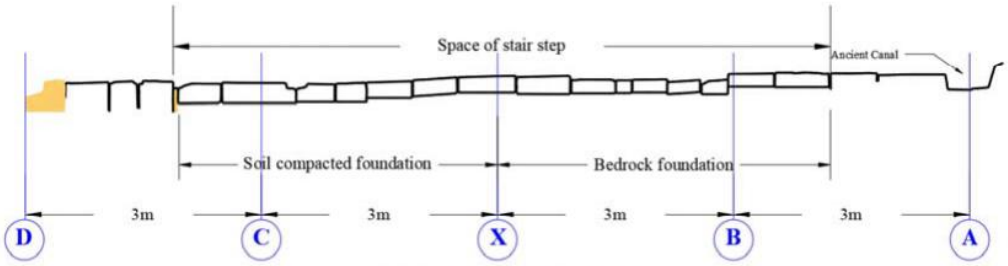


Preliminary manhole design in the west of section 5 to collect rainwater

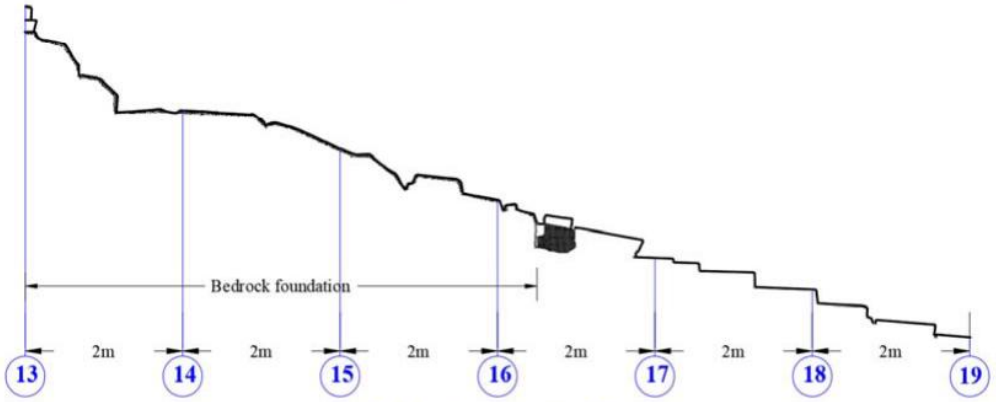




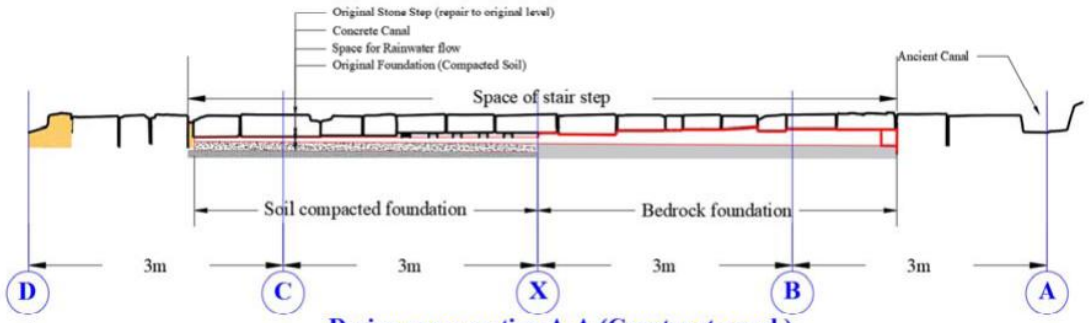
Flow diversion plan of rainwater at the end of section 8



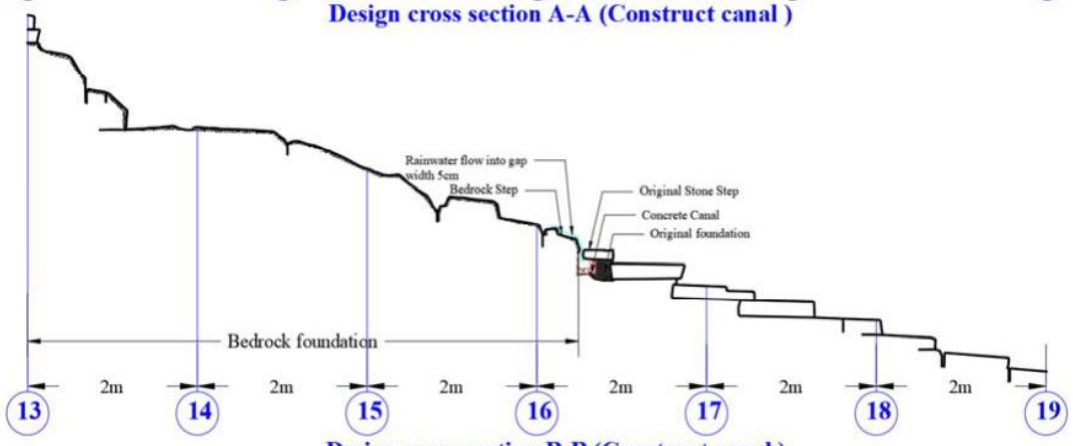
Original cross section A-A



Original cross section B-B



Design cross section A-A (Construct canal)



Design cross section B-B (Construct canal)

Original cross section and preliminary designed embedded canal at section 8-9

Annex 9: Archaeological survey

- Trench 01 and 03

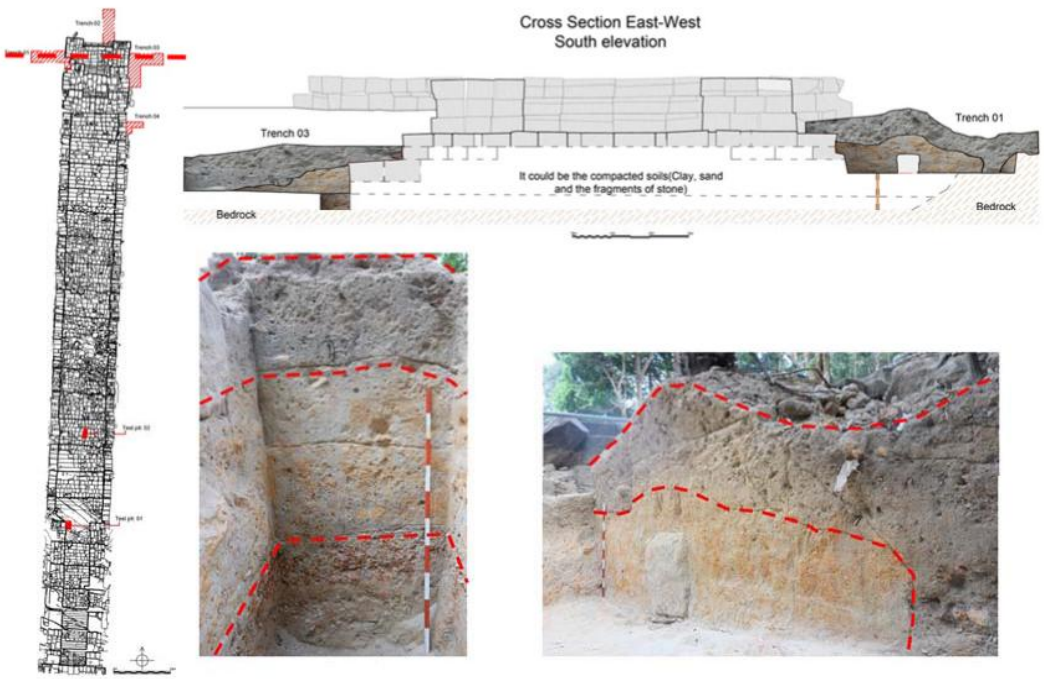
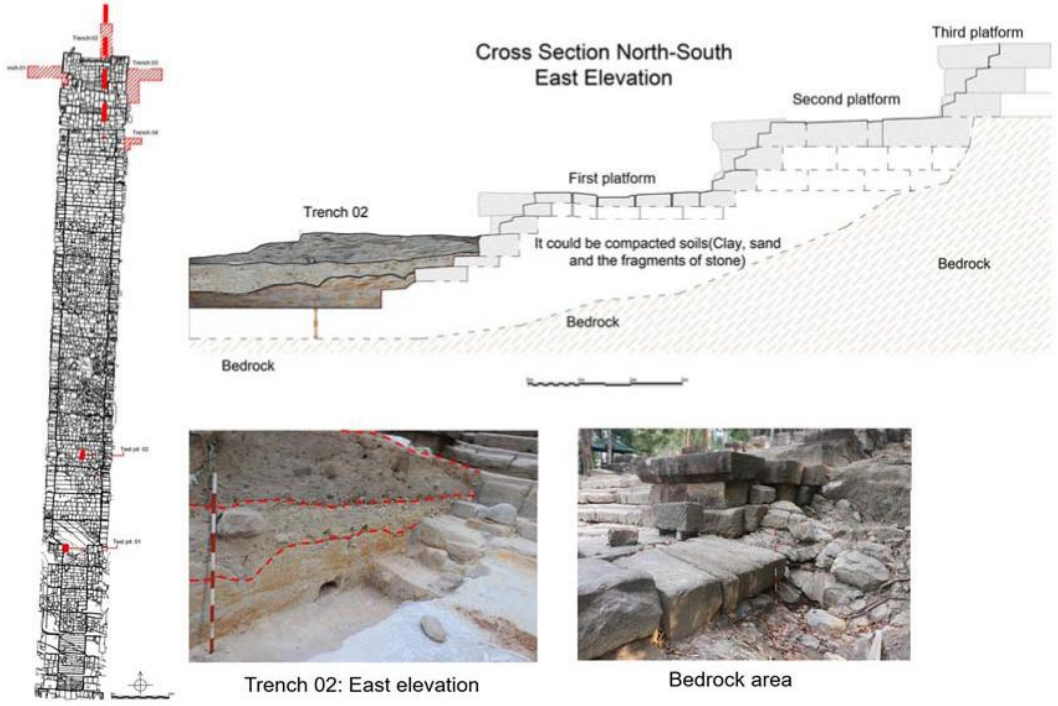
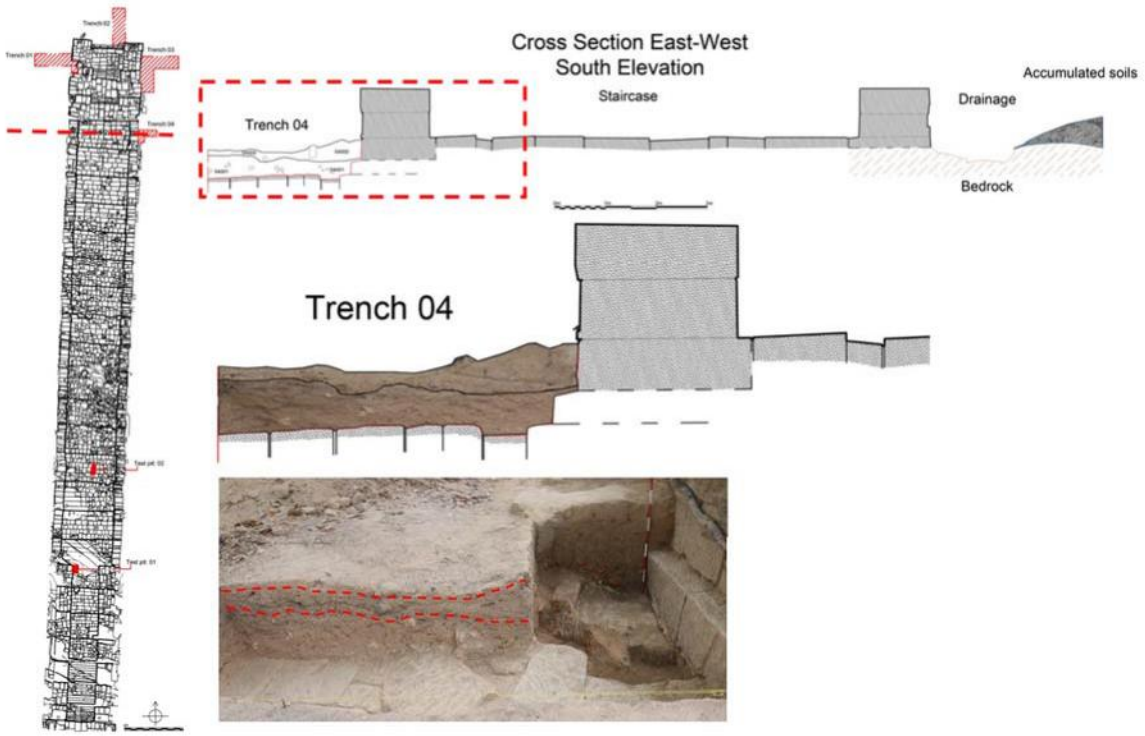


Figure 11: Soil profile at trenches 01 and 03

Trench 02



Soil profile at Trench 02



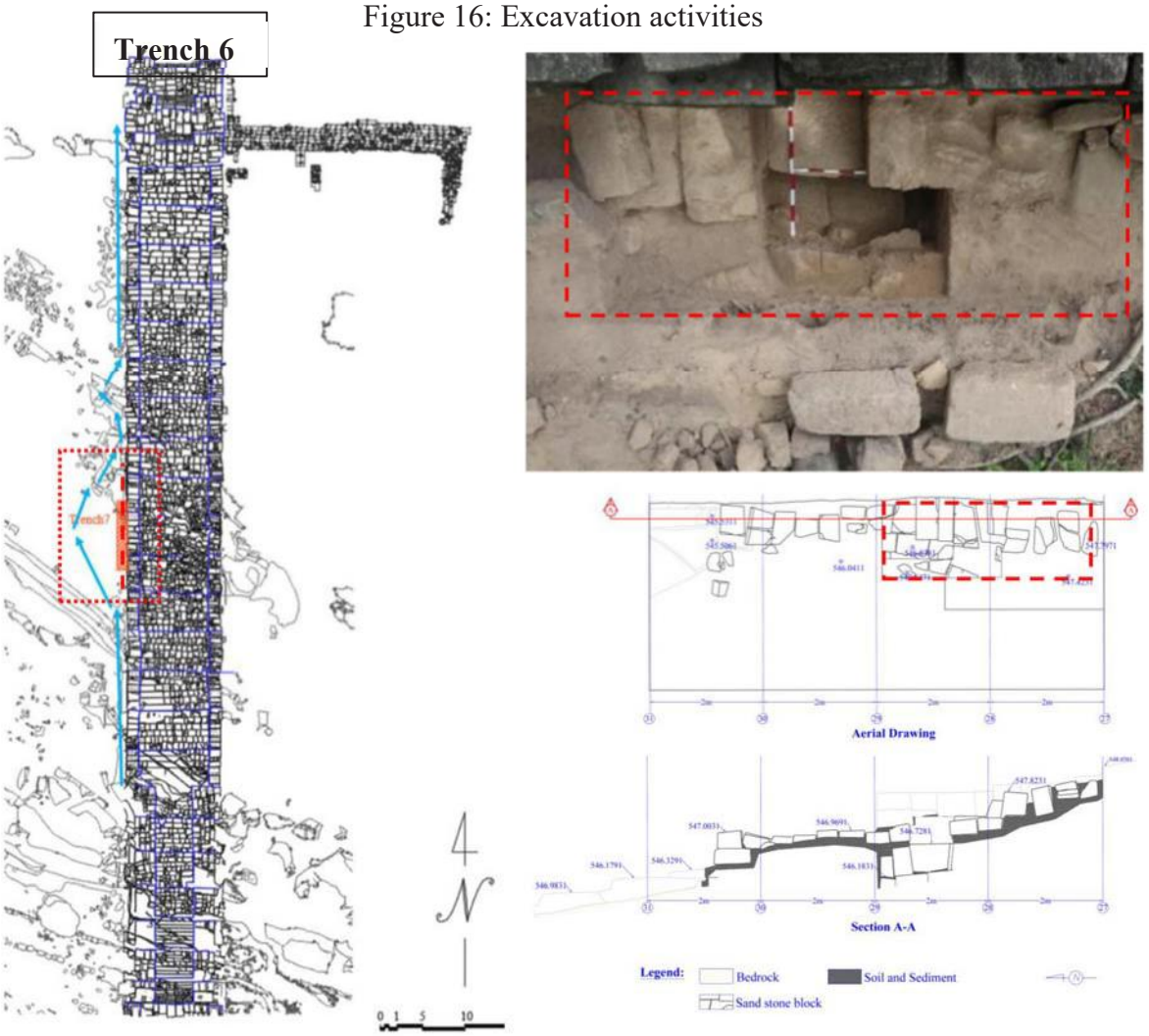
Soil profile at Trench 04



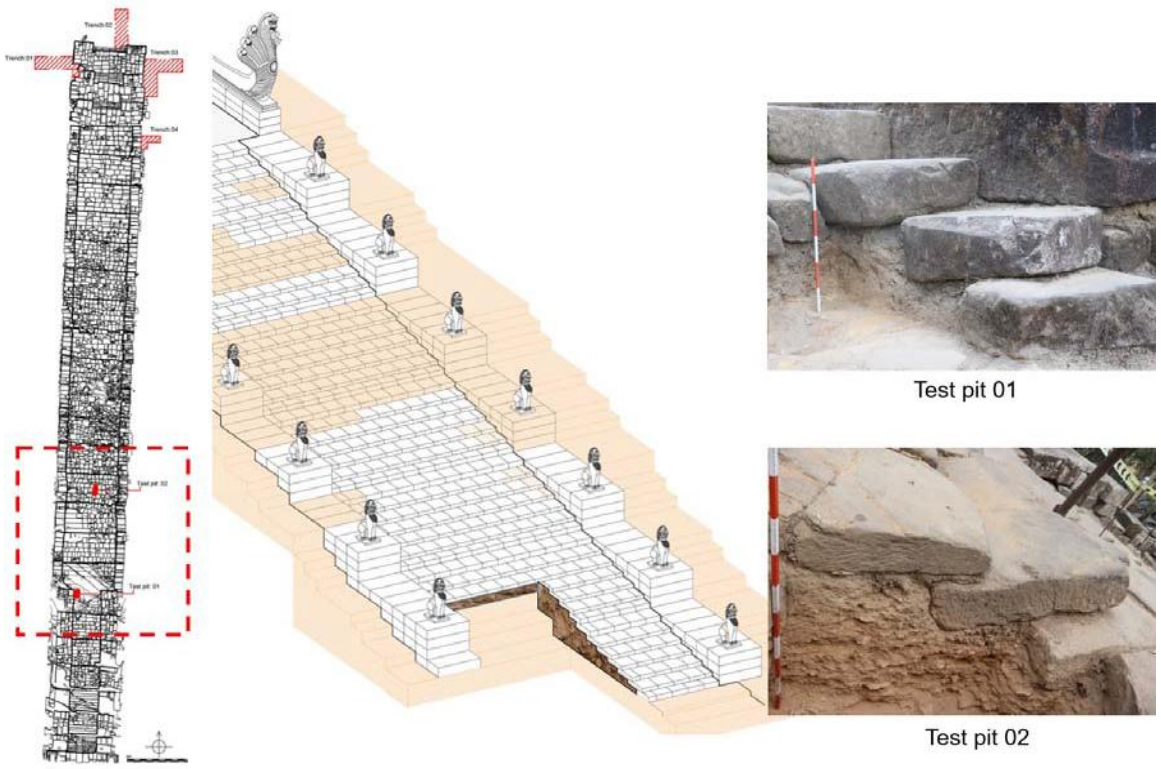
Excavated on the embankment to understand the extension of platform



Figure 16: Excavation activities



Excavation at trench 06 to understand the connection of ancient drainage system



Soil profile at test pit 01 and 02

Annex 10: Pilot conservation and restoration



Detail survey of architectural plan at section 5 before dismantling stone steps



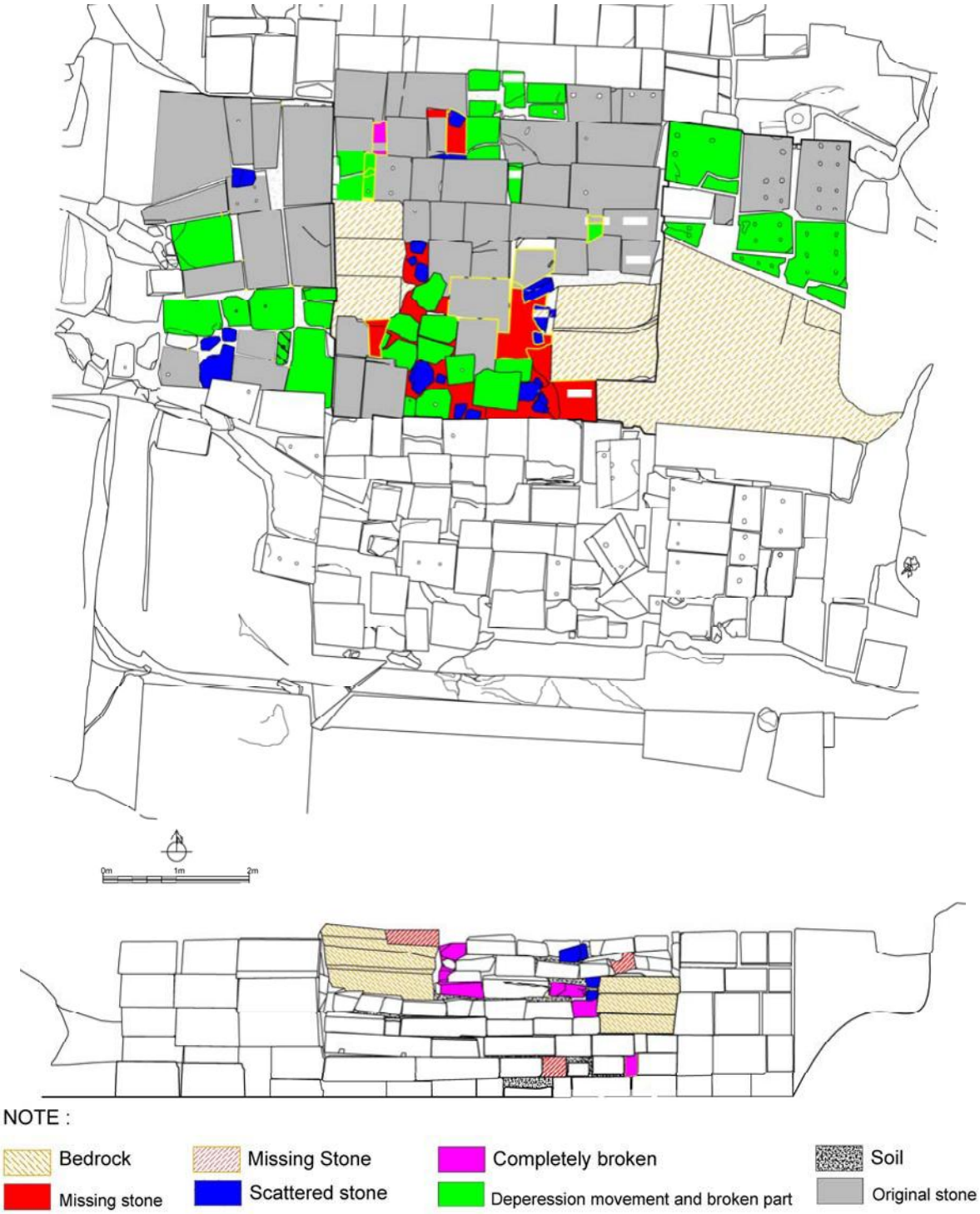
Pathology of stone step and foundation at section 5



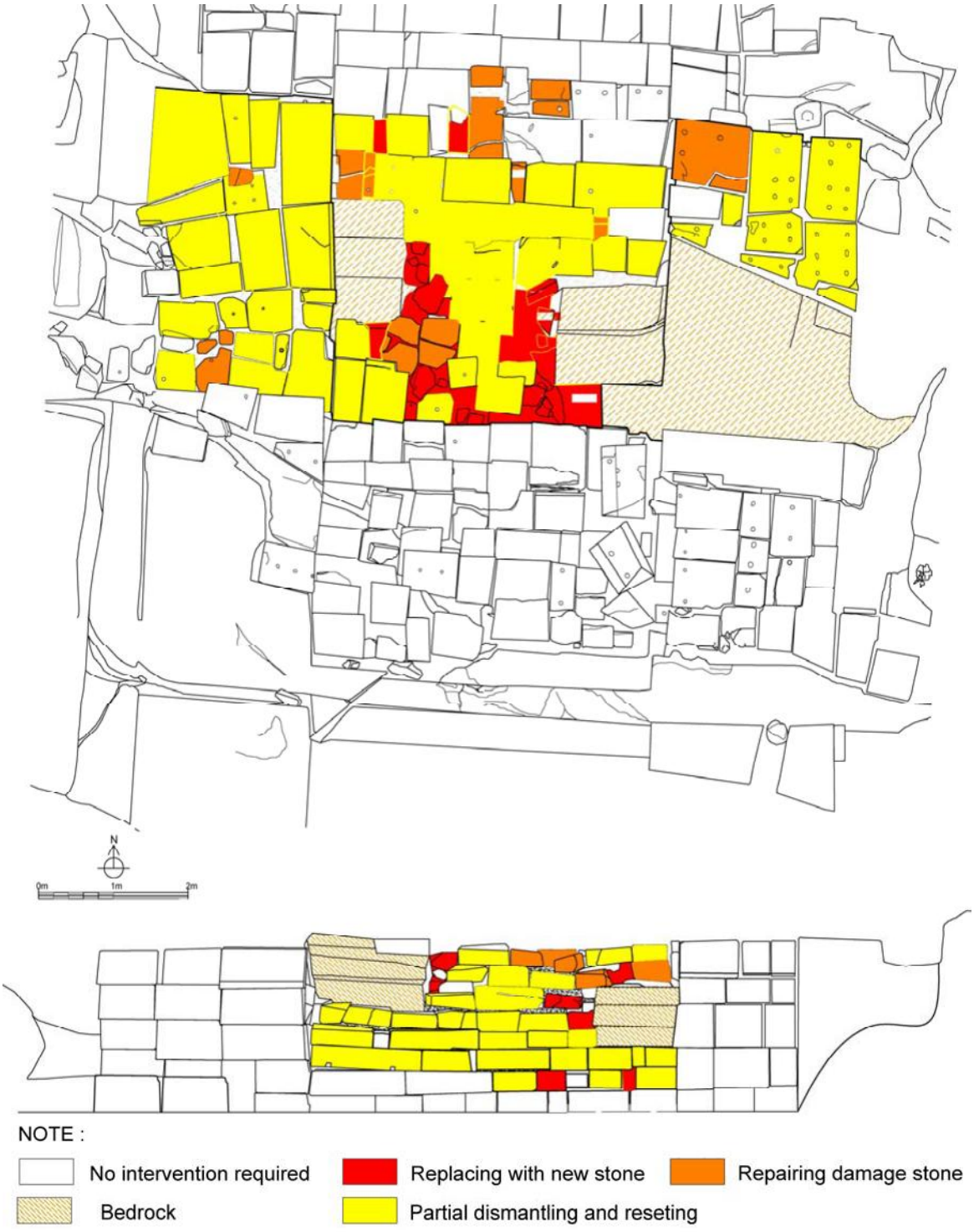
Stone work activities



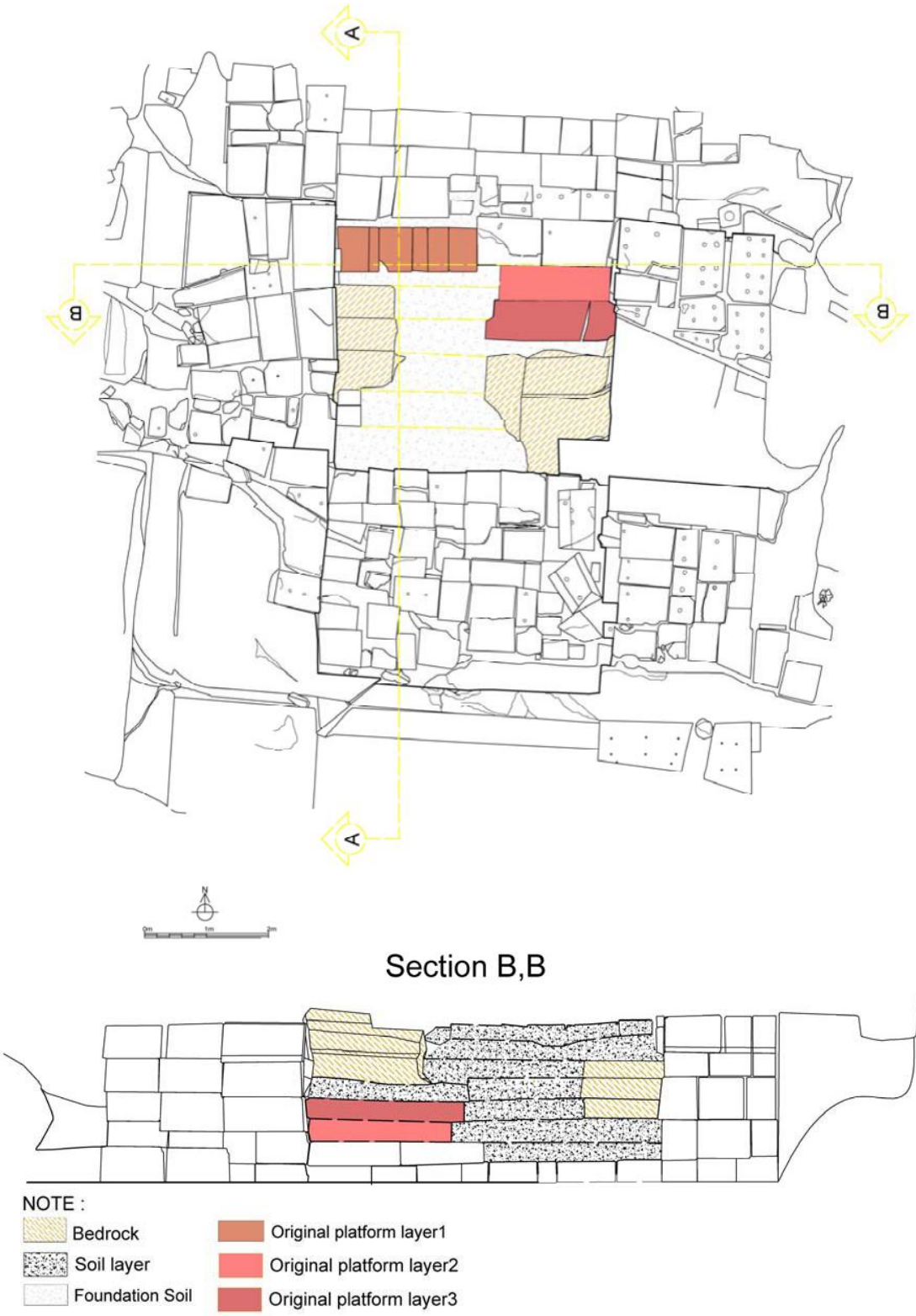
Pilot restoration at section 5



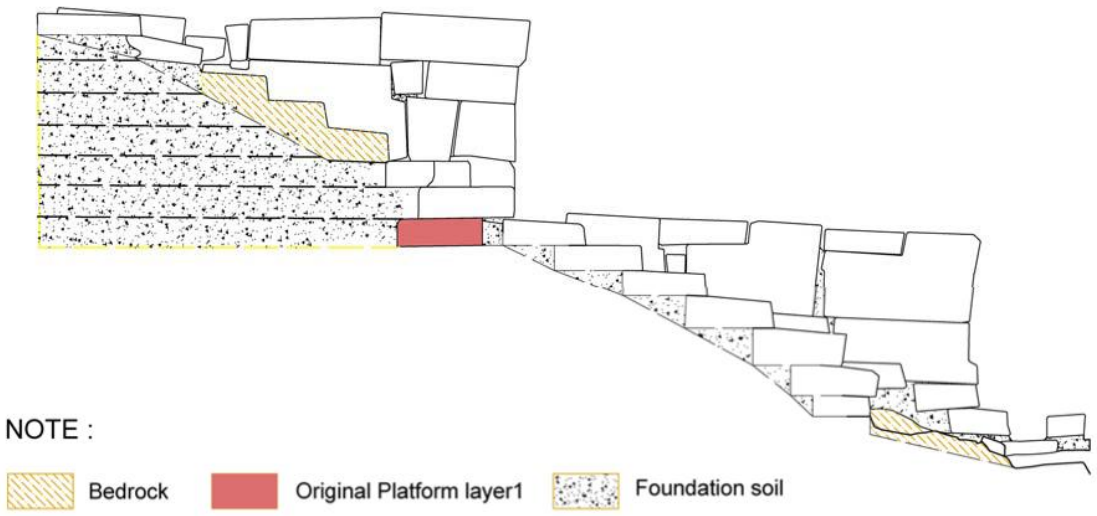
Stone condition at section 5 (Aerial and elevation plan)



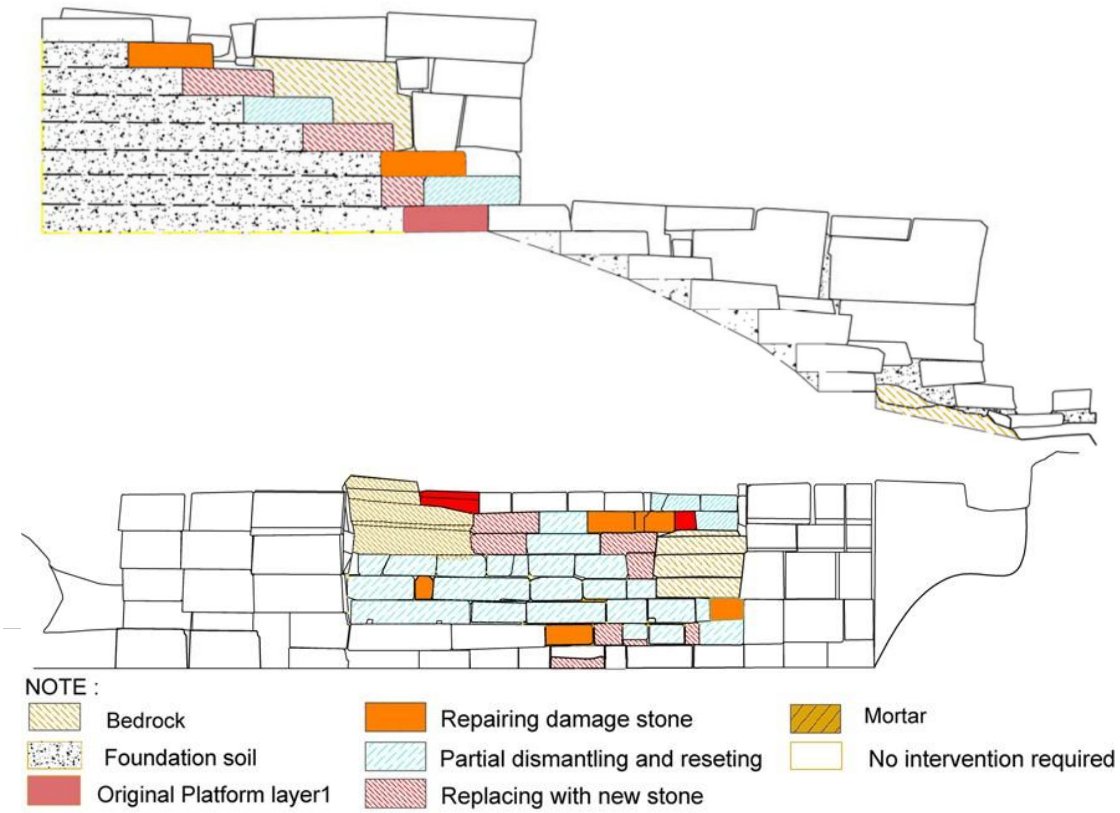
Typology of intervention for conservation and restoration at section 5 (Aerial and elevation plan)



Plan from aerial view and cross section B-B after dismantling



Cross section view A-A at section 5



Design elevation (West View) and North view



Status of section before (above) and after (below) restoration

Annex 11: Outreach and exchange programs

11.1 Outreach program

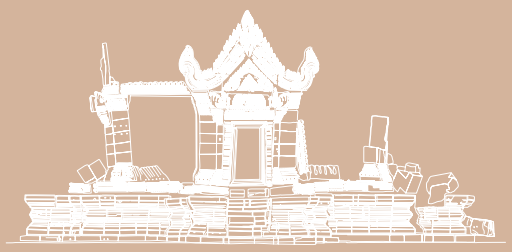


Activities of outreach program for local school students at the northern staircase

11.2 Exchange program



Skill Worker of the project attended field training at Bakheng temple with the World Monument Fund



Phase II : 2020-2021

INDEX

ANNEX – PHASE 2

1. Photos of the Activities and Architectural Drawings

Management Structure of the Project Team

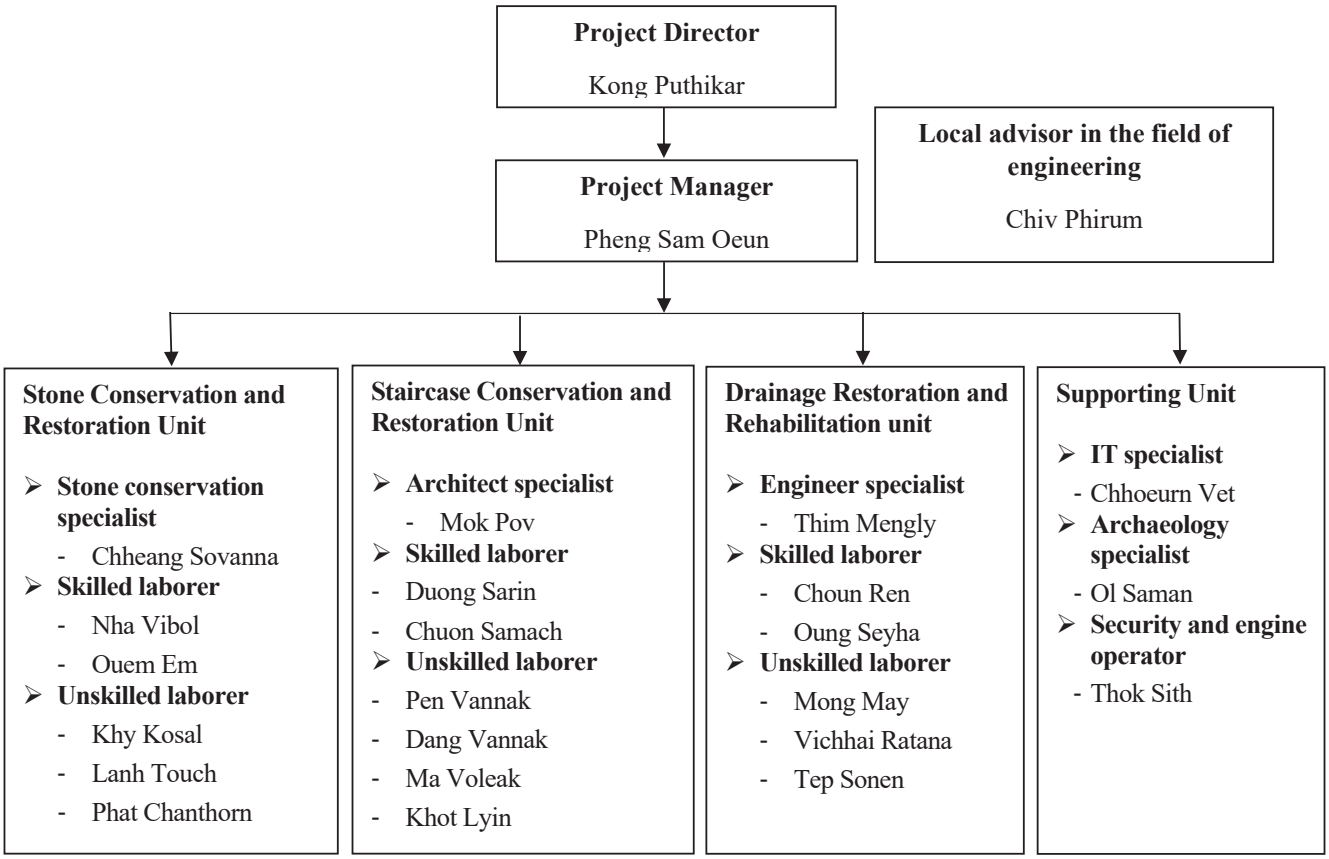


Figure 1: The structure list of conservation and restoration northern ancient staircase team

Building Project Team





Figure 2: Meeting led by the Director General to brief about the project and define roles of the project staff and laborers

Project Launching Ceremony



Figure 3: Signing ceremony on grant agreement between H.E Dr. Phoeurng Sackona, Minister of Culture and Fine Arts and H.E W. Patrick Murphy, the U.S. Ambassador to Cambodia



Figure 4: Group photo at the end of the event

Site preparation



Figure 5: The long red line indicates rail plan installed along the western causeway to move new sandstone to the restoration area



Figure 6: Activities to installed rail of 75 m long and 1 m wide, connecting from stone storage ground to section 4 where restoration is taken place in order to move stone for restoration



Figure 7: Set up two storage grounds which cover 36 m^2 and 24 m^2 to store new stone

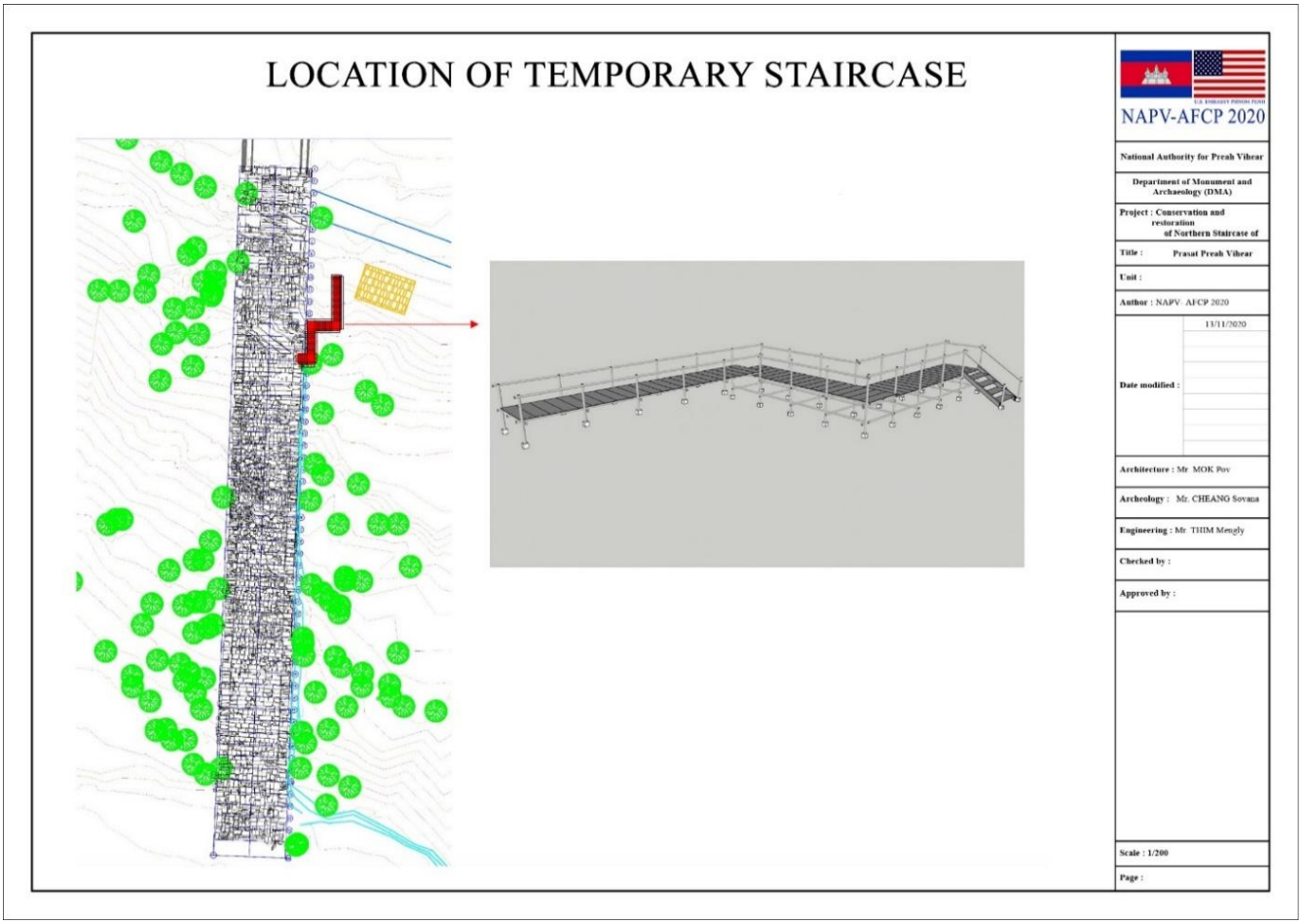


Figure 8: A zig zag red line on the western staircase shows plan of temporary bypass trail for visitors to move up and down along the staircase



Figure 9: Temporary steel-made bypass of 27 m long and 1.85 m wide and repair wooden staircase of 4 m long and 1.90 m wide



Figure 10: Shelter made of steel structure of 48m^2 with tarpaulin roof being installed at the restoration area

Lime Mortar Production



Figure 11: Activities of lime mortar trial with 7 formulars applying different proportion of raw materials



Figure 12: Condition of lime mortar in the steel-made mold

Archaeological Survey

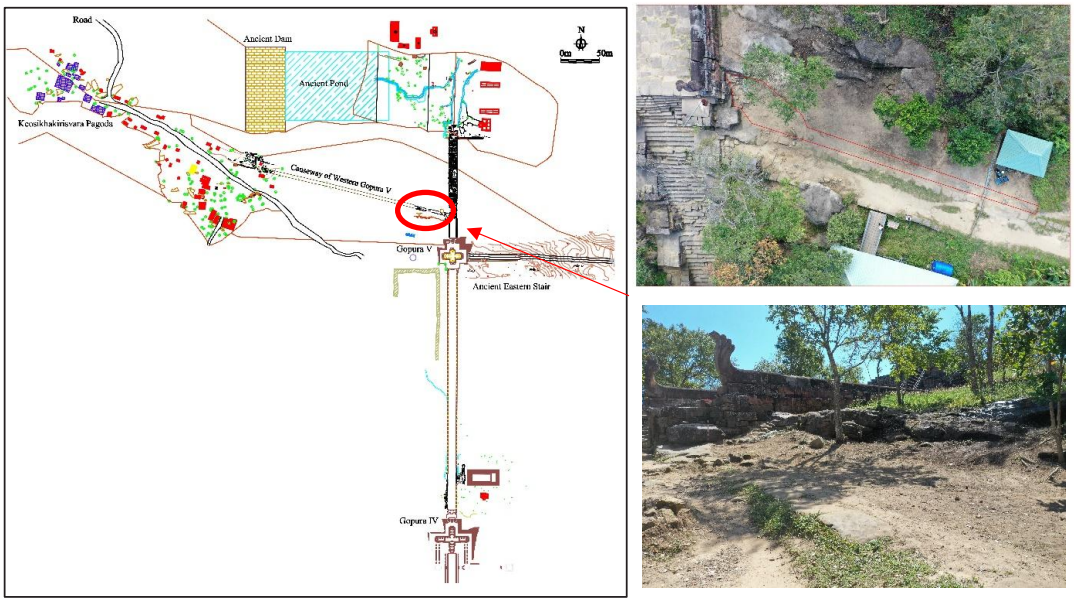


Figure 13: Red circle encircling a small portion in the west of Naga balustrade, and photos in the right-hand side show location of test pit and excavation trench.



Figure 14: A small portion adjacent to the western Naga balustrade shows test pit location where soil was excavated to study the archaeological evidence



Figure 15: Activity to move deposited soil



Figure 16: Depth of deposited soil that may caused by human

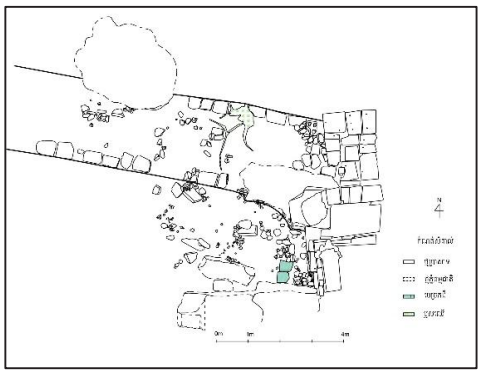


Figure 17: Overall plan showing condition before deposited soil was removed



Figure 18: Measurement of stone elevation before stones were dismantled

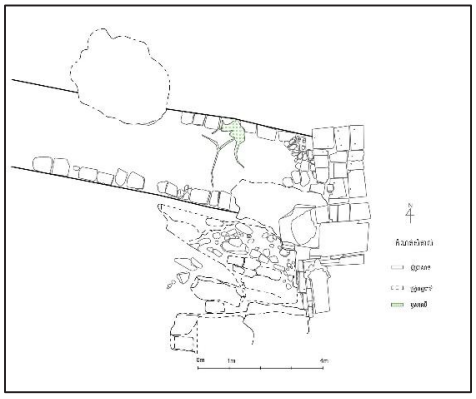




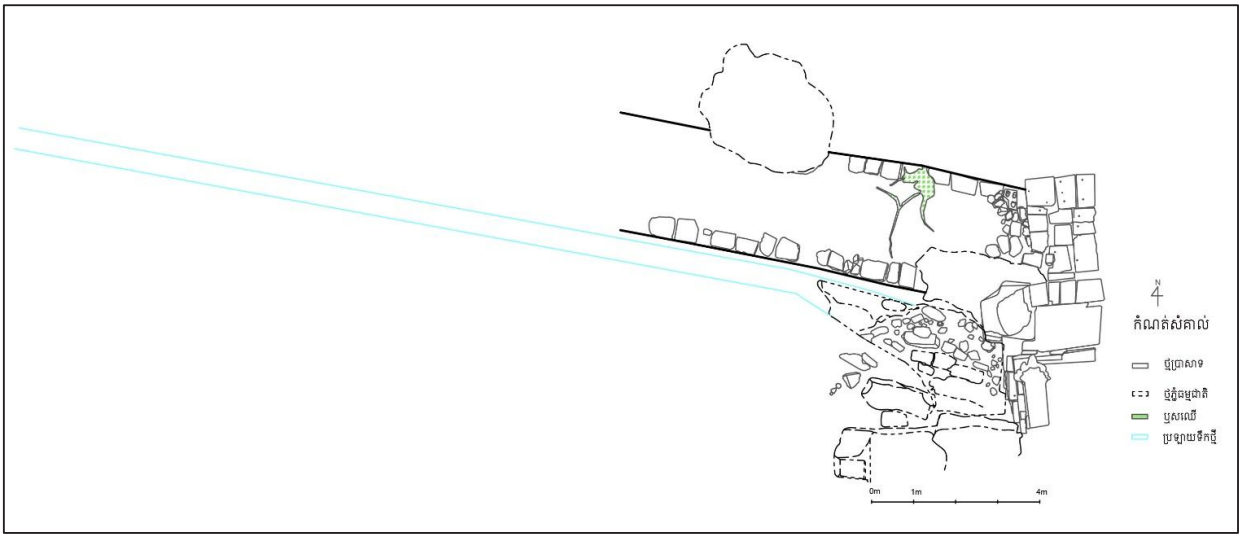
Figure 19: The plan and picture showing before removed soil deposits



Figure 20: Ancient artifacts found in the test pits



Figure 21: Current utilities during excavation





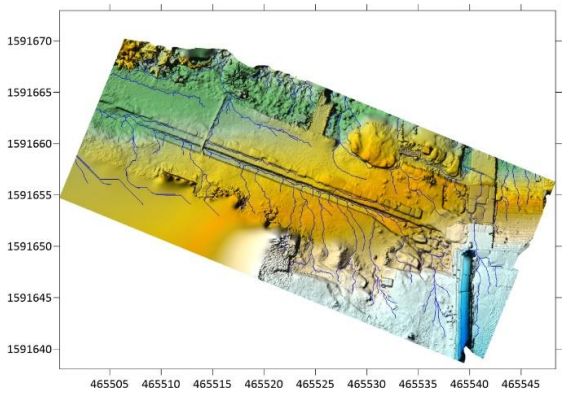


Figure 22: The above sketch in sky lines, photo of a long canal in the left-hand side, and photogrammetry at the right-hand side show a 28 m long canal being rehabilitated to divert rainwater to the west so as to mitigate of rainwater pressure on the northern staircase.

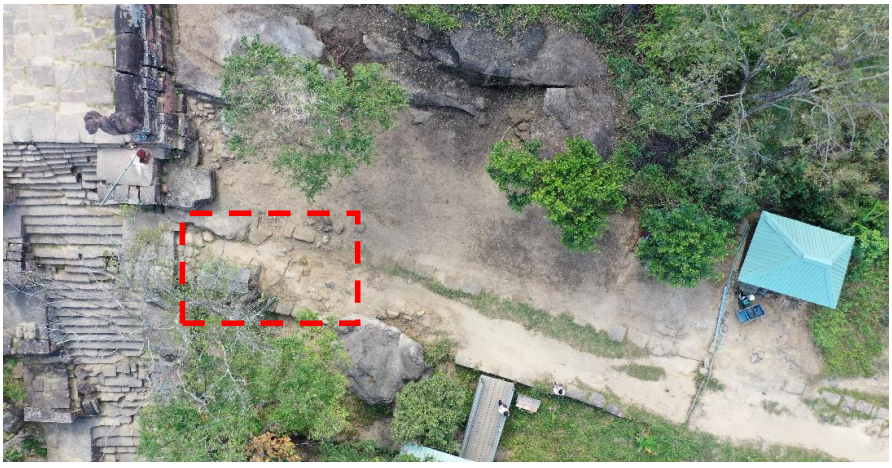


Figure 23: The red box showing location of excavation trench on western causeway (9m)



Figure 24: The general condition of the western causeway during the rain in 2008 (East view)



Figure 25: The general condition of western causeway in the dry season in 2017 (East view)

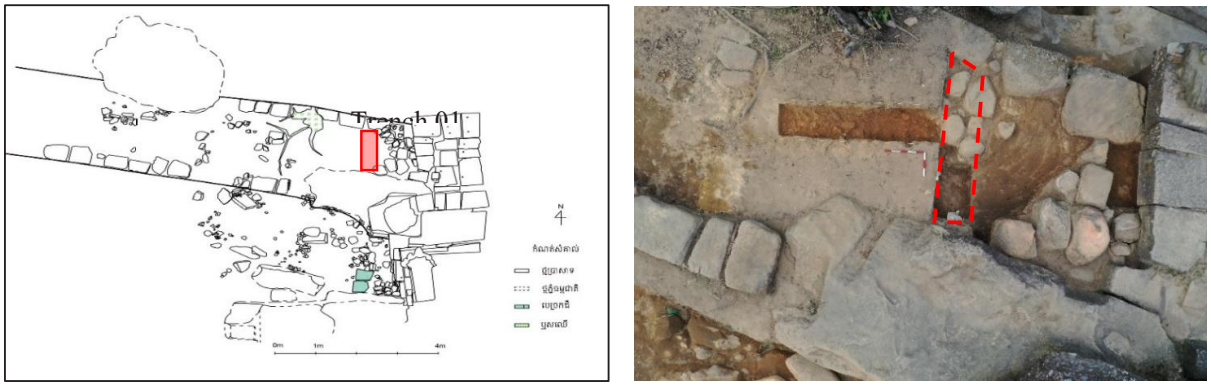


Figure 26: The red box on plan at left side is location of excavation trench 01 and right is general condition excavation trench (top view)



Figure 27: Stone pieces laid on surface of the causeway and current remains found at the excavation trench

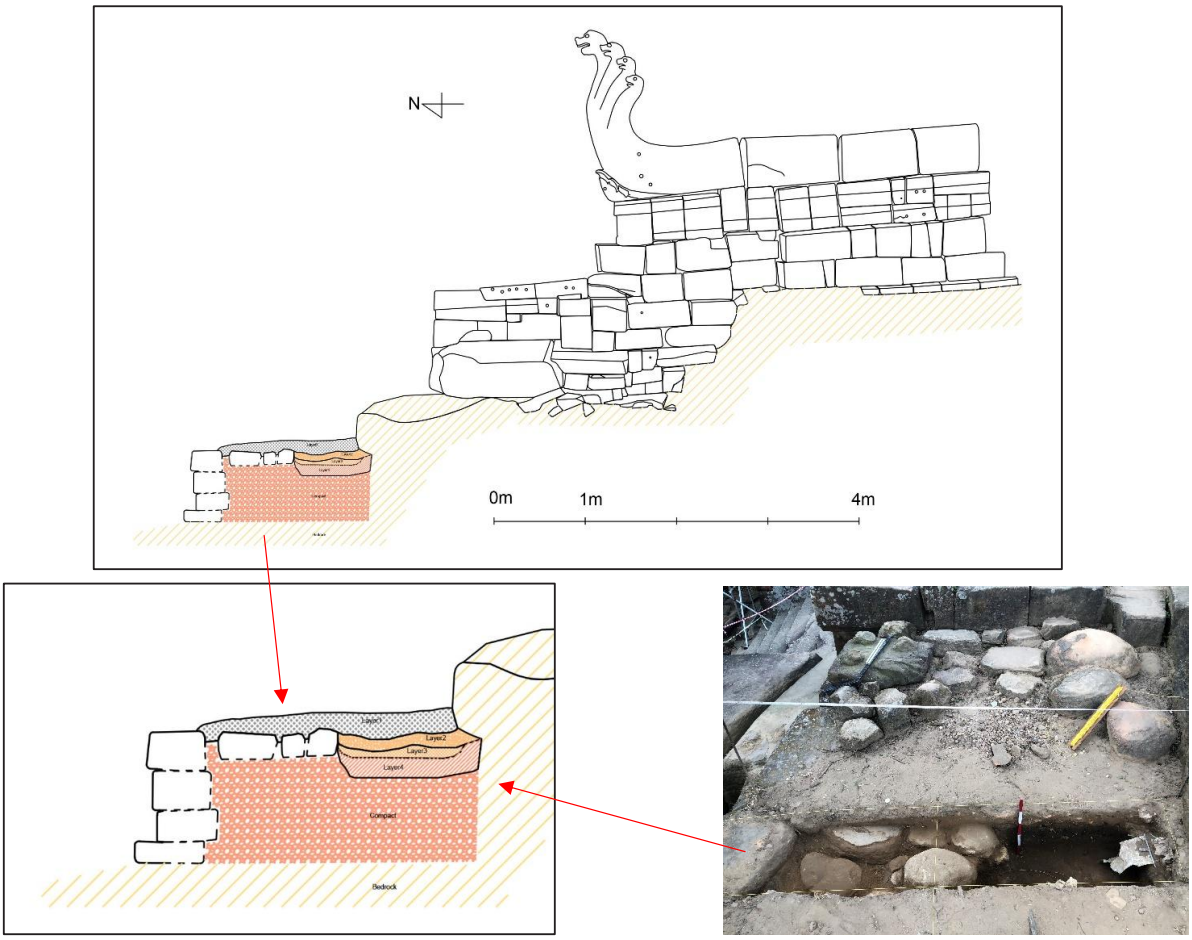


Figure 28: The eastern elevation of excavation trench no. 01



Figure 29: The red box shows location of excavation trench no. 02 on the western causeway



Figure 30: general view at the western elevation of excavation trench on western causeway



Figure 31: Plan sketch and study of soil profile at the excavation trench

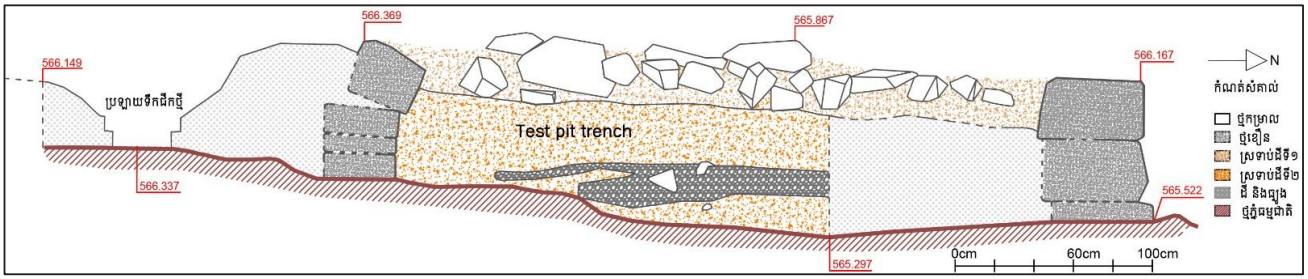


Figure 32: Cross section to show soil layer damage structure of the western causeway



Figure 33: Indicating soil layer at the excavation trench

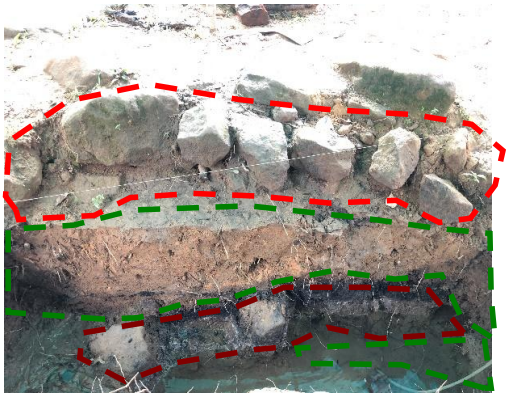


Figure 34: Classifying soil layers (profile) at the excavation trench

Conservation and Restoration of Lion and Singha Sculptures

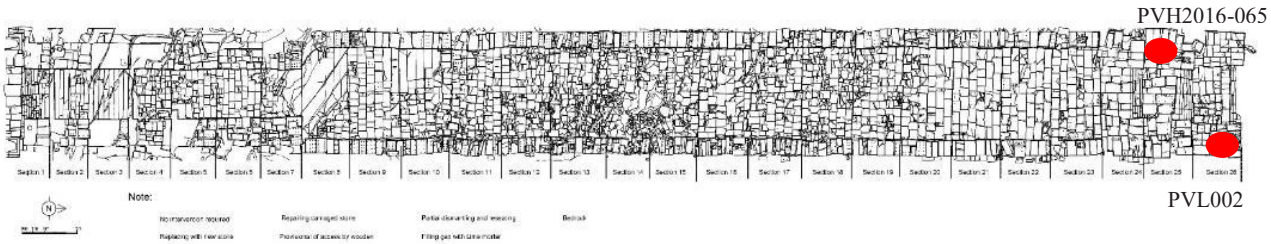


Figure 35: The red circle are positions of three lion and Gaja Singha sculptures

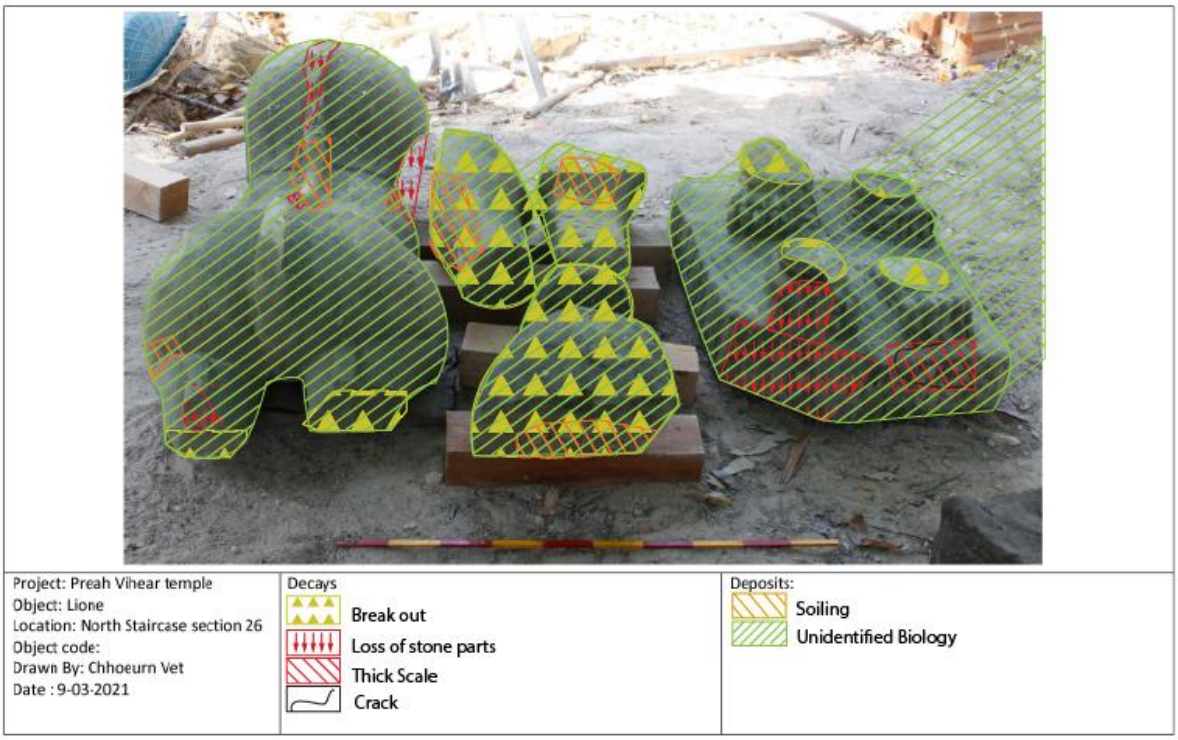


Figure 36: Digital mapping of Singha sculpture Code PVL002

ប្រាសាទព្រះវិហារ ឯកសារ និងបញ្ជីសារពើភណ្ឌ					Code: PVL002		
ប្រភេទសិល្បៈ :ចម្លាក់គុជសីហ៍							
ទីតាំង: ជណ្តើរបុរាណខាងជើង ថ្នាក់ទី២៦							
ប្រភេទវត្ថុ: ថ្មភក់	ពណ៌: ប្រផេះ						
លេខបញ្ជីសារពើភណ្ឌ: PVL002							
ចំនួនបណែក: ៥ បំណែក							
ទំហំ(cm)	បំណែកដាច់ខ្លួន	ជើងមុខ(ឆ្វេង)	ជើងមុខ(ស្តាំ)	ខ្នង	ជើងទម្រ		
កម្ពស់(Hight)	៤៦	២២	២៣	២៣	៣៤		
ទទឹង(Width)	៦៤	៣១	៣០	៤២	៦៥		
បណ្តោយ(Long)	១២៤	៦១	៥៦	៥៥	៨៦		

រូបភាពមុនពេលជួសជុល/ រូបភាពក្រោយពេលជួសជុល



ចម្លាក់គុជសីហ៍មុនពេលជួសជុល

អន្តរាគមន៍ពីមុន: គ្មាន

ស្ថានភាពខូចខាតជាក់ស្តែង:

ចម្លាក់គុជសីហ៍ មានការខូចខាតខ្លាំង ដោយបានបែកជាប់ណែកៗ ក្នុងនោះបំណែកចំនួន៥ បានរកឃើញ ឯបំណែកផ្សេងទៀតដូចជាផ្នែកមុខ និងទ្រុងមួយចំហៀងបានបាត់បង់ មានស្នាមសឹកត្រង់កន្ទុយ របកជាស្រកាត្រង់ក្រអូមមាត់ កំណកដី និងតួខ្លួនទាំងមូលត្រូបដណ្តប់ដោយស្មៅ។

វិធីសាស្ត្រអភិរក្ស និងជួសជុល:

- ស្វែករកបំណែក នៅជុំវិញបរិវេណជណ្តើរបុរាណខាងជើង
- សម្អាតស្ងួត ដោយបោសយកកំណាដីចេញ និងបន្តលាងសម្អាតសើម ប្រើថ្នាំអាស៊ីត H_2O_2 ជាមួយទឹកបន្សុទ្ធ នៅត្រង់ស្នាមថ្នេរ និងមុខដំណាថ្ម
- បន្សាបជាតិអំបិលចេញពីផ្ទៃថ្ម ដោយប្រើម្សៅបំពកកូលធីស(ម្សៅក្រដាស ១០០០ & ៤០ ជាមួយម្សៅដីឥដ្ឋ)
- ពង្រឹងផ្ទៃថ្មពុកផុយ ជាថ្នាំអ៊ីធីស៊ីលីខេត ៣០០
- បំណែកឡើងវិញ ដោយស្អាងជាក់ស្តែលFiberglass ជាមួយកាវញើឈ្មោល Sikadur 752
- បិតបាយអ អ៊ីធីស៊ីលីខេត ៥០០ តាមដំណាថ្ម និងលាបបាយអអ៊ីធីស៊ីលីខេត ៥០០

ឈ្មោះអ្នកធ្វើបញ្ជី: ឈឿន វេត	ថ្ងៃ/ខែ/ឆ្នាំ 25/02/2021

Figure 37: Inventory of Singha sculpture (code PVL002)

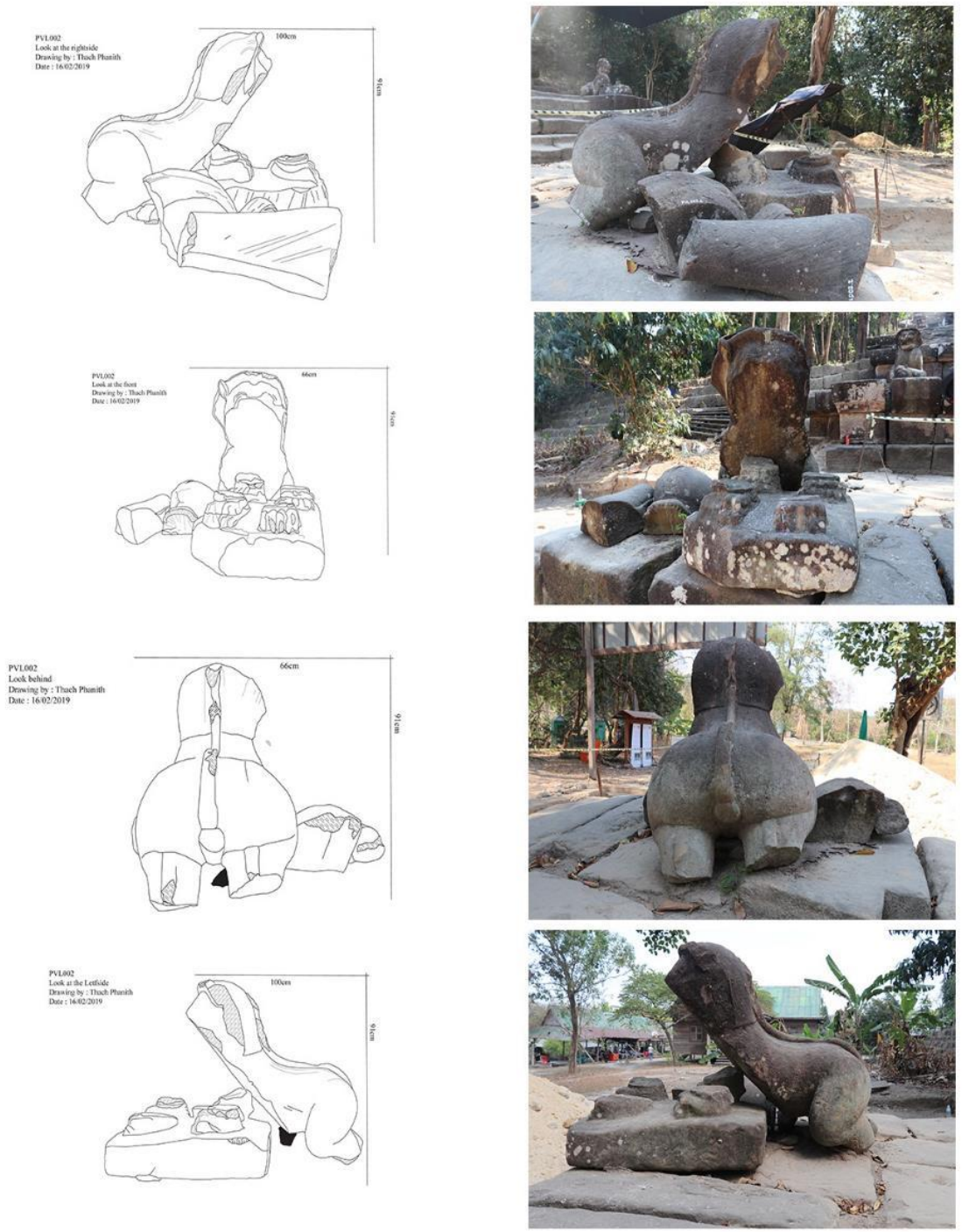


Figure 38: Drawing and picture of the Singha sculpture before treatment (Code: PVL002)

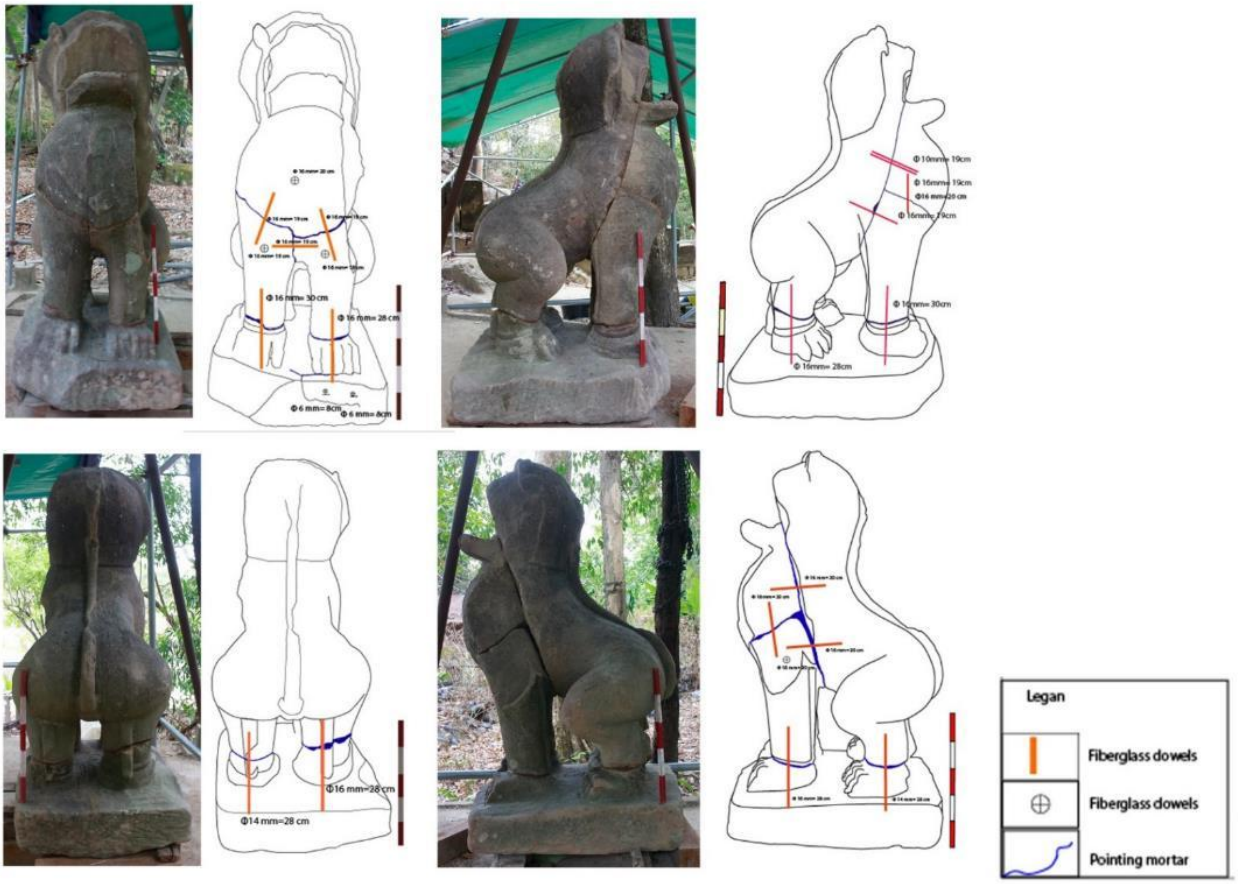


Figure 39: Picture and drawing showing technical treatment (Code: PVL002)

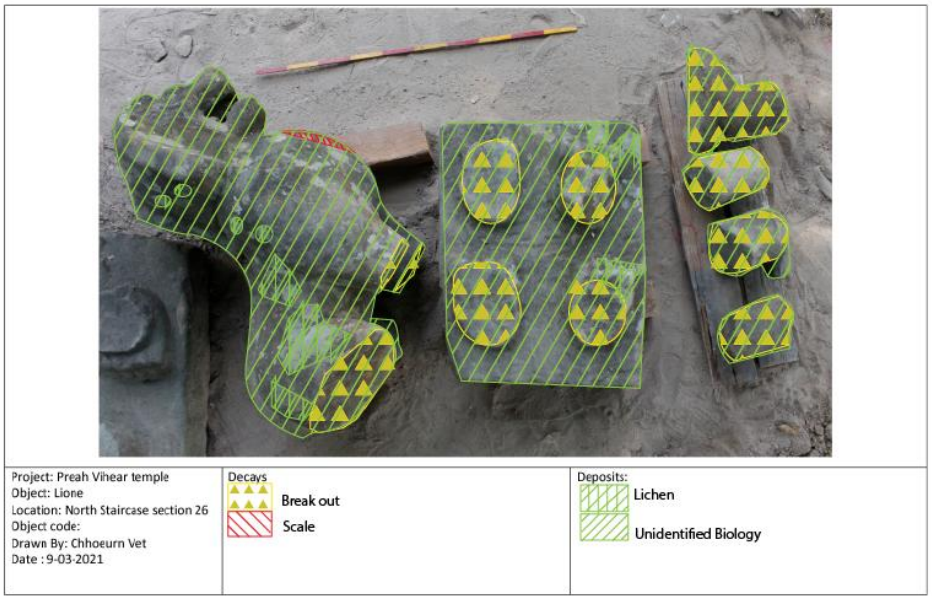


Figure 40: Digital mapping of lion sculpture (Code: PVH2016-062)

ប្រាសាទព្រះវិហារ ឯកសារ និងបញ្ជីសារពើភណ្ឌ						Code: PVH2016-062	
វត្ថុសិល្បៈ : ចម្លាក់តោ							
ទីតាំង: ជណ្តើរបុកណាខាងជើង ថ្នាក់ទី២៦							
វត្ថុធាតុ: ថ្មភក់	**ពណ៌**: ប្រផេះ						
លេខបញ្ជីសារពើភណ្ឌ:							
ចំនួនបំណែក: ៦ បំណែក							
ទំហំ(cm)	បំណែកដែងខ្លួន	ជើងមុខ(ទទេង)	ជើងមុខ(ស្តាំ)	ជើងក្រោយ(ទទេង)	ជើងក្រោយ(ស្តាំង)	ជើងទម្រ	
កម្ពស់(Hight)	៨០	២២	២០	២០	៣៤	៣១	
ទទឹង(Width)	៤៤	១៦	១៦	១៦	១៨	៥៣	
បណ្តោយ(Long)	៩០	១៦	១៦	២១	៣១	៦៧	

រូបភាពមុនពេលជួសជុល/ រូបភាពក្រោយពេលជួសជុល



ចម្លាក់តូចសីហ៍មុខពេលជួសជុល

អន្តរាគមន៍ពីមុន: គ្មាន

ស្ថានភាពខូចខាត់ជាក់ស្តែង:

ចម្លាក់តោបានការបែកជា៦ បំណែកចេញពីគ្នា និងបំណែកជើងមុខខាងស្តាំ បានបាត់បំណែក មានស្នាមប្រេះ ថ្មប្រហោងក្នុង របកជាស្រកាវ នៅជើងទម្រផ្នែកខាងមុខ និងខ្នែងតោ។ តួដែងខ្លួនចម្លាក់តោទាំងមុល មានកំណែកដី និងត្របដណ្តប់ដោយស្មៅ។

វិធីសាស្ត្រអភិរក្ស និងជួសជុល:

- សម្អាតសួត ដោយបោសយកកំណាដីចេញ និងបន្តលាងសម្អាតសើម ប្រើថ្នាំអាស៊ីត H_2O_2 ជាមួយទឹកបន្សុទ្ធ នៅត្រង់ស្នាមផ្លេះ និងមុខដំណាថ្ម
- បន្ទប់ជាតិអំបិលចេញពីផ្ទៃថ្ម ដោយប្រើម្សៅបំពកភ្លុលដែស(ម្សៅក្រដាស ១០០០ & ៤០ ជាមួយម្សៅដែតផ្ទៃ)
- ពង្រឹងផ្ទៃថ្មពុកផុយ ជាថ្នាំអ៊ីធីស៊ីលីខេត ៣០០
- សង្គ្រោះស្នាមប្រេះ និងថ្មប្រហោងក្នុង ដោយស្អានជាក់ស្តួលFiberglas ជាមួយការ Sikadur 752
- ផ្គុំបំណែកឡើងវិញ ដោយស្អានជាក់ស្តួលFiberglass ជាមួយការញើណោល Sikadur 752
- បិតបាយអ អ៊ីធីស៊ីលីខេត ៥០០ តាមដំណាថ្ម និងលាបបាយអអ៊ីធីស៊ីលីខេត ៥០០

ឈ្មោះអ្នកធ្វើបញ្ជី: ឈឿន វ៉ត	ថ្ងៃ/ខែ/ឆ្នាំ 25/02/2021

Figure 41: Inventory of Singha sculpture (code: PVH2016-062)

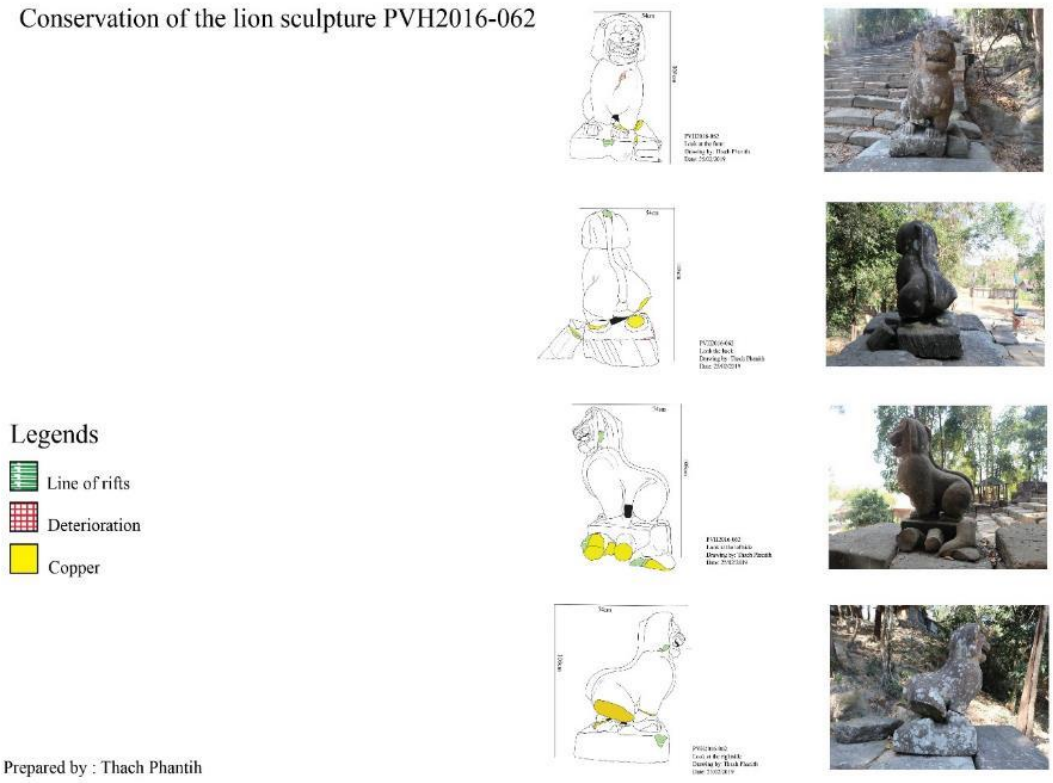


Figure 42: The lion sculpture before restoration

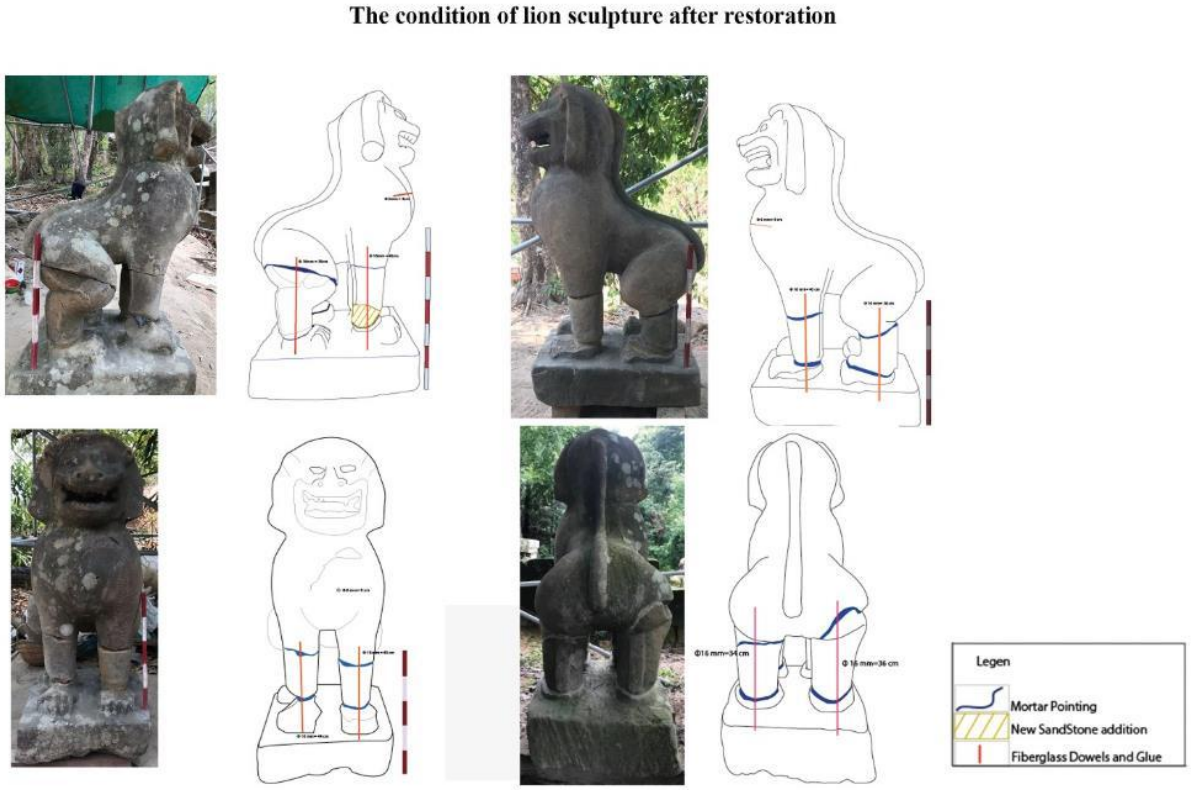


Figure 43: Pictures and drawings showing restoration technique of lion sculpture, and its complete shape after restoration



Figure 44: Desalination by poultice from the stone



Figure 45: Reassemble pieces of lions and fix with fiberglass dowel and glue



Figure 46: Put back lion sculpture to original place



Figure 47: The lion sculpture before restoration



Figure 48: The lion sculpture after restoration

Restoration and Rehabilitation of Drainage System

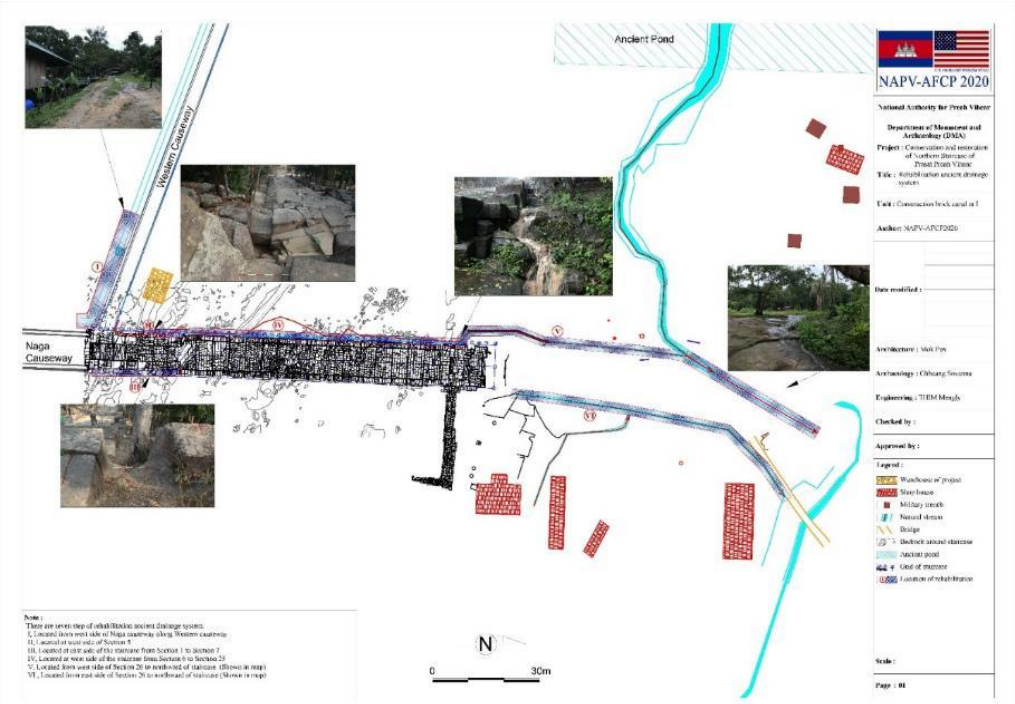


Figure 49: Master plan showing overall view of the northern staircase, western causeway and it surrounding area

Rehabilitation of 28 m long canal along the western causeway

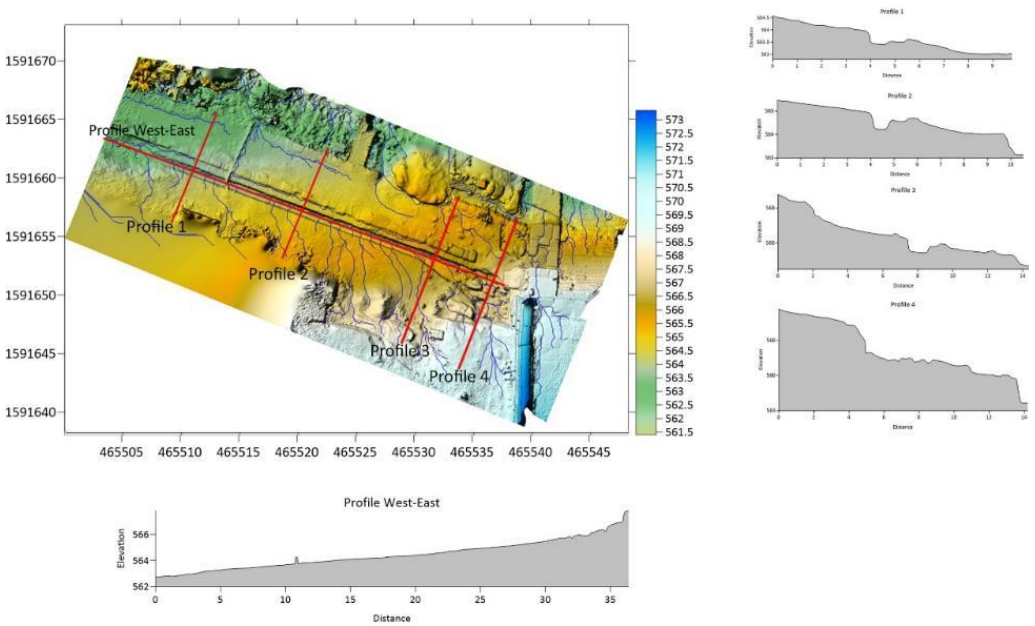


Figure 50: Map showing topography and flowing direction of rainwater

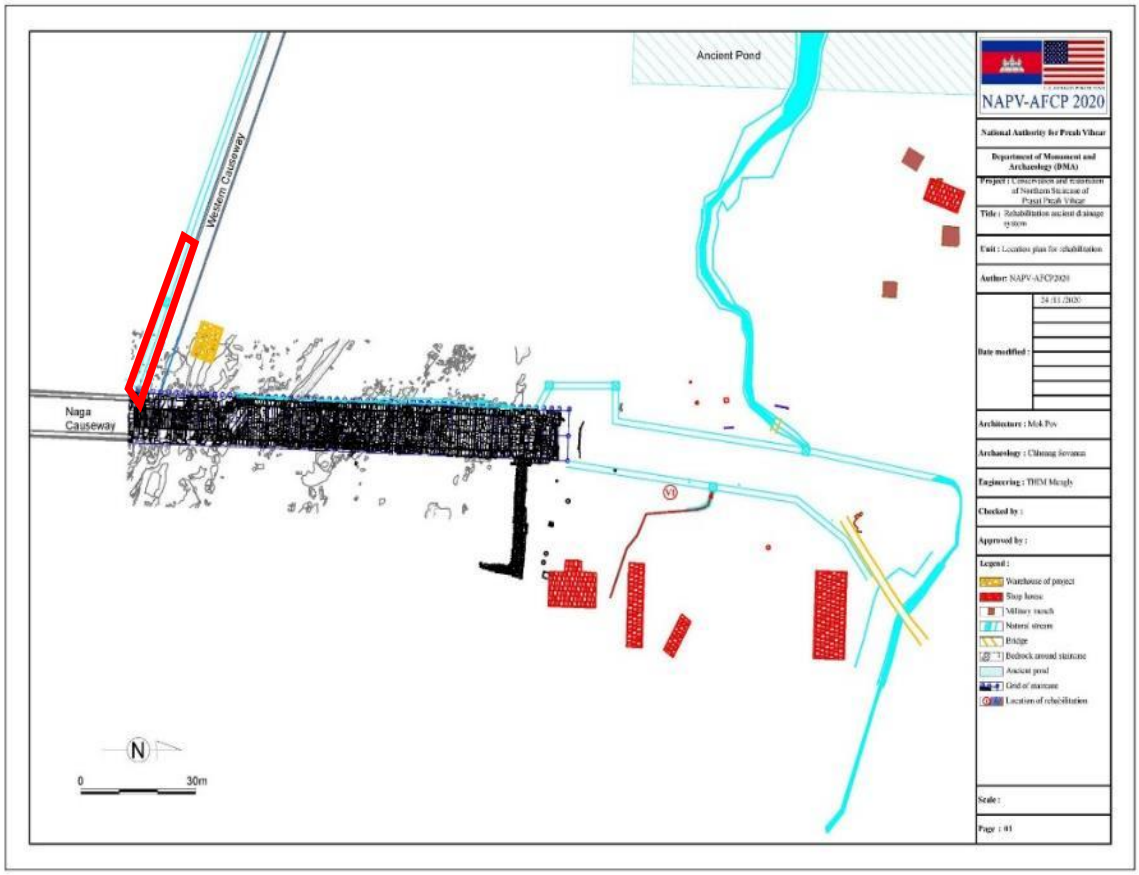


Figure 51: Red line at above left is a canal along the western causeway being rehabilitated



Figure 52: General view of drainage system at the west Naga head before restoration




Figure 53: The activities relating to rehabilitation drainage system



Figure 54: Before rehabilitated



Figure 55: After rehabilitated

Rehabilitation of drainage System in the West of the Northern Staircase

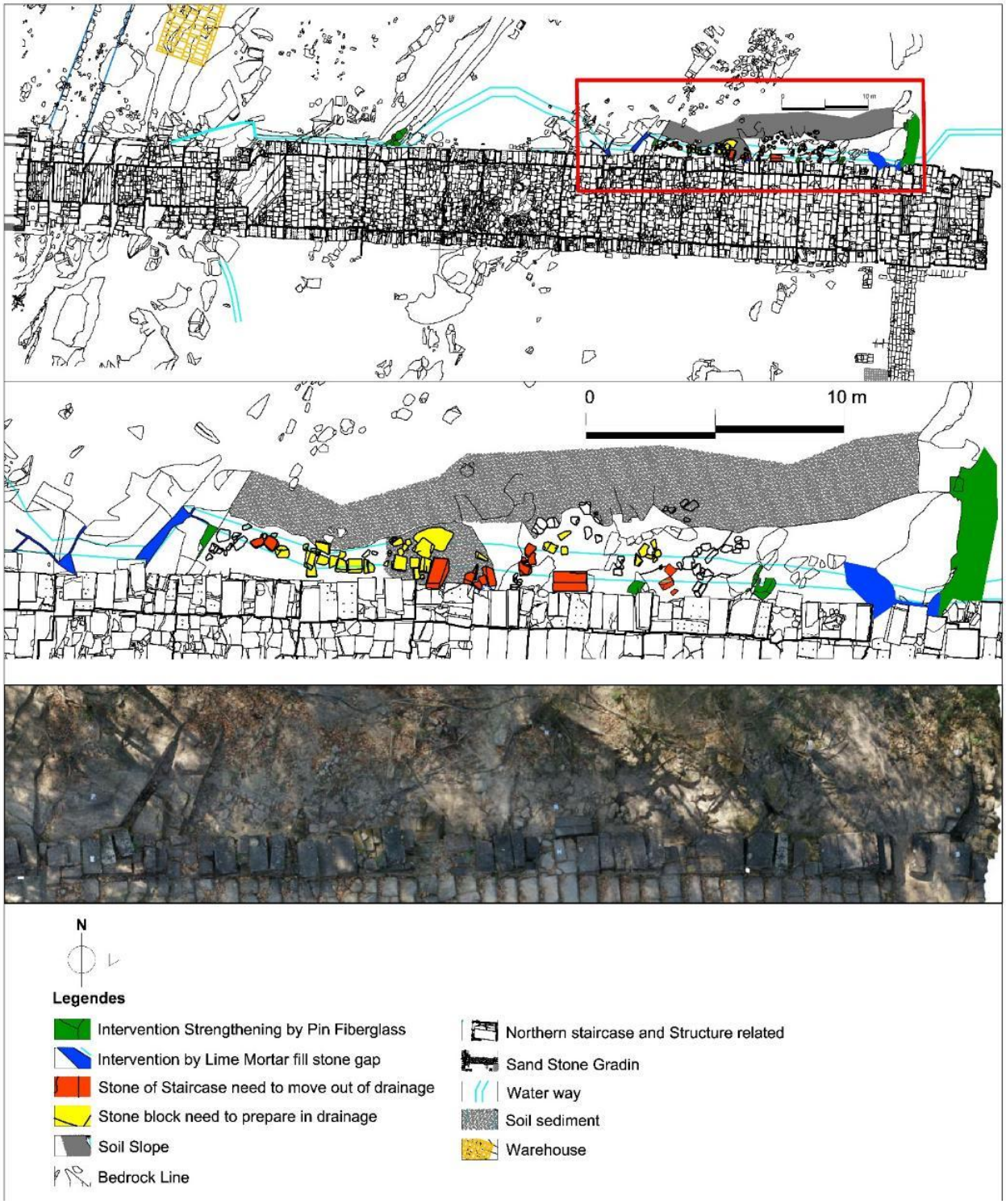


Figure 56: Map showing western ancient canal at sections 11-25 including activities of stone removal, fixing bedrock, and applying mortar to prevent from infiltration of rainwater



Figure 57: Removing stone blocks from the ancient drainage system beside the western stair wall



Figure 58: Restoring deformed bedrock by drilling hold to insert Fiberglass dowels and glue

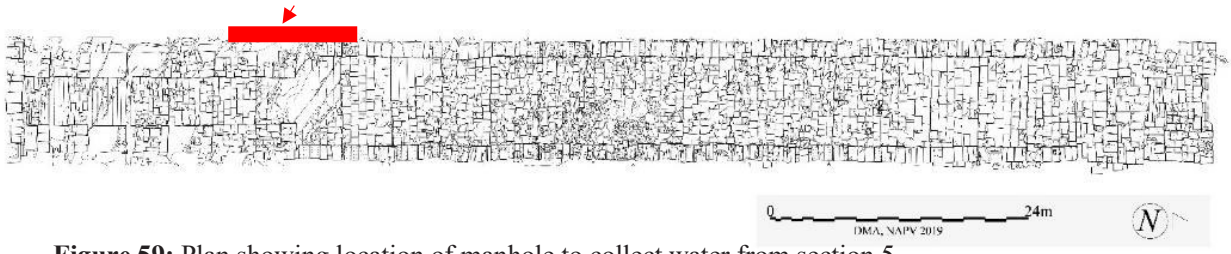


Figure 59: Plan showing location of manhole to collect water from section 5

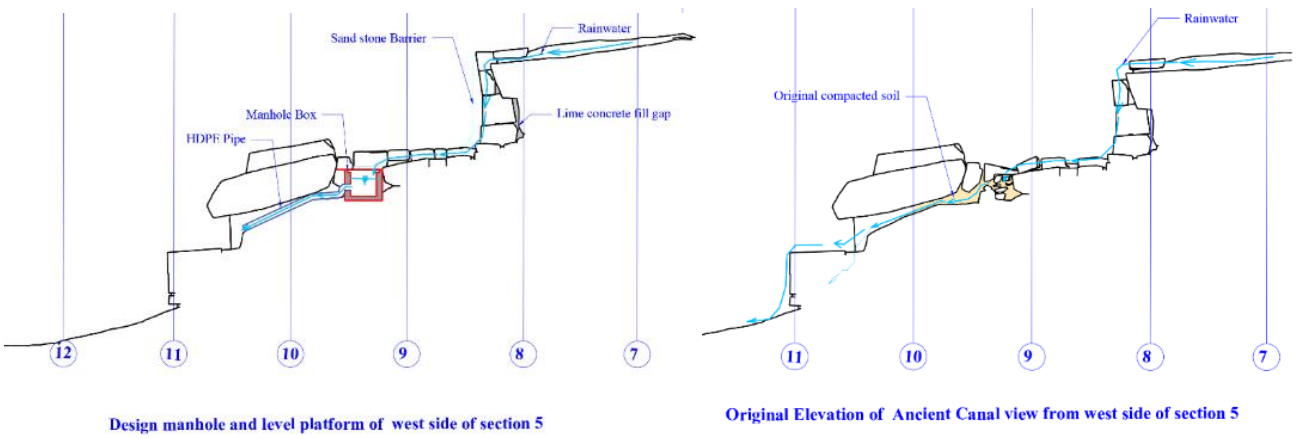


Figure 60: Manhole design in the west of section 5 to collect rainwater





Figure 61: A manhole of 90 cm long x 50 cm wide x 50 cm deep was completely constructed in the west of section 5 of the staircase, and a pipe of 8.60 m long and 15 cm diameter is connected from the manhole to the downward ancient canal at section 8



Figure 62: Manhole with pipe connected to bring water down to sections 5-7



Figure 63: Photo showing connection of pipe from manhole section 8

Rehabilitation of Drainage System in the East of the Northern Staircase

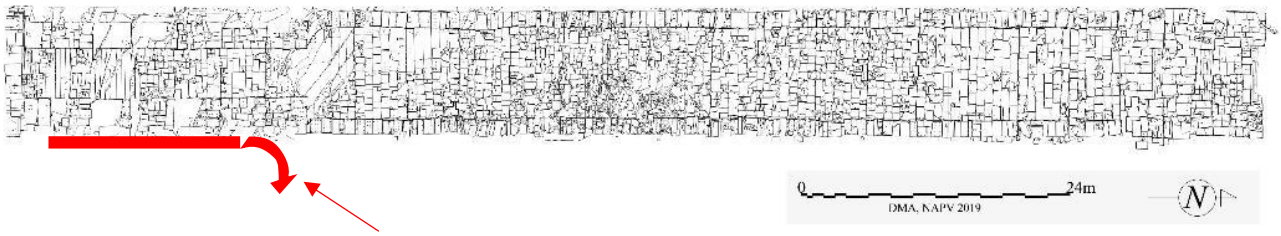


Figure 64: The red line mark on plan showing the location of rehabilitated drainage system

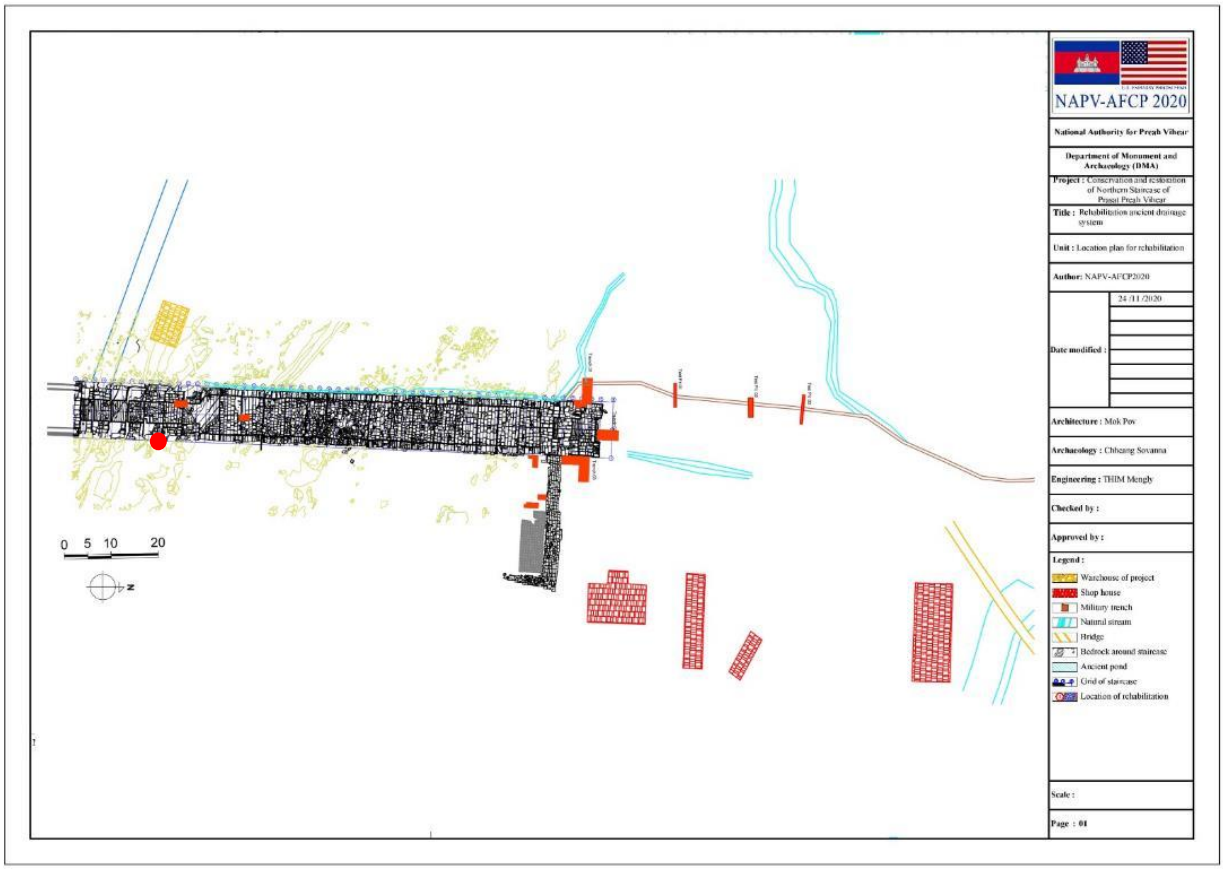


Figure 65: A red dot point in circle shows location of tree being removed at section 5, beside the eastern wall of the staircase



Figure 66: Activities to remove a tree and roots at section 5 that block flow of rainwater in the canal beside the eastern wall of the staircase



Figure 67: Ancient canal from carving of bedrock in the eastern side of the staircase



Figure 68: The condition before remove the tree



Figure 69: The condition after removed the tree





Figure 70: Activities relating to excavating the canal to divert rainwater to the side of staircase

Constructing a New Canal to Bring Water Northwards

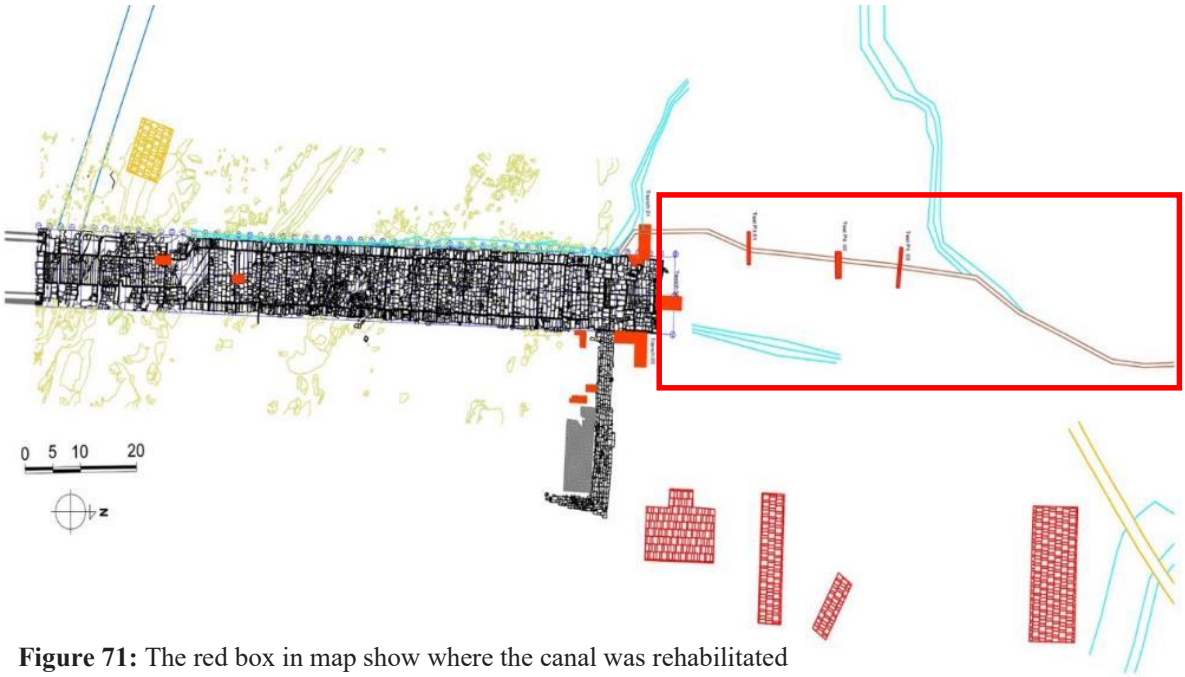


Figure 71: The red box in map show where the canal was rehabilitated

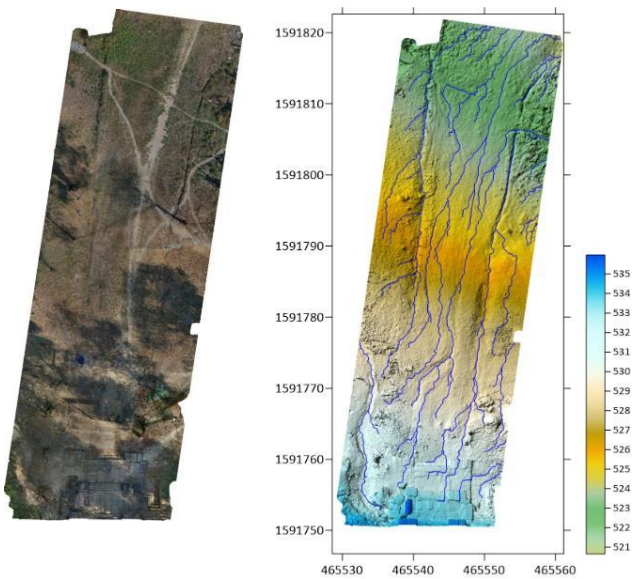


Figure 72: Photo at the right hand shows aerial photo of existing landform condition, and photo at the left hand is a modeling of flow current of rainwater at the northern end of ancient staircase.



Figure 73: Activity involved in excavating a test pit

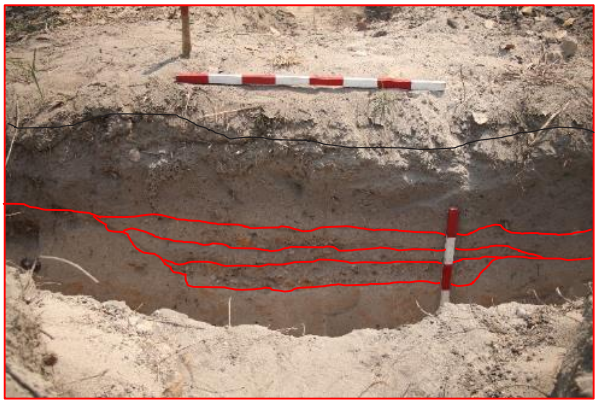


Figure 74: Soil profile in the test pit on the ancient northwestern canal show different layers of soil deposited over year





Figure 75: Activity involved in rehabilitation and construction of brick canal from ancient staircase northwards



Figure 76: The general condition of brick canal after constructed

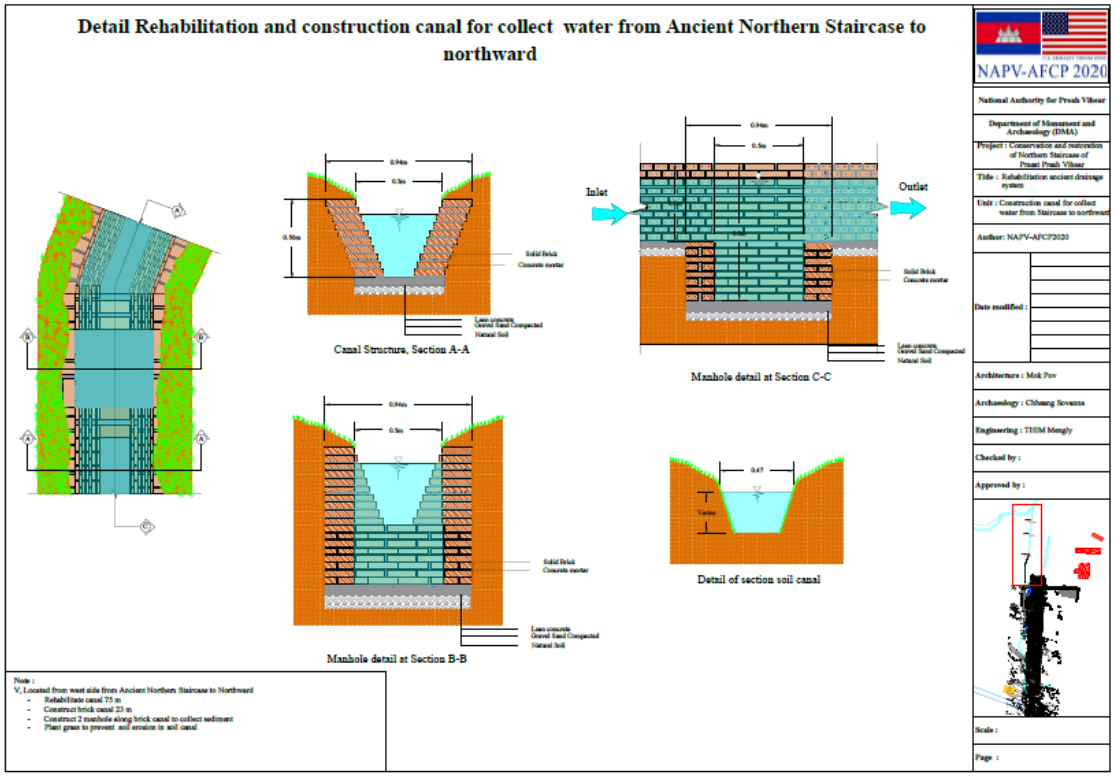


Figure 77: Plan for rehabilitation of ancient canal and construction of new canal

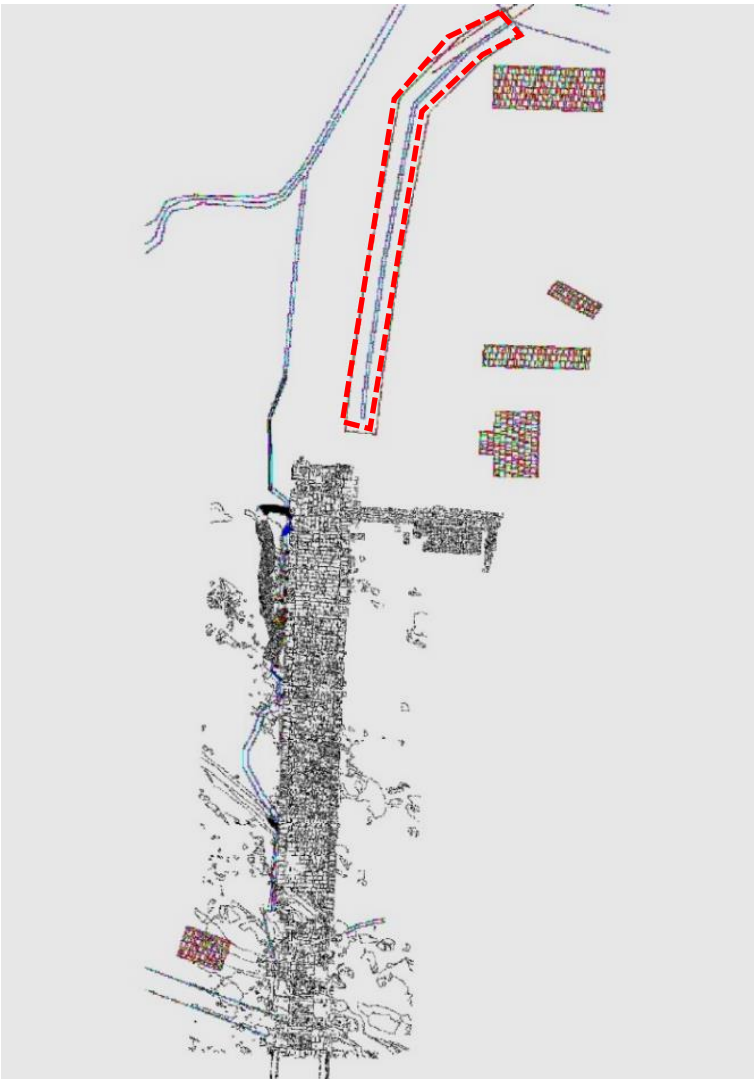


Figure 78: Rehabilitation of the northeastern canal to improve flow of rainwater to a natural stream in the north



Figure 79: Undertake levelling canal bed



Figure 80: Rehabilitate drainage system from ancient staircase northwards

Conservation and Restoration of Staircase Structure

Location

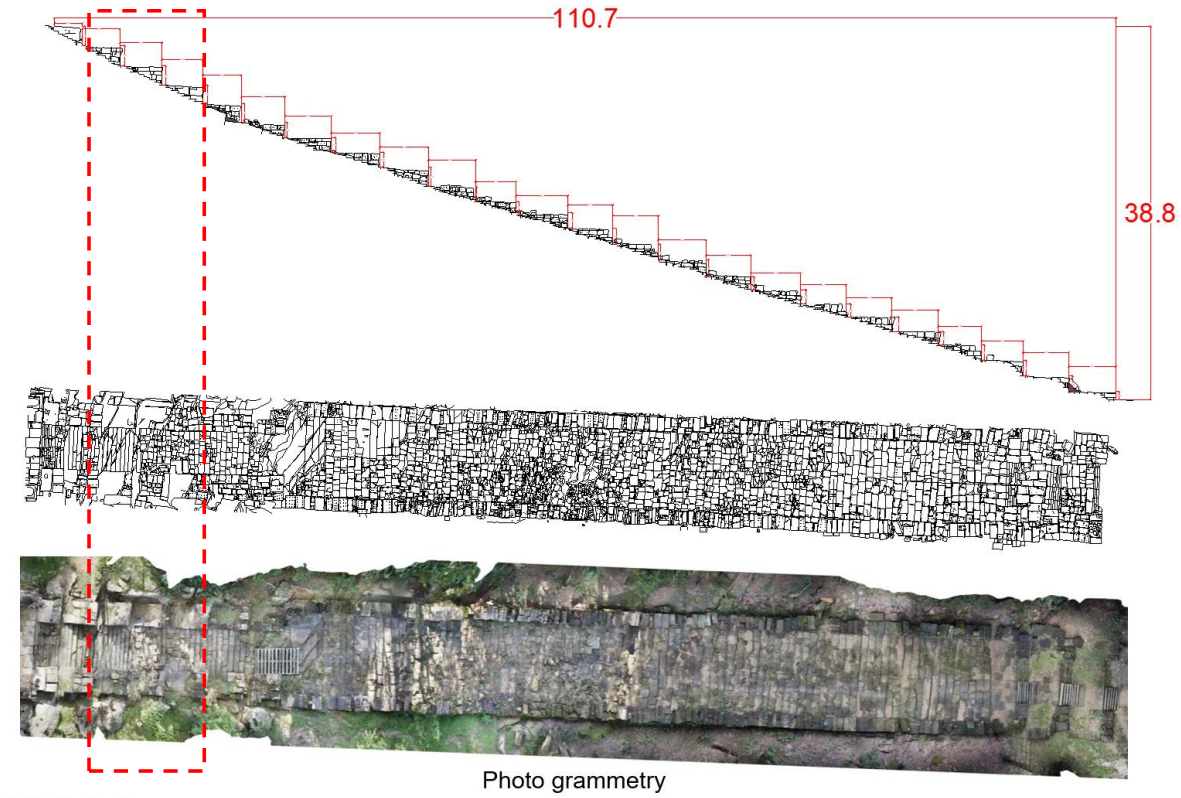


Figure 81: Plan and elevation of northern ancient staircase of Preah Vihear temple.



Figure 82: The red line showing location and condition of the staircase section 2-4

Analysis conditions of staircase section 2 to section 4



Figure 83: The general condition and existing plan of staircase section 2-section 4



Figure 84: Risk analysis structure of the northern ancient staircase



Figure 85: Typology of intervention for restoration and conservation

Photos showing condition of section 4 before restoration and restoration activities

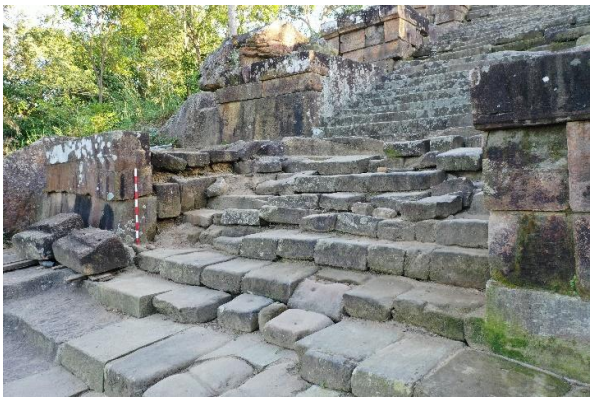


Figure 86: Collapsed Staircase wall and steps



Figure 87: Tree root penetrated into foundation



Figure 88: Dismantling stone slabs and removing sediment



Figure 89: The red box shows stone slabs being used for stair step's foundation





Figure 90: Foundation of stair step with compacted soil and stone chips

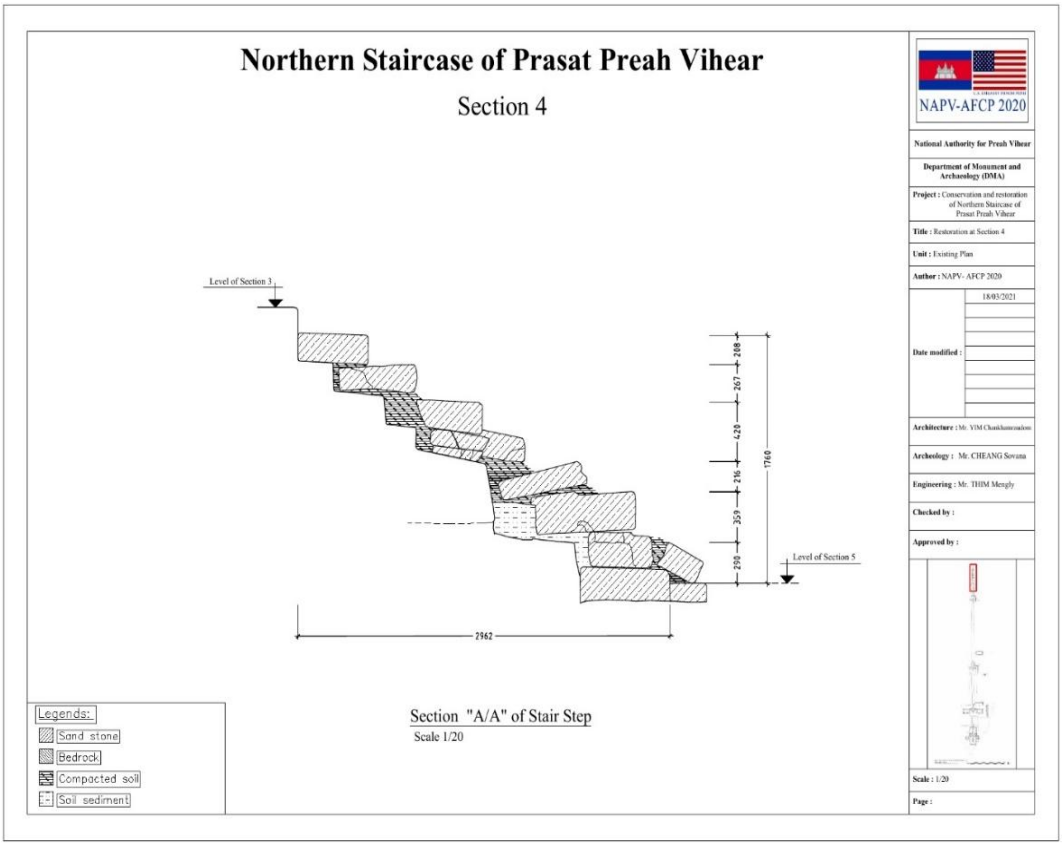


Figure 91: Profile of stair steps showing the arrangement of stone slabs at the foundation and steps at section 4



Figure 92: Carving new sandstone to replace broken stones at section 4



Figure 93: Recompacted foundation at section 4



Figure 94: Reassemble stone slabs of stair step to their original positions at section 2



Figure 95: Applied Lime mortar to prevent rainwater infiltration



Figure 96: Staircase foundation testing by applying Dynamic Cone Penetration Test (DCPT) before restoration



Figure 97: Staircase foundation testing after restoration by applying DCPT

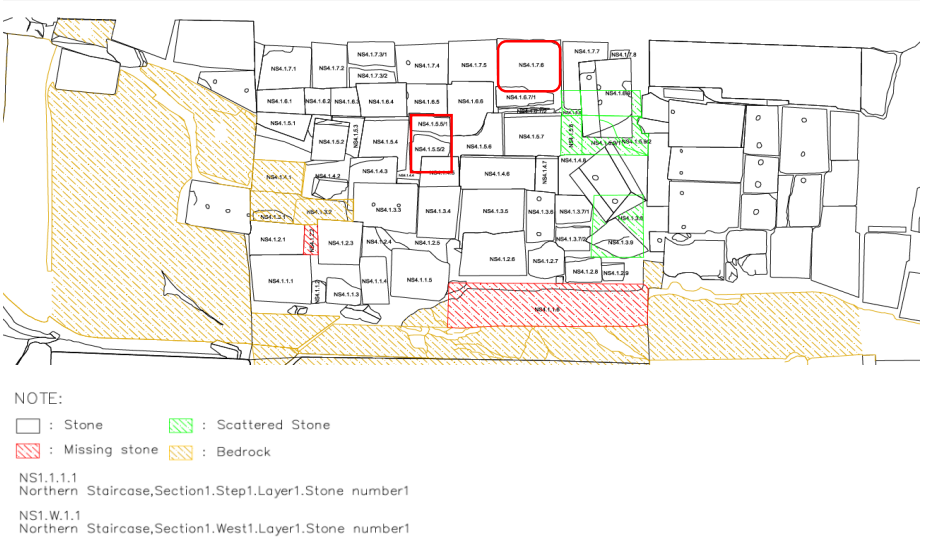


Figure 98: Plan showing location where DCPT is conducted



Figure 99: Photo showing location where DCPT is conducted

Re-Assembling of Stone blocks Staircase at section4 by Fiberglass Dowel					
No	**Code of Stone Block**	**Type**	**Diameter of dowel(mm)**	**Number of dowel**	**length of dowel (cm)**
1	NS4.1.5.6	Sandstone	10 mm	2	19cm
2	NS4.1.5.5	Sandstone	10 mm	2	19 Cm
3	NS4.1.5.9	Sandstone	12 mm	2	19 Cm
4	NS5.1.1.5	Sandstone	16 mm	2	20 cm
5	NS4.	Sandstone	12 mm	2	23 cm
Stone blocks Staircase'East wall at section4					
1	NS4.E.1.7	Sandstone	16 mm	2	20 Cm
2	NS4.E.19	Sandstone	16 mm	2	18 Cm
3	Unknown	Sandstone	12 mm	2	18 Cm

Figure 100: List of stones conducted treatment



Figure 101: The general view at section 4 before restoration



Figure 102: The general view at section 4 after restoration

Photos showing staircase condition at section 3 before and after restoration



Figure 103: The cracking bedrock



Figure 104: Dismantling stone blocks at the eastern stair wall of section 3



Figure 105: Securing cracking bedrock by drilling dowels hole to put fiberglass dowel with glue



Figure 106: The general condition of section 3 (top view) before restoration



Figure 107: The general condition of staircase section 3 (top view) after restoration

Photos showing condition of section 2 before restoration and restoration activities

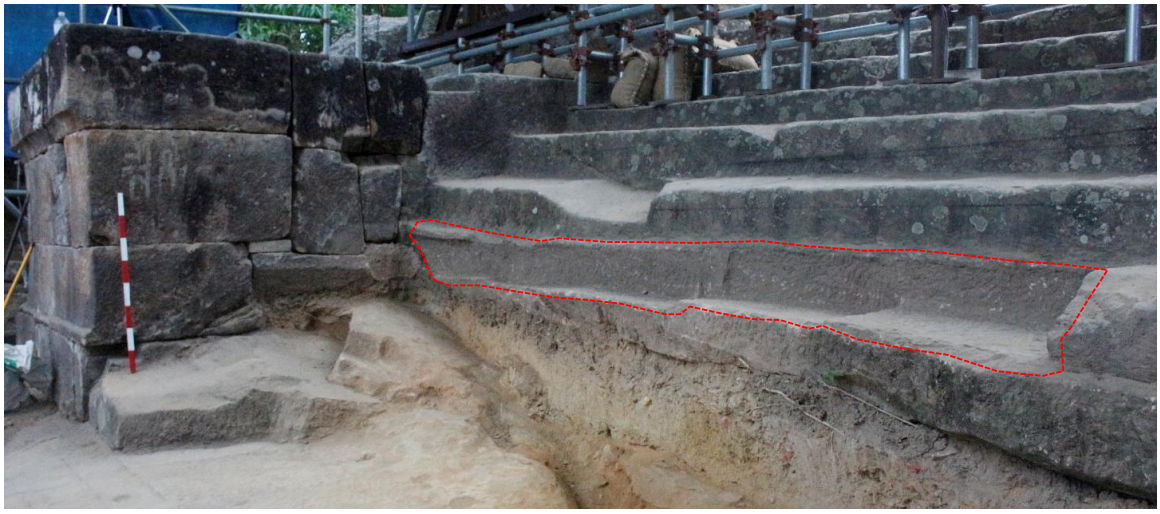


Figure 108: Red line shows connection technique of stone slabs with bedrock (carving bedrock to insert stone slab

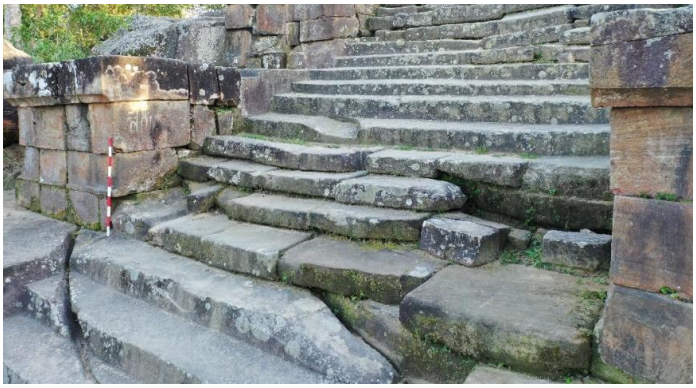


Figure 109: Current condition of stair steps before restoration



Figure 110: Movement of stone blocks at the eastern stair wall at section 2



Figure 111: Dismantle stone blocks at section 2 in the west



Figure 112: Remove soil, tree roots and debris at section 2 in the west

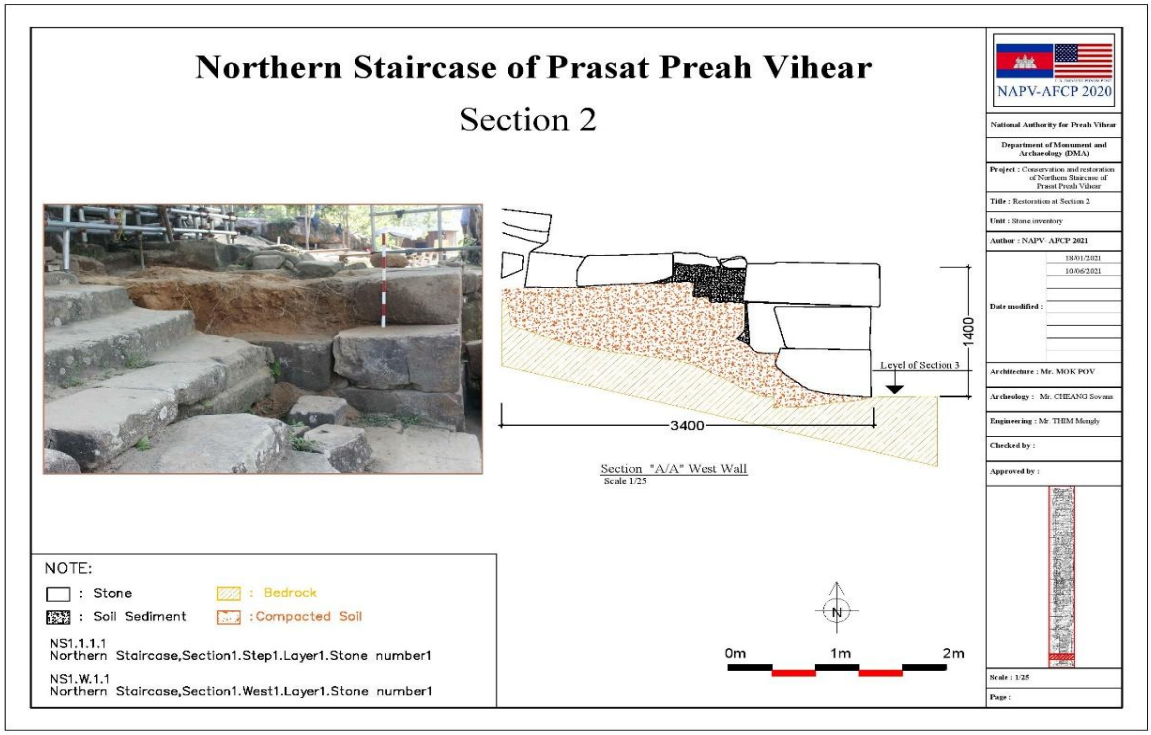


Figure 113: Cross section plan at section 2 in the west (East view)



Figure 114: Photo at left hand shows cross section of stair wall foundation in the west with original compacted soil, and photo at right hand shows bedrock after soil was removed.

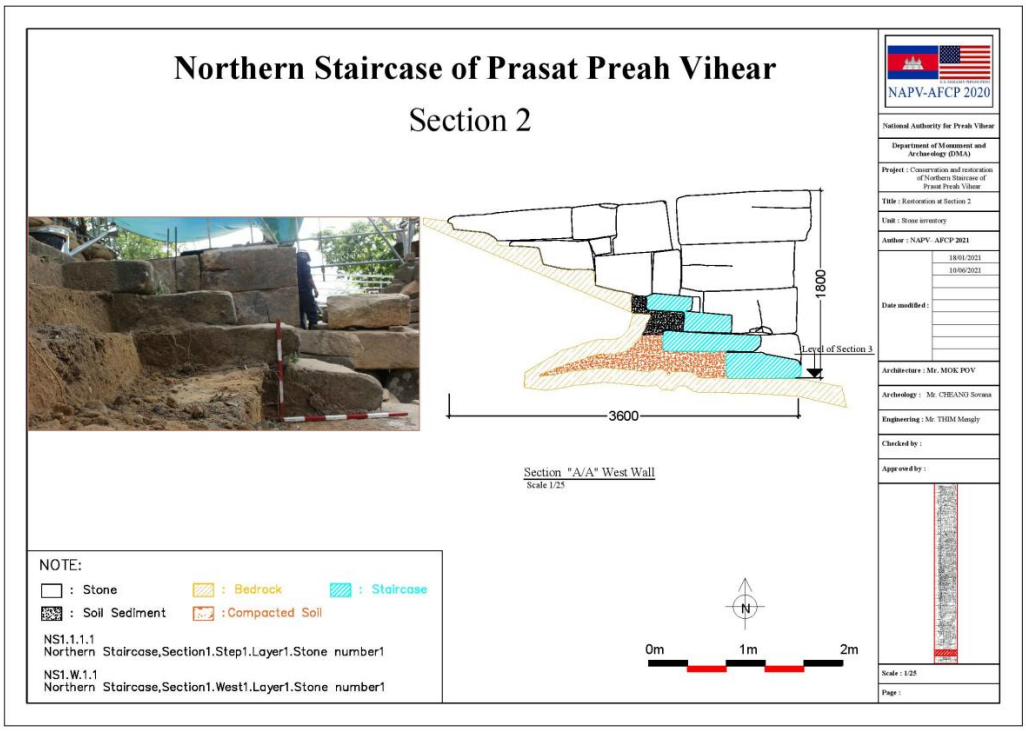


Figure 115: Cross section at axis of stair step at section 2 showing the construction technique

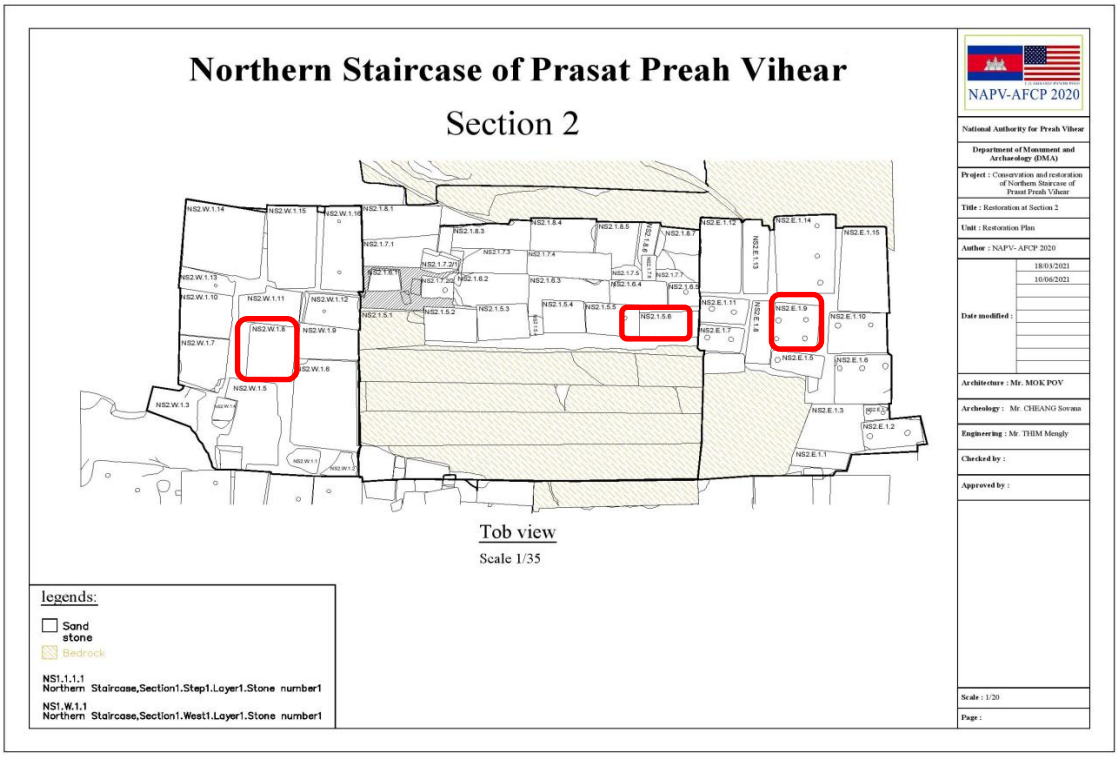


Figure 116: Red boxes show locations where DCP test were conducted at section 2



Figure 117: Apply DCPT cone tip to test foundation-bearing capacity on stair step before removal of original soil



Figure 118: Apply DCPT cone tip to test foundation-bearing capacity on stair step after foundation is recompacted with new mixture



Figure 119: Reconnect broken stone slabs by drilling hole to insert Fiberglass and injecting Epoxy Sikadur resin 752 TH



Figure 120: Restoration of stair steps at section 2





Conservation and treatment stone list at section 2 of Northern Staircase of Preah Vihear Phase II

No	Code	Type	Typology	Risk	Condition	Restoration	Fiberglass Dowell	Others
1	NS2.W.3.2	Sandstone	West Wall	Meduim	Cracking	Drilling holl to put fiberglass dowell with Epoxy Sikadur Resin 752 TH	Φ 16mm=39cm Φ 16mm=39cm	
2	NS2.W.2.9	Sandstone	West Wall	Meduim	Cracking	Drilling holl to put fiberglass dowell with Epoxy Sikadur Resin 752 TH	Φ 8mm=24cm Φ 8mm=25cm Φ 8mm=25cm Φ 8mm=25cm	
3	NS2.W.1.7	Sandstone	West Wall	Meduim	Cracking	Drilling holl to put fiberglass dowell with Epoxy Sikadur Resin 752 TH	Φ 8mm=13.50cm Φ 8mm=13.50cm	
4	NS2.E.2.8	Sandstone	East Wall	Meduim	Cracking	Drilling holl to put fiberglass dowell with Epoxy Sikadur Resin 752 TH	Φ 8mm=18cm Φ 8mm=20cm Φ 8mm=20cm	
5	NS2.E.1.5	Sandstone	East Wall	Meduim	Cracking	Drilling holl to put fiberglass dowell with Epoxy Sikadur Resin 752 TH	Φ 8mm=14cm Φ 8mm=18cm Φ 8mm=18cm	
6	NS2.1.7.1	Sandstone	Step	Meduim	BreakOut	Drilling holl to put fiberglass dowell with Epoxy Sikadur Resin 752 TH	Φ 14mm=19cm Φ 14mm=19cm	
7	NS2.W.2.11	Sandstone	West Wall	Meduim	Cracking	Drilling holl to put fiberglass dowell with Epoxy Sikadur Resin 752 TH	Φ 8mm=23.50cm Φ 8mm=23.50cm Φ 8mm=23.50cm	
8	NS2.W.1.16	Sandstone	West Wall	Meduim	Cracking	Drilling holl to put fiberglass dowell with Epoxy Sikadur Resin 752 TH	Φ 14mm=22cm Φ 14mm=21cm	
9	NS2.E.1.14	Sandstone	East Wall	Meduim	Cracking	Drilling holl to put fiberglass dowell with Epoxy Sikadur Resin 752 TH	Φ 16mm=24.50cm Φ 16mm=23.50cm	
10	NS2.1.3.1	Bedrock	Step	Meduim	Cracking	Drilling holl to put fiberglass dowell with Epoxy Sikadur Resin 752 TH	Φ 14mm=20cm Φ 10mm=19cm	
11	NS2.1..7.7	Bedrock	Step	Meduim	Cracking	Drilling holl to put fiberglass dowell with Epoxy Sikadur Resin 752 TH	Φ 16mm=24cm Φ 16mm=24cm	
12	NS2.1.5.6	Sandstone	Step	Meduim	Cracking	Drilling holl to put fiberglass dowell with Epoxy Sikadur Resin 752 TH	Φ 8mm=10cm Φ 8mm=10cm	

Figure 121: List of stone slabs, stone blocks and bedrock being carried out treatment



Figure 122: General condition of staircase at section 2 (top view) before restoration



Figure 123: General condition of staircase at section 2 (top view) after restoration

General condition in picture and plan survey at section 4 before and after restoration

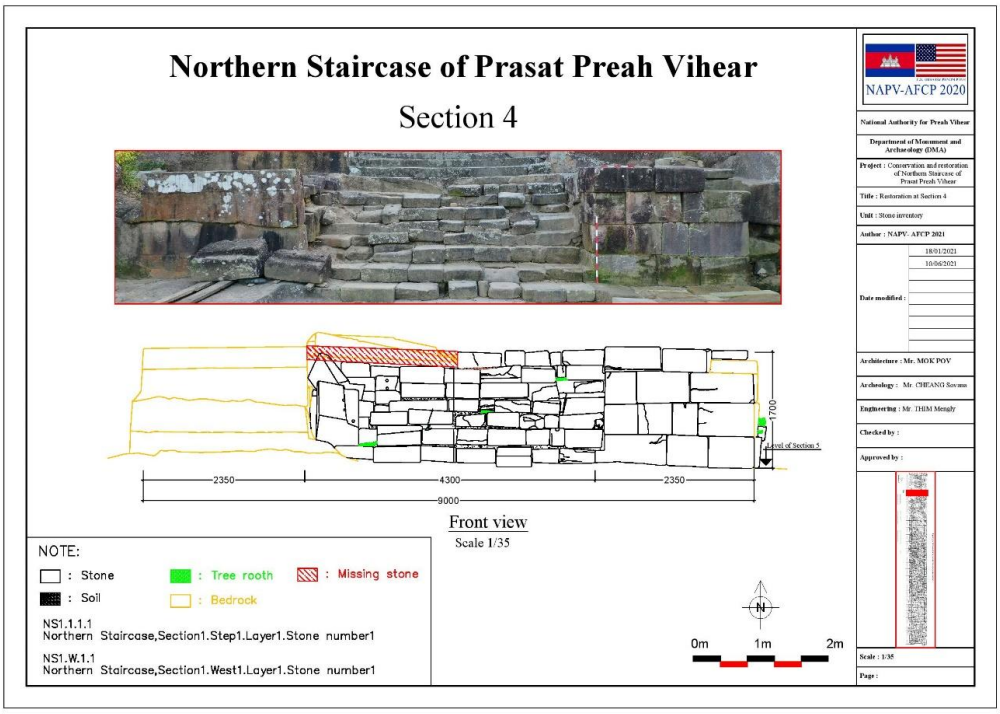


Figure 124: Risk analysis of staircase at section 4 before restoration (front view)

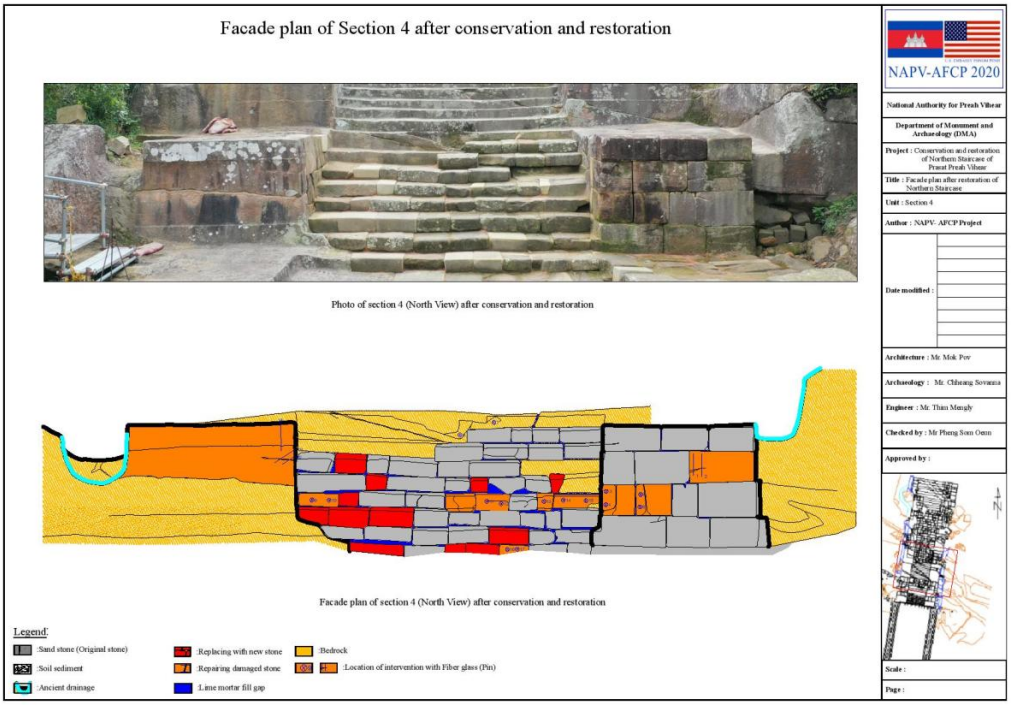


Figure 125: Risk analysis of staircase at section 4 after restoration (front view)

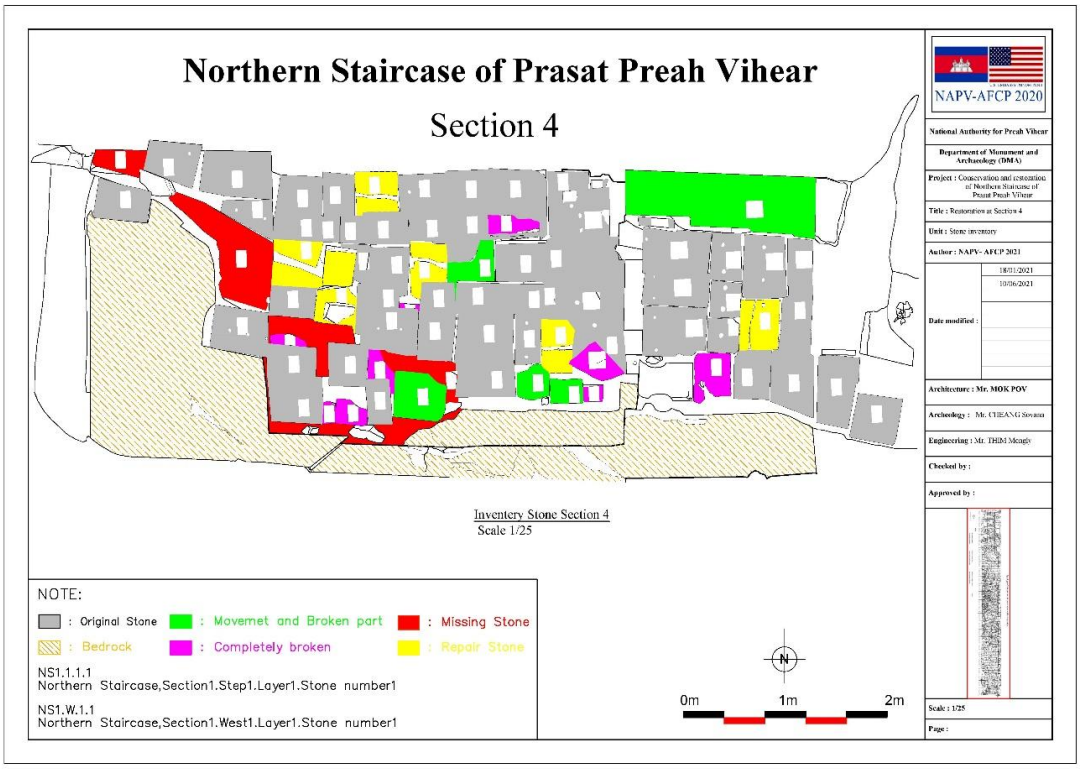


Figure126: Risk analysis of staircase at section 4 before restoration (top view)

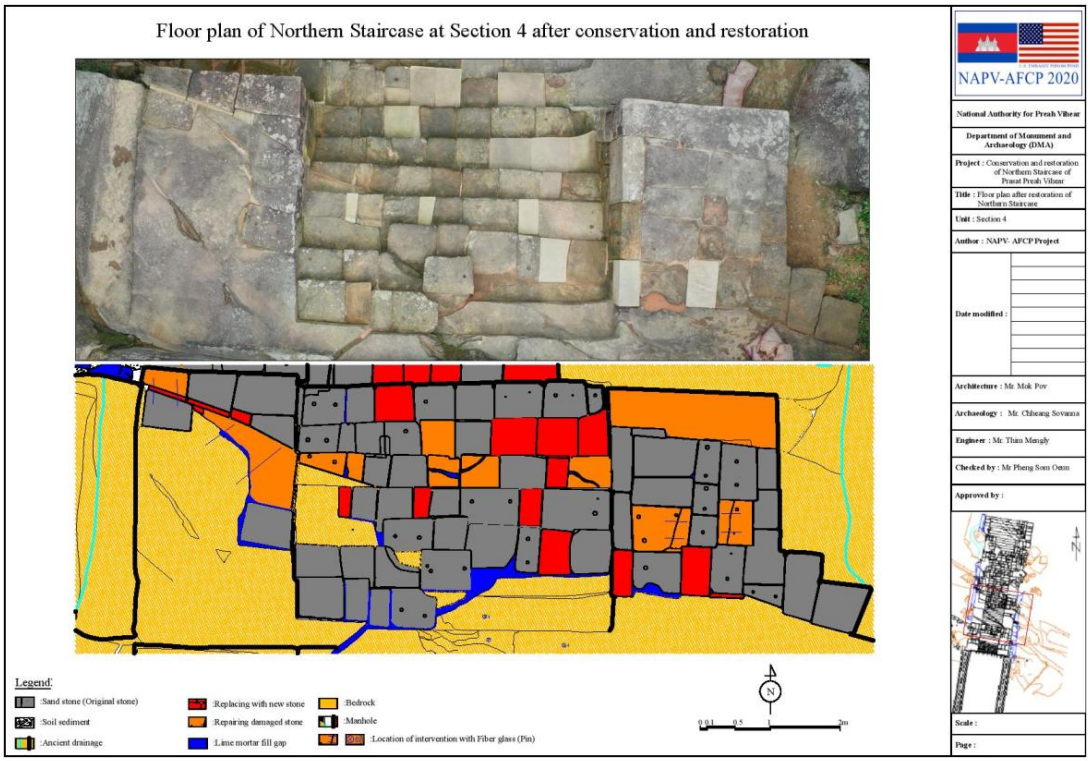


Figure 127: Risk analysis of staircase at section 4 before restoration (top view)

General condition in picture and plan survey of section 3 before and after restoration

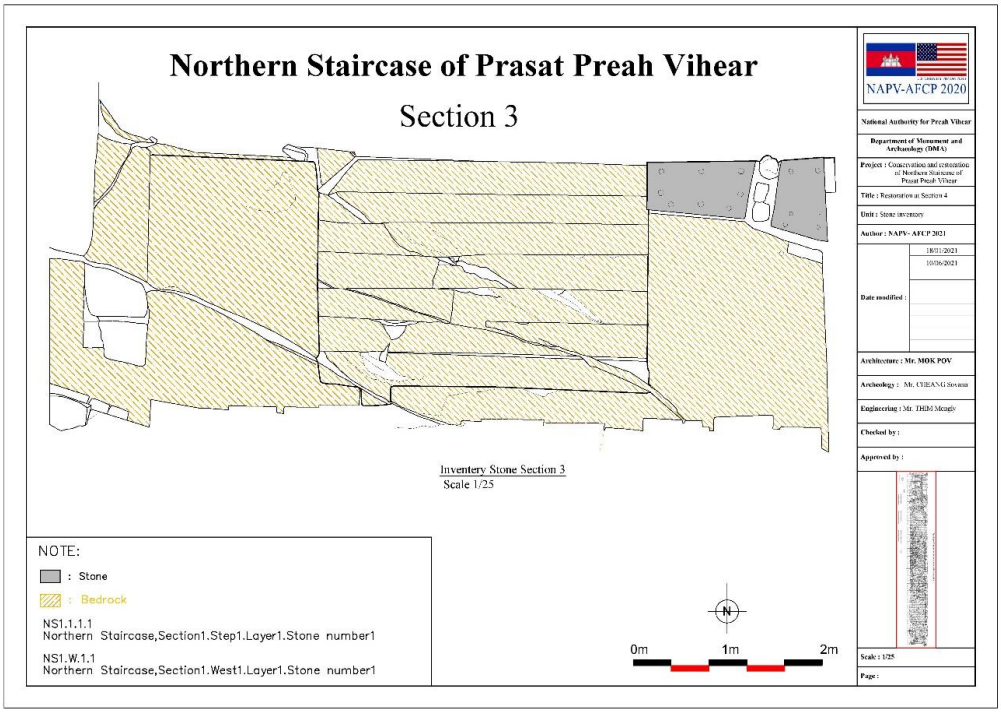


Figure 128: Plan showing general condition of staircase at section 3 before restoration (top view)



Figure 129: Plan showing general condition of staircase at section 3 after restoration (top view)

General condition in picture and plan survey at section 2 before and after restoration

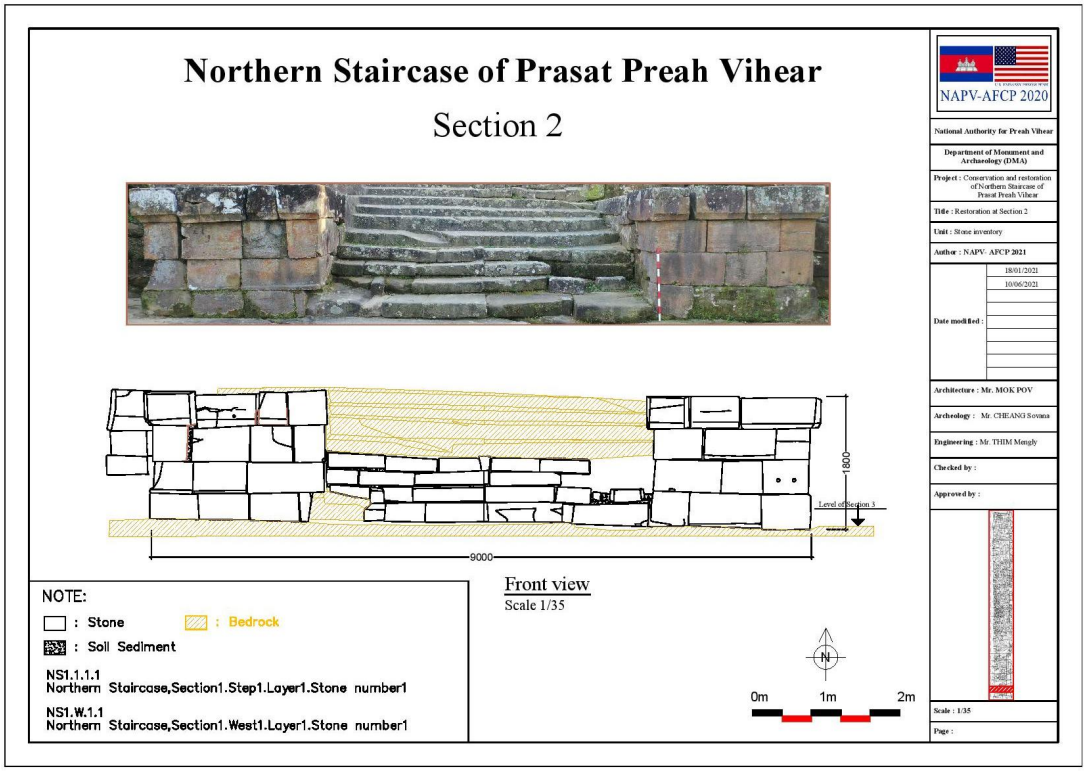


Figure 130: Plan showing overall condition at section 2 before restoration (front view)

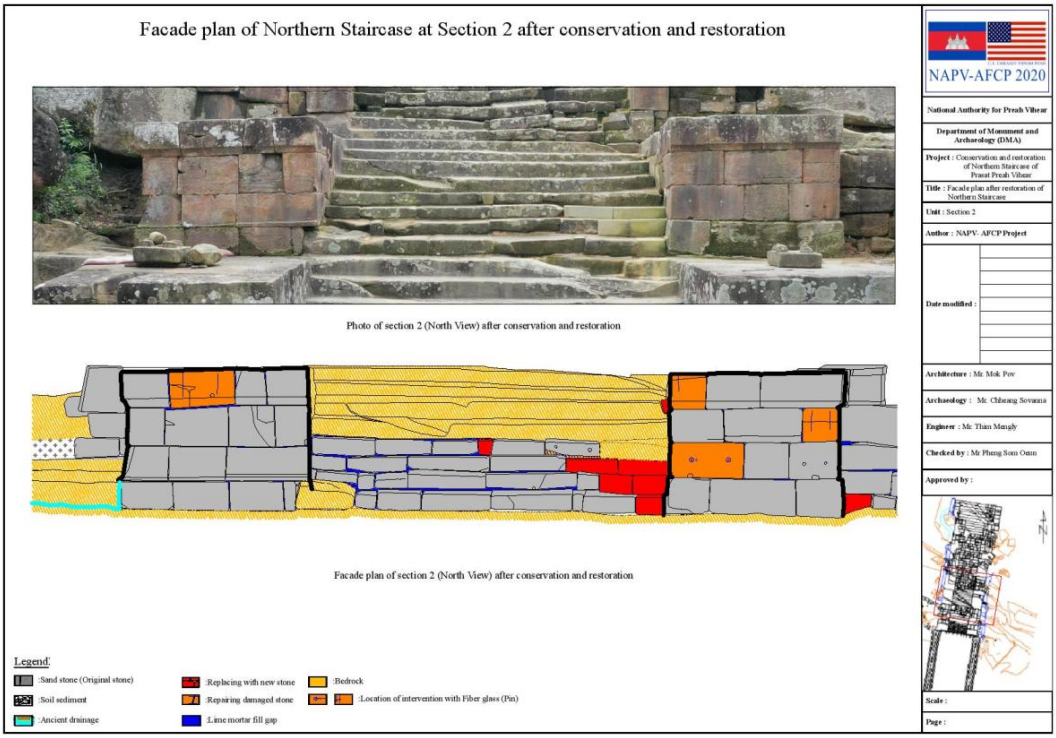


Figure 131: Plan showing overall condition at section 2 after restoration (front view)

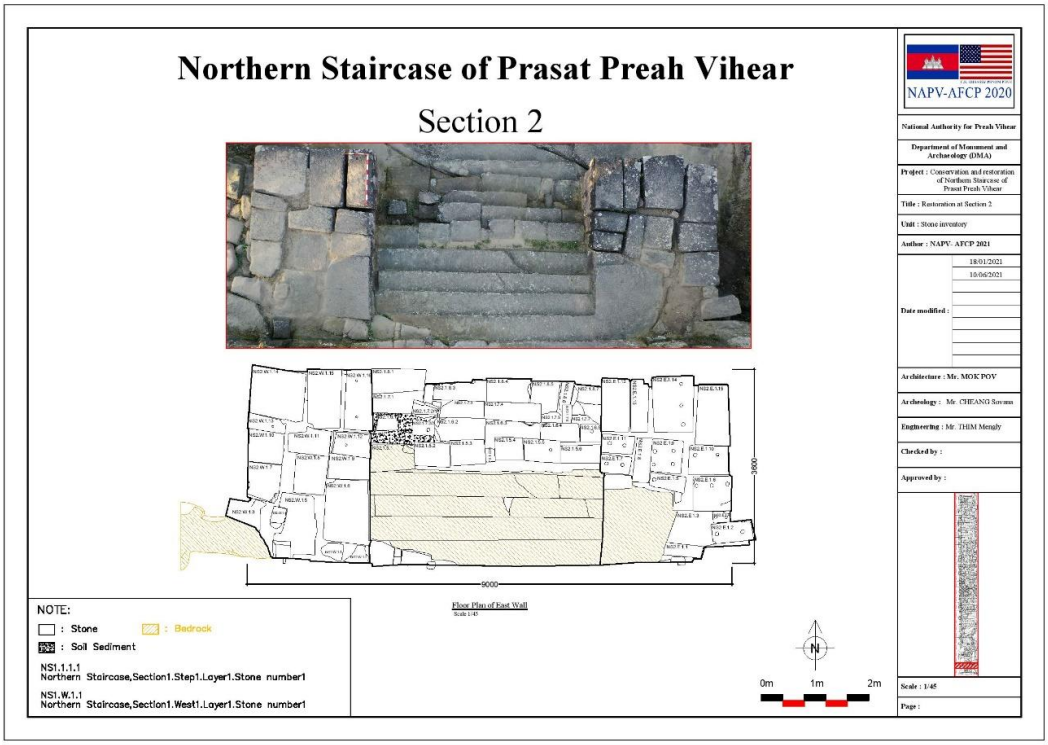


Figure 132: Plan showing overall condition at section 2 before restoration (top view)

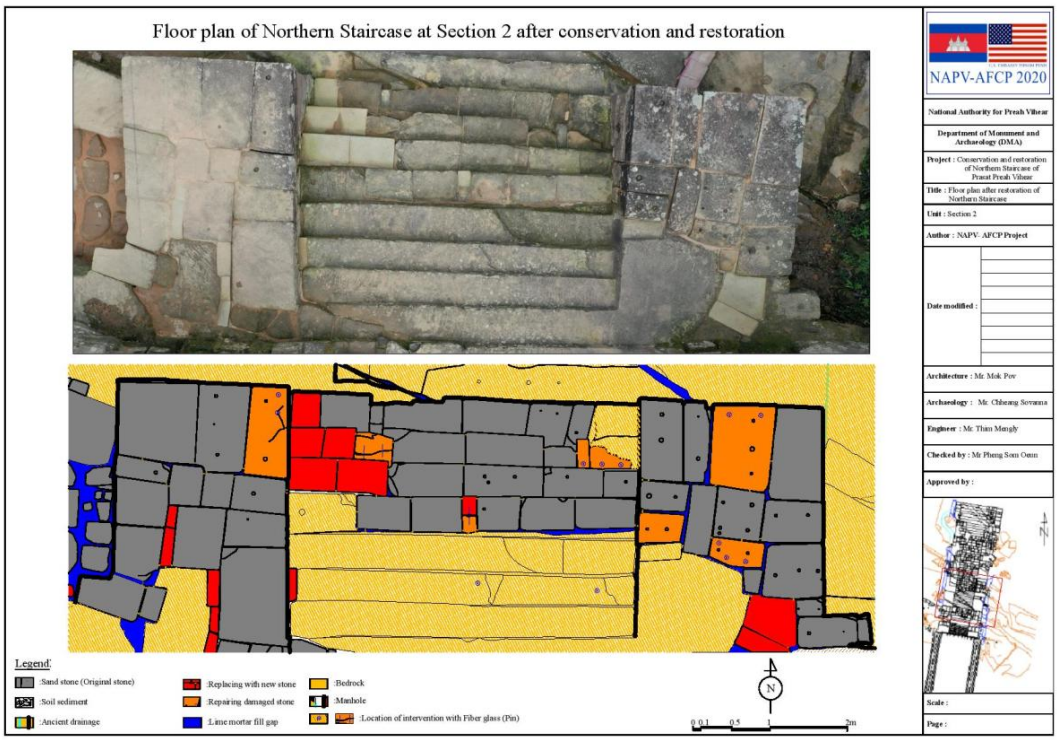


Figure 133: Plan showing overall condition at section 2 after restoration (top view)



Figure 134: General condition of staircase at sections 2-4 before restoration (north view)



Figure 135: General condition of staircase at sections 2-4 after restoration (north view)

Restoration of the Western Causeway

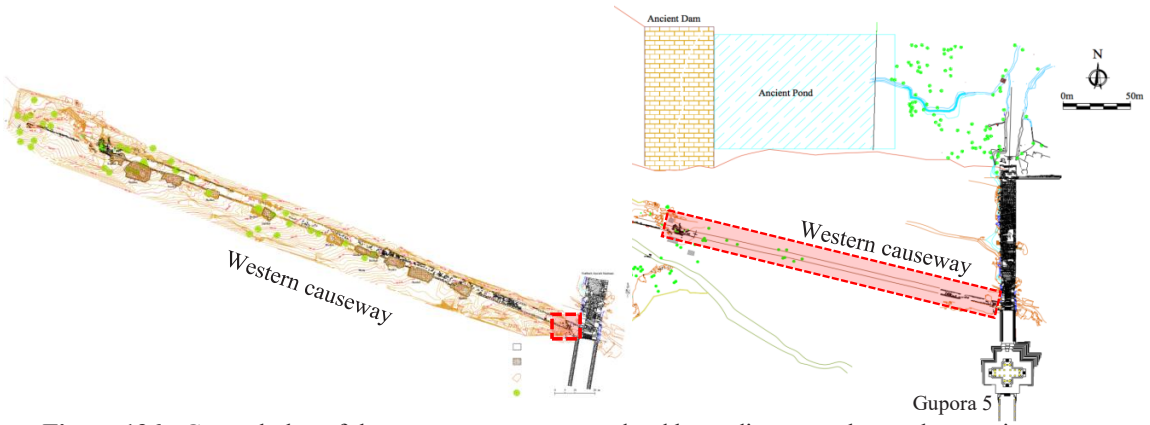


Figure 136: General plan of the western causeway, and red box adjacent to the northern staircase at section 2 indicating conservation and restoration location



Figure 137: General condition of western causeway (west view)



Figure 138: General condition of western causeway after tree was removed (top view)



Figure 139: The general condition of northern elevation of the western causeway before restoration





Figure 140: Tree root penetrating to the structure of the northern elevation of the western causeway led to settlement and movement of stone blocks.

General architectural plan of the western causeway before restoration

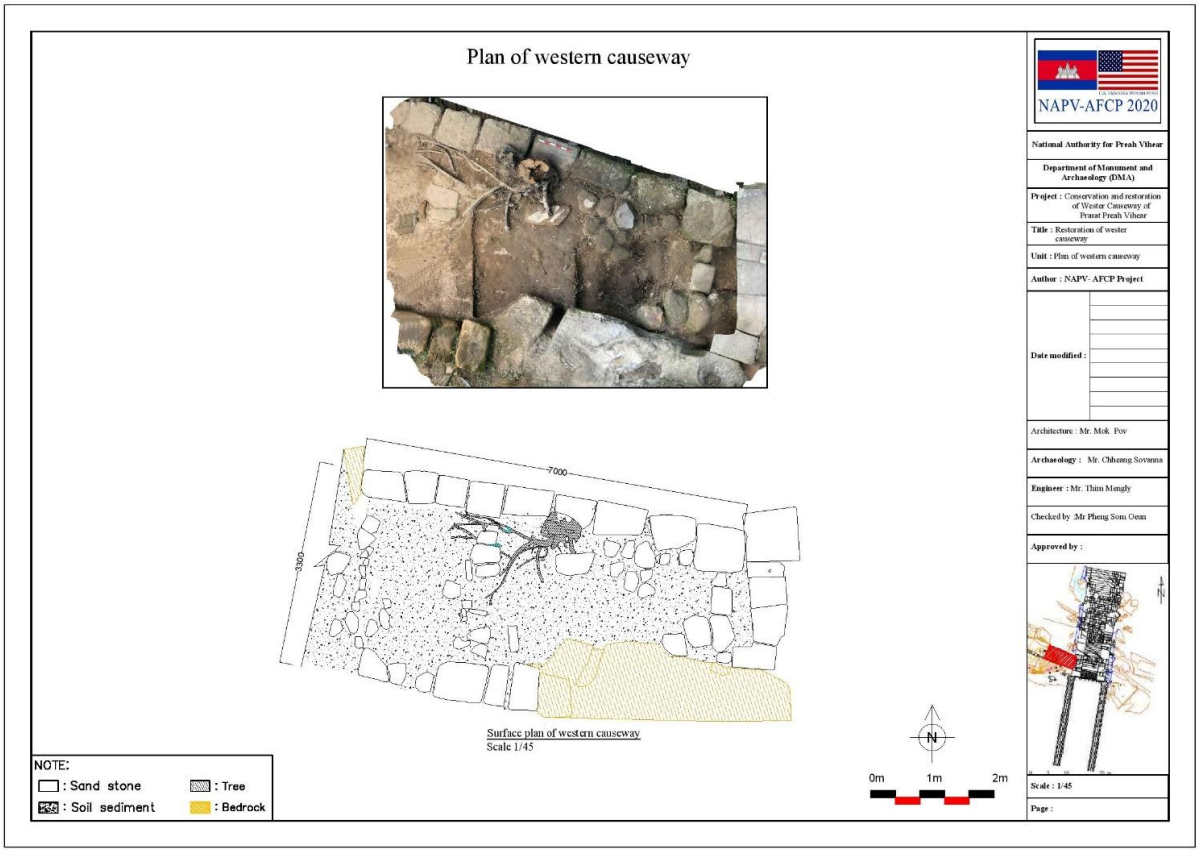


Figure 141: Existing plan of 9 m long section, western causeway, before intervention was taken place

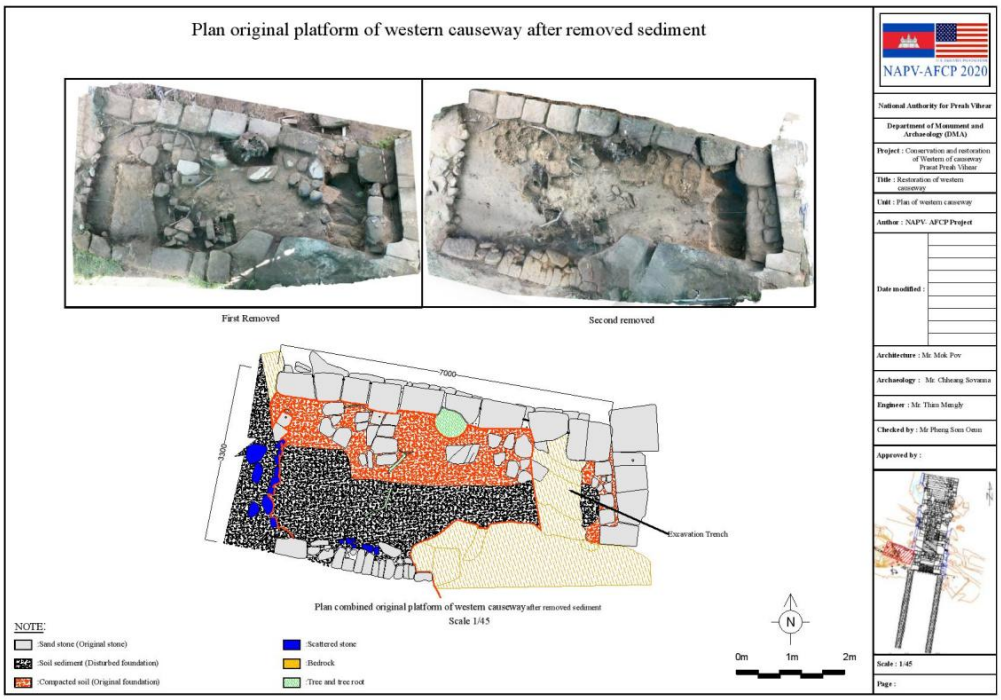


Figure 142: Existing plan of the 9 m long section (top view), western causeway, after top soil that was refilled during the civil war was removed

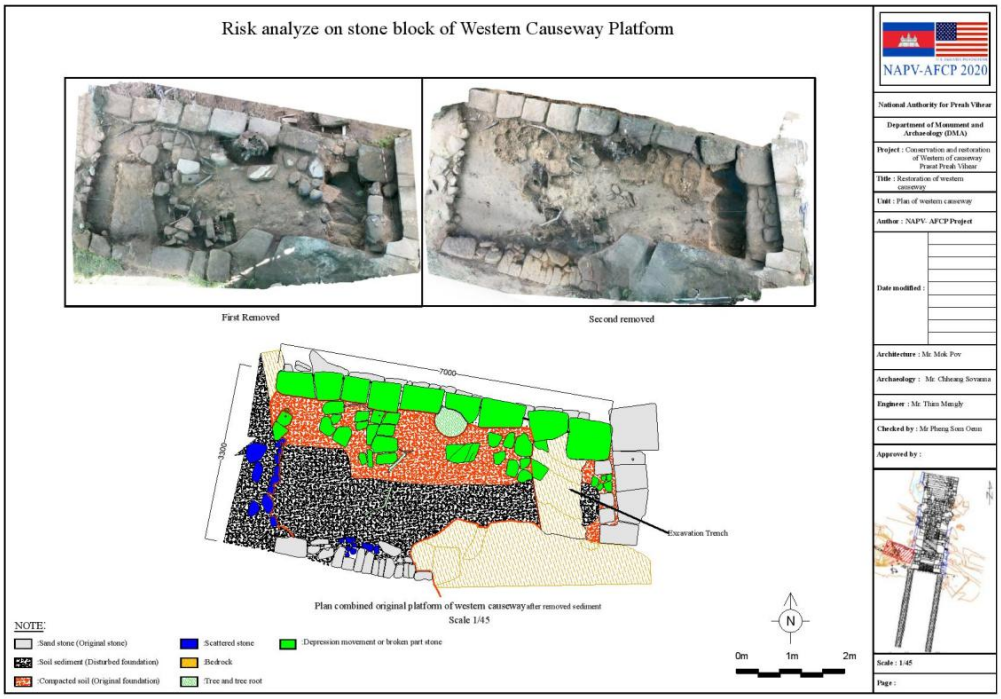


Figure 143: Risk analysis of the causeway after top soil was removed.

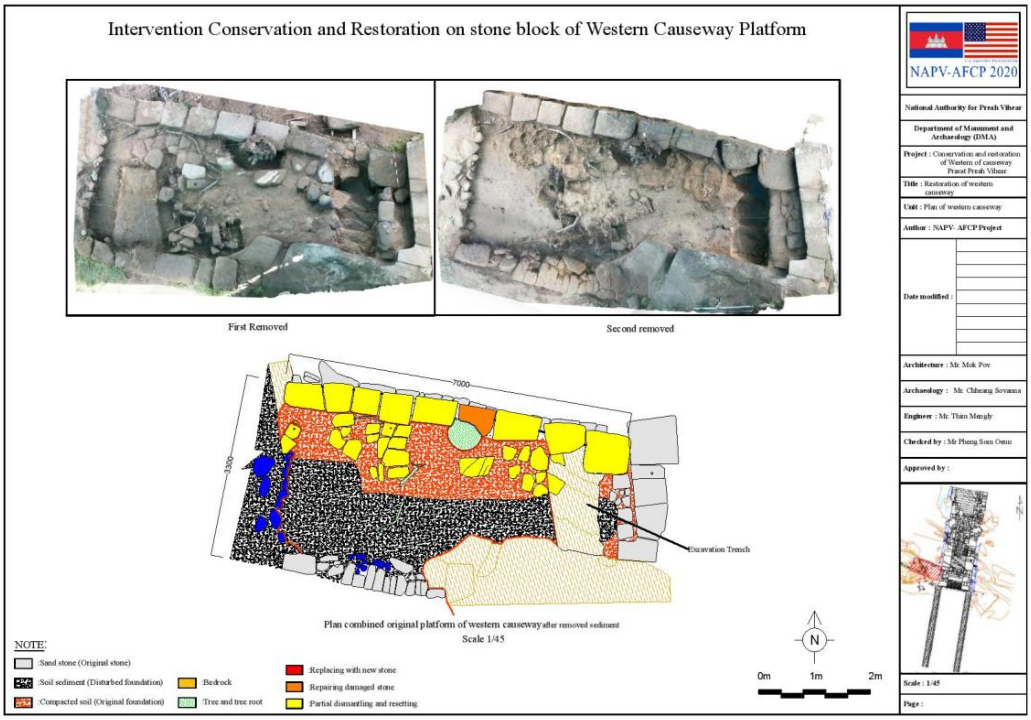


Figure 144: Typology of intervention for conservation and restoration of the causeway

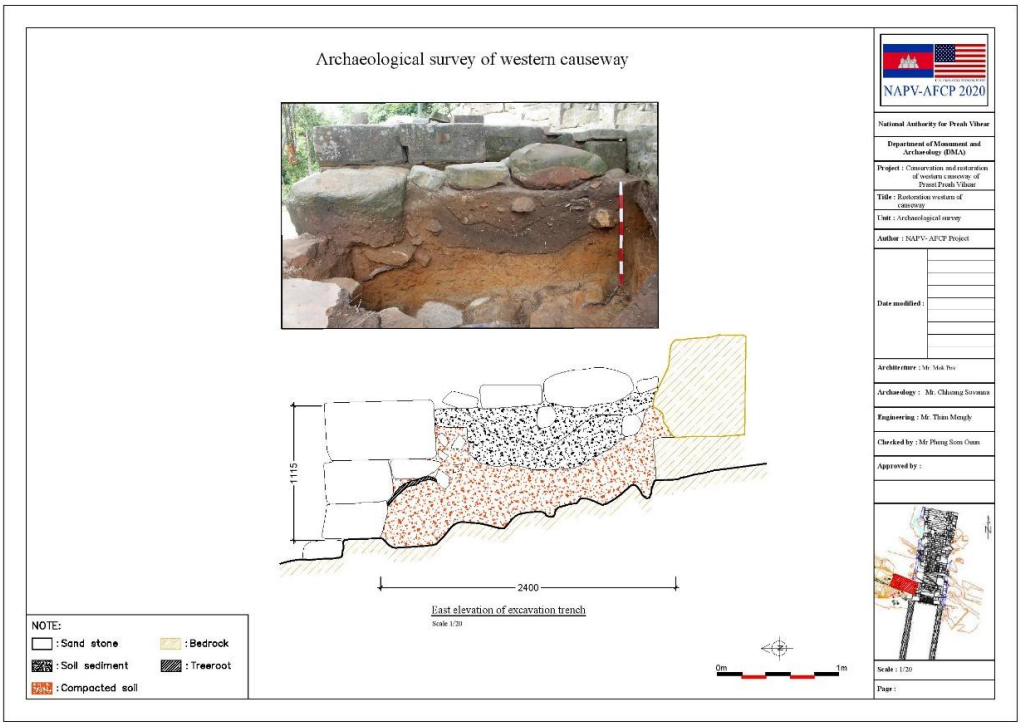


Figure 145: Cross section of the causeway (west view) - it is close to western stair wall at section 2 of the northern staircase.

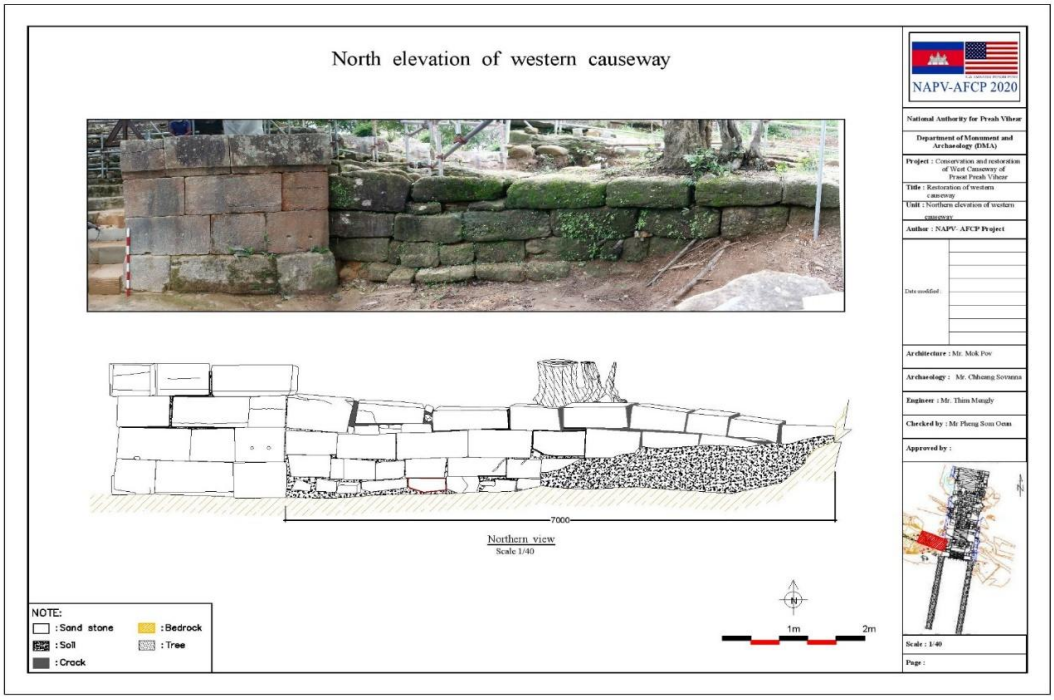


Figure 146: Existing elevation plan of the northern wall structure (north view) before sediment was removed.

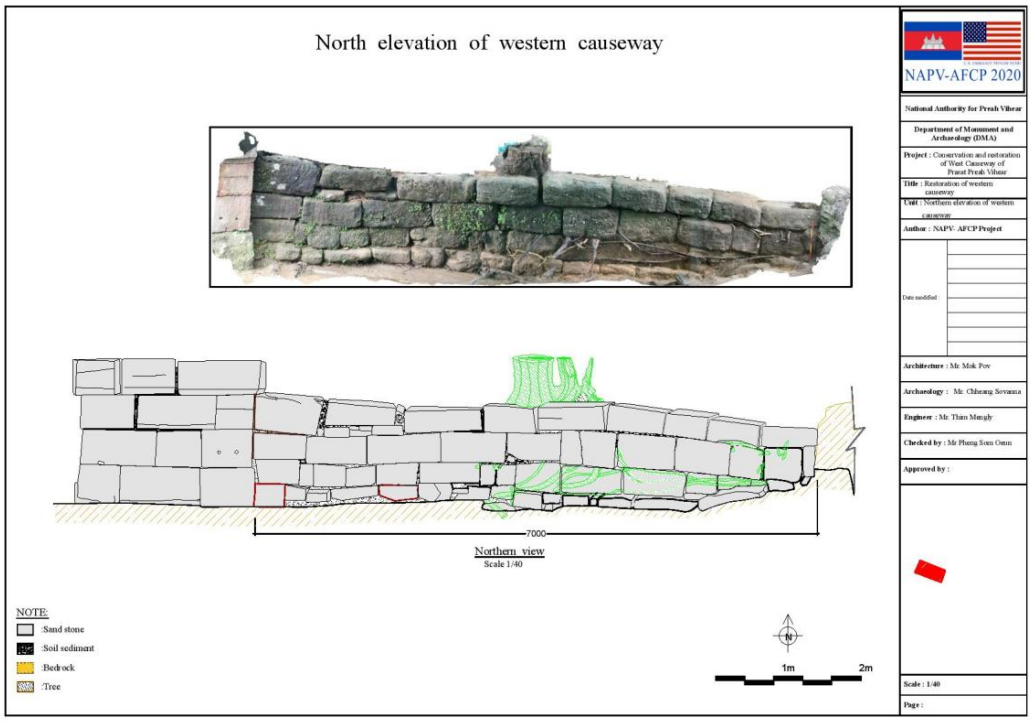


Figure 147: The existing elevation plan of the northern wall structure after sediment was removed

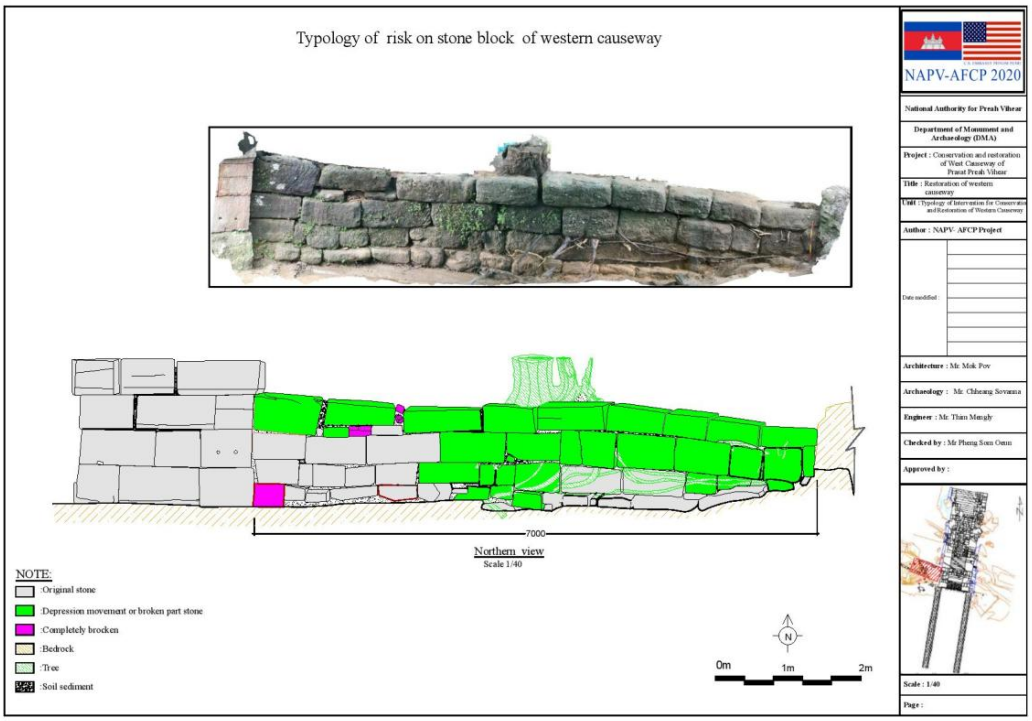


Figure 148: Risk analysis of the northern wall structure

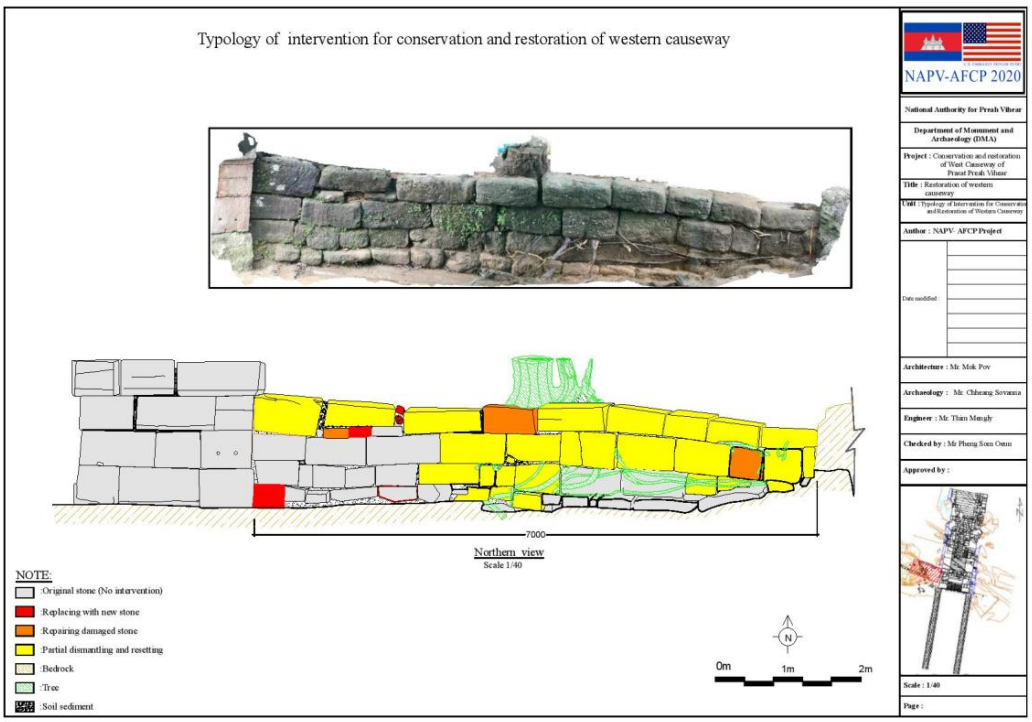


Figure 149: Typology of intervention for conservation and restoration plan

Restoration activities at the 9 m long section of the western causeway



Figure 150: The activities involved in removing a tree (left), excavating soil/sediment and removing tree roots (middle), and dismantling stone blocks (right)

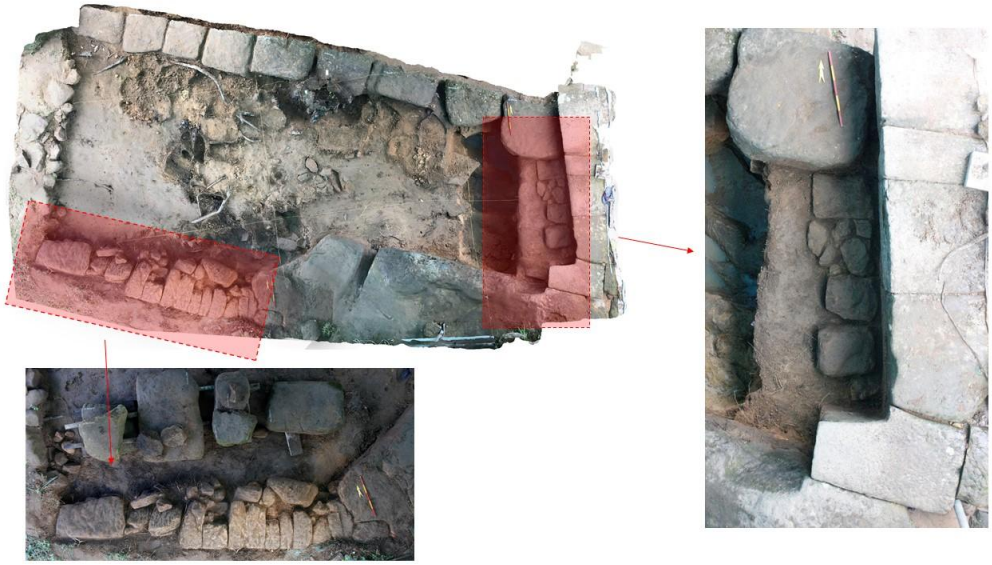


Figure 151: The southern original causeway wall (Photo at the below left side) and original platform at right side were found after deposited soil was removed.





Figure 152: Two layers of Geotextile were applied on the foundation with a total size of 8.8 m^2 and 1 cm thick in order to prevent from erosion of the foundation



Figure 153: Stone blocks were reassembled to original position and recompact foundation



Figure 154: Stone slabs were reassembled at their original positions



Figure 155: Lime mortar was applied at joint of each layer in order to prevent interior part of the foundation from water infiltration

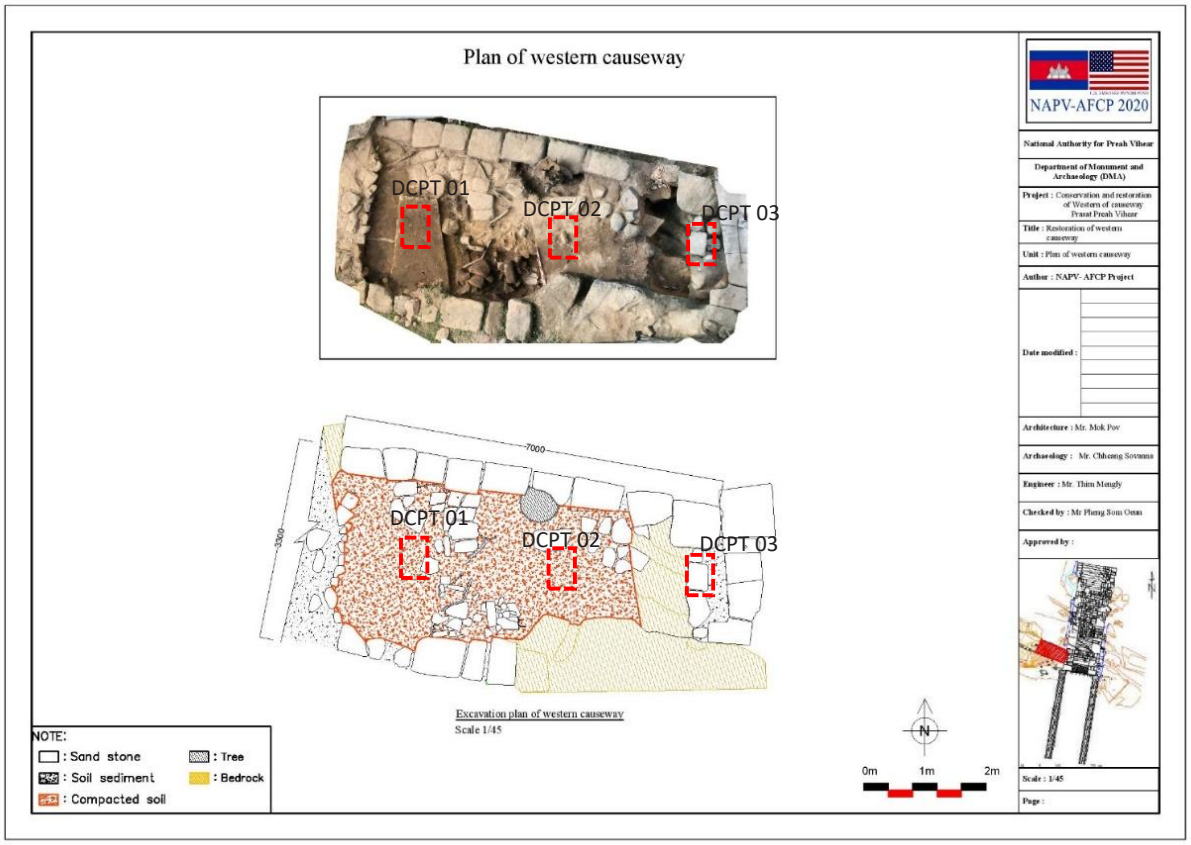


Figure 156: Red boxes are location where DCPT was undertaken on the foundation of the causeway



Figure 157: The left hand side is undertaken DCPT of foundation before soil compaction and the right hand side is undertaken DCPT after soil compaction (location DCPT-03)



Figure 158: Profile of the foundation near DCPT shows different soil layers. It divides in three layers - top and second layer have light brown soil being filled by human, and third layer is original foundation

The western causeway after restoration

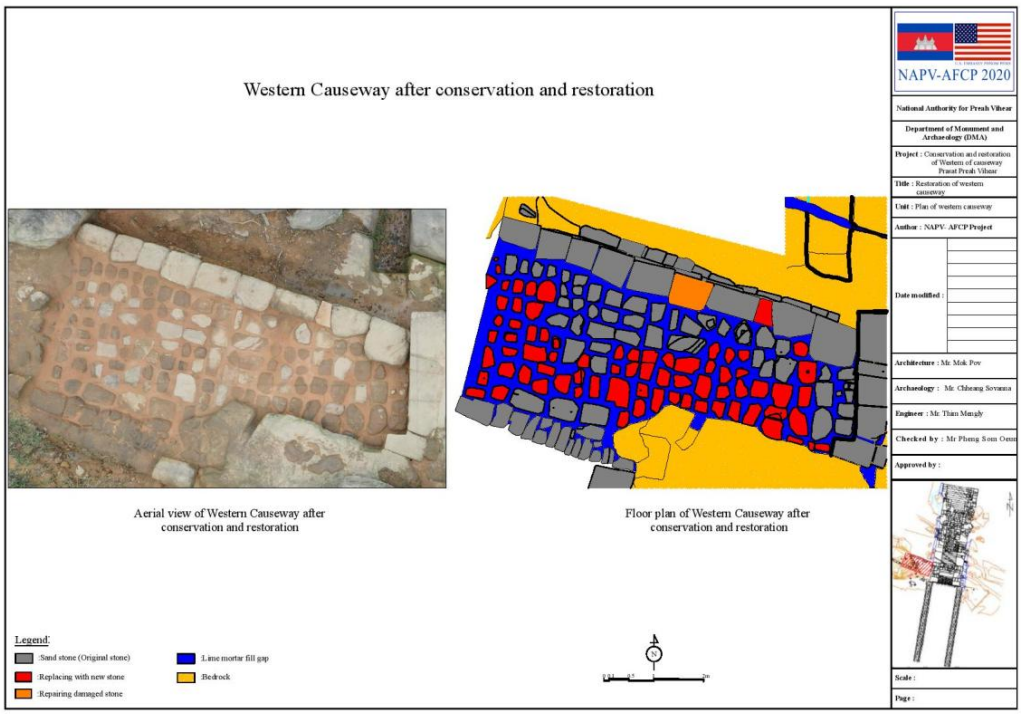


Figure 159: Photo at left shows general condition of the 9 m long section after restoration and the right side shows restoration technique (top view)

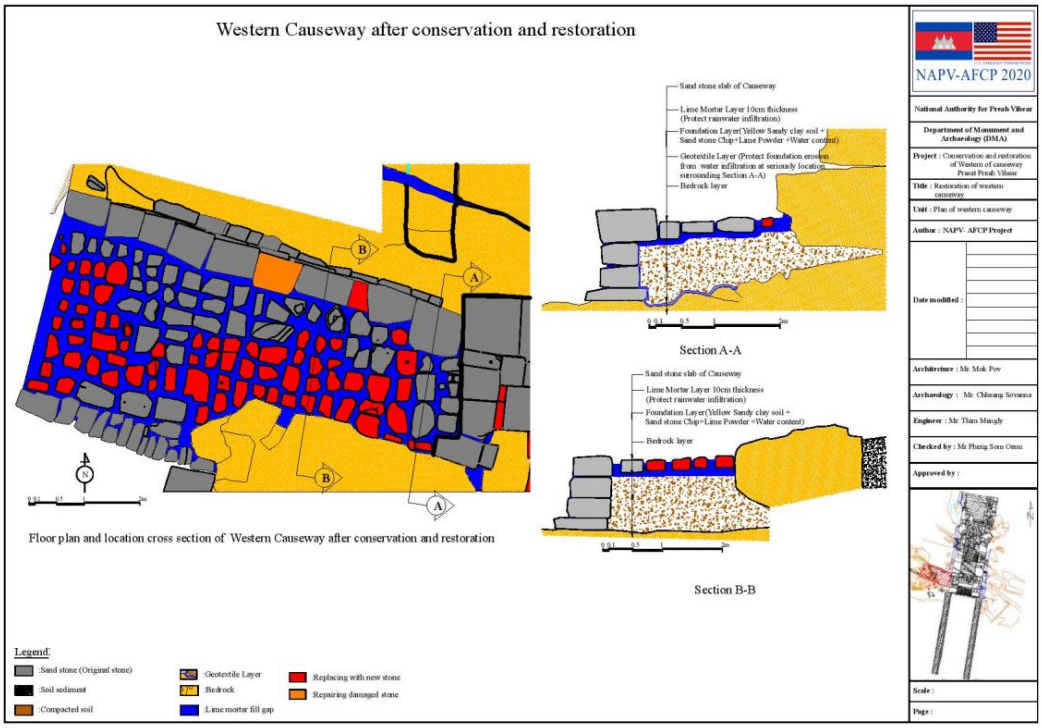


Figure 160: Detail plan describes about restoration technique

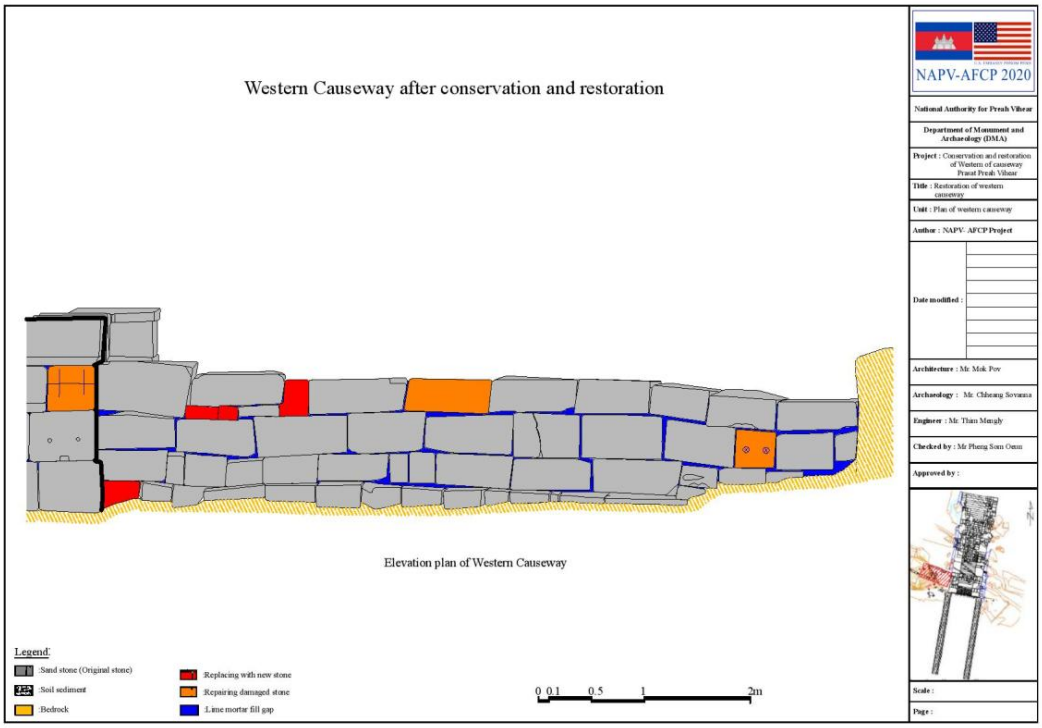


Figure 161: Plan shows condition of the northern wall structure after restoration



Figure 162: Comparison of the 9 m long section of the causeway before restoration (left) and after restoration (right)



Figure 163: Overall view from the west of the causeway after restoration

2- DATA OF DCP TEST

Foundation test section 4(DCPT)

តារាងទិន្នន័យពិសោធន៍សម្រុតកោនទីណាមិក (Dynamic Cone Penetration Test-DCPT)

គម្រោង: អភិរក្ស និងជួសជុលជណ្តើរបុរាណខាងជើងនៃប្រាសាទព្រះវិហារ
ទីតាំងពិសោធន៍: ថ្នាក់ទី៤ (គ្រឹះក្រោមថ្មកាំជណ្តើរលេខកូដ NS4.1.5.5)
ជម្រៅចំនុចសូន្យនៅក្រោមផ្ទៃ: 0.00m
កាលបរិច្ឆេទពិសោធន៍: 16/02/2021

ចំនួនដងនៃការទម្លាក់ញញួរ Number of Blow	កំណើនសម្រុត (mm) Cumulative Penetration (mm)	ប្រវែងសម្រុត(mm) Penetration Between Readings(mm)	សម្រុតតាមការទម្លាក់ញញួរ (mm) Pernetration per Blow (mm)	មេគុណញញួរ Hammer Factor	សន្ទស្សន៍ DCP(mm/blow) DCP Index(mm/blow)	តម្លៃ CBR(%)
0	0	-	-	-	-	
5	161	161	32.2	1	32.2	6
5	273	112	22.4	1	22.4	9
5	358	85	17.0	1	17	12
5	468	110	22.0	1	22	9
5	591	123	24.6	1	24.6	8
5	718	127	25.4	1	25.4	8
5	838	120	24.0	1	24	8
5	929	91	18.2	1	18.2	11
5	951	22	4.4	1	4.4	56
5	991	40	8.0	1	8	28
5	1069	78	15.6	1	15.6	13
5	1174	105	21.0	1	21	10
5	1228	54	10.8	1	10.8	20
5	1255	27	5.4	1	5.4	44
5	1276	21	4.2	1	4.2	59
10	1315	39	3.9	1	3.9	64
10	1355	40	4.0	1	4	62
10	1396	41	4.1	1	4.1	60
10	1436	40	4.0	1	4	62
10	1483	47	4.7	1	4.7	52
10	1521	38	3.8	1	3.8	65
10	1561	40	4.0	1	4	62
10	1613	52	5.2	1	5.2	46
10	1660	47	4.7	1	4.7	52
10	1713	53	5.3	1	5.3	45
10	1747	34	3.4	1	3.4	74
10	1769	22	2.2	1	2.2	100
10	1800	31	3.1	1	3.1	82
10	1824	24	2.4	1	2.4	100
10	1855	31	3.1	1	3.1	82
10	1894	39	3.9	1	3.9	64
10	1924	30	3.0	1	3	85
10	1930	6	0.6	1	0.6	100
10	1951	21	2.1	1	2.1	100
10	1970	19	1.9	1	1.9	100
10	1989	19	1.9	1	1.9	100
10	2005	16	1.6	1	1.6	100
10	2018	13	1.3	1	1.3	100
10	2033	15	1.5	1	1.5	100

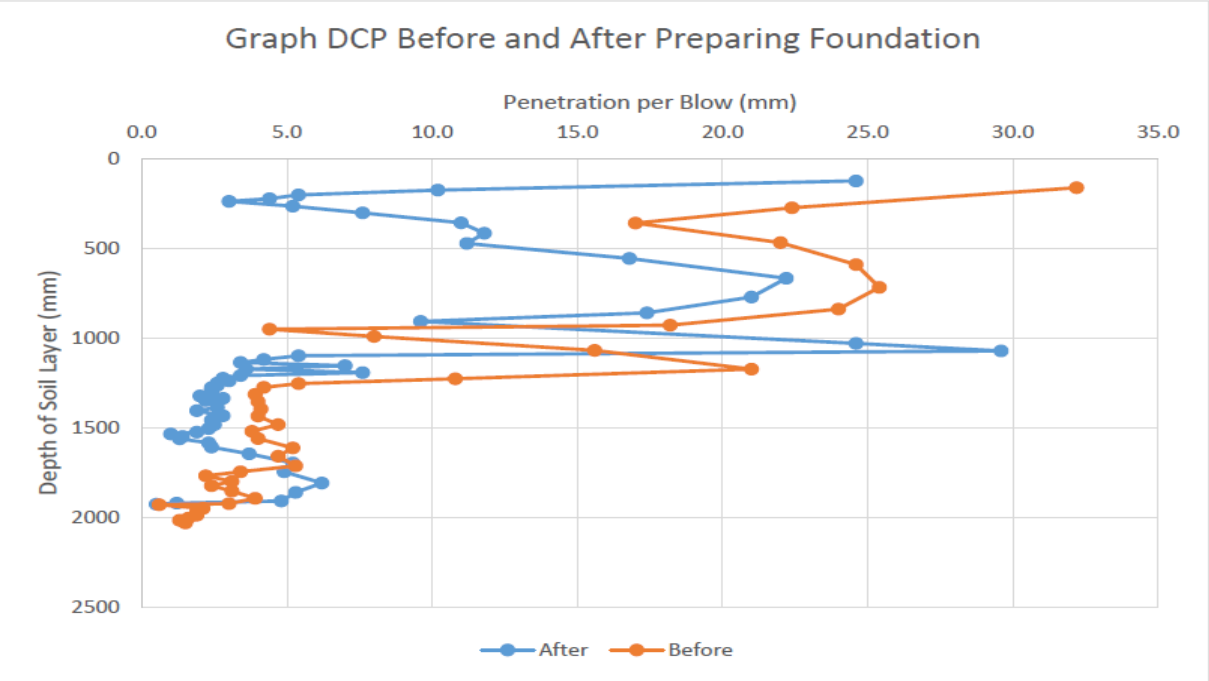
DCPT data before reinforcing staircase foundation NS4.1.5.5

តារាងទិន្នន័យពិសោធន៍សម្រុតកោនឌីណាមិក (Dynamic Cone Penetration Test-DCPT)

គម្រោង: អភិរក្ស និងជួសជុលជណ្តើរបុរាណខាងជើងនៃប្រាសាទព្រះវិហារ
ទីតាំងពិសោធន៍: ថ្នាក់ទី៤ (គ្រឹះក្រោមថ្មកាំជណ្តើរទីNS 4.1,5,5)
ជម្រៅចំនុចសូន្យនៅក្រោមផ្ទៃ: 0.00m
កាលបរិច្ឆេទពិសោធន៍: 17/03/2021

ចំនួនដងនៃការទម្លាក់ញញួរNumber of Blow	កំណើនសម្រុត (mm) Cumulative Penetration (mm)	ប្រវែងសម្រុត(mm) Penetration Between Readings(mm)	សម្រុតតាមការទម្លាក់ញញួរ (mm) Pernetration per Blow (mm)	មេគុណញញួរ Hammer Factor	សន្ទស្សន៍ DCP(mm/blow) DCP Index(mm/blow)	CBR(%)	តម្លៃ CBR(%)
0	0	-	-	-	-	-	
5	123	123	24.6	1	24.6	8	8
5	174	51	10.2	1	10.2	22	22
5	201	27	5.4	1	5	44	44
5	223	22	4.4	1	4.4	56	56
5	238	15	3.0	1	3	85	85
5	264	26	5.2	1	5.2	46	46
5	302	38	7.6	1	7.6	30	30
5	357	55	11.0	1	11	20	20
5	416	59	11.8	1	11.8	18	18
5	472	56	11.2	1	11.2	20	20
5	556	84	16.8	1	16.8	12	12
5	667	111	22.2	1	22.2	9	9
5	772	105	21.0	1	21	10	10
5	859	87	17.4	1	17.4	12	12
5	907	48	9.6	1	9.6	23	23
5	1030	123	24.6	1	24.6	8	8
5	1072	148	29.6	1	29.6	7	7
5	1099	27	5.4	1	5.4	44	44
5	1120	21	4.2	1	4.2	59	59
5	1137	17	3.4	1	3.4	74	74
5	1155	35	7.0	1	7	33	33
5	1173	18	3.6	1	3.6	70	70
5	1193	38	7.6	1	7.6	30	30
5	1210	17	3.4	1	3.4	74	74
5	1224	14	2.8	1	2.8	92	100
5	1239	15	3.0	1	3	85	82
5	1252	13	2.6	1	2.6	100	100
5	1265	13	2.6	1	2.6	100	100
5	1277	12	2.4	1	2.4	110	100
5	1289	12	2.4	1	2.4	110	100
5	1301	12	2.4	1	2.4	110	100
5	1313	12	2.4	1	2.4	110	100
5	1323	10	2.0	1	2	134	100
5	1337	14	2.8	1	2.8	92	92
5	1348	11	2.2	1	2.2	121	100
5	1361	13	2.6	1	2.6	100	100
10	1387	26	2.6	1	2.6	100	100
10	1406	19	1.9	1	1.9	142	100
10	1434	28	2.8	1	2.8	92	92
10	1458	24	2.4	1	2.4	110	100
10	1483	25	2.5	1	2.5	105	100
10	1506	23	2.3	1	2.3	115	100
10	1525	19	1.9	1	1.9	142	100
10	1535	10	1.0	1	1	292	100
10	1549	14	1.4	1	1.4	200	100
10	1562	13	1.3	1	1.3	218	100
10	1585	23	2.3	1	2.3	115	100
10	1609	24	2.4	1	2.4	110	100
10	1646	37	3.7	1	3.7	67	67
10	1698	52	5.2	1	5.2	46	46
10	1747	49	4.9	1	4.9	49	49
10	1809	62	6.2	1	6.2	38	38
10	1862	53	5.3	1	5.3	45	45
10	1910	48	4.8	1	4.8	50	50
10	1922	12	1.2	1	1.2	238	100
10	1927	5	0.5	1	0.5	635	100

DCPT data after reinforcing foundation NS4.1.5.5



Graph DCP before and after preparing foundation at NS4.1.5.5

តារាងទិន្នន័យពិសោធន៍សម្រុតកោនឌីណាមិក (Dynamic Cone Penetration Test-DCPT)

គម្រោង: អភិរក្ស និងជួសជុលជណ្តើរបុរាណខាងជើងនៃប្រាសាទព្រះវិហារ
ទីតាំងពិសោធន៍: ថ្នាក់ទី៤ (គ្រឹះក្រោមថ្មកាំជណ្តើរលេខកូដ NS4.1.7.6)
ជម្រៅចំនុចសូន្យនៅក្រោមផ្ទៃ: 0.00m
កាលបរិច្ឆេទពិសោធន៍: 16/02/2021

ចំនួនដងនៃការទម្លាក់ញញួរ Number of Blow	កំណើនសម្រុត (mm) Cumulative Penetration (mm)	ប្រវែងសម្រុត(mm) Penetration Between Readings(mm)	សម្រុតតាមការទម្លាក់ញញួរ (mm) Pernetration per Blow (mm)	មេគុណញញួរ Hammer Factor	សន្ទស្សន៍DCP(mm/blow) DCP Index(mm/blow)	តម្លៃ CBR(%)
0	0	-	-	-	-	-
5	133	133	26.6	1	26.60	7
5	350	217	43.4	1	43.40	4
5	462	112	22.4	1	22.40	9
5	534	72	14.4	1	14.40	15
5	592	58	11.6	1	11.60	19
5	623	31	6.2	1	6.20	38
5	646	23	4.6	1	4.60	53
5	673	27	5.4	1	5.40	44
5	693	20	4.0	1	4.00	62
5	712	19	3.8	1	3.80	65
5	730	18	3.6	1	3.60	70
5	750	20	4.0	1	4.00	62
5	768	18	3.6	1	3.60	70
5	784	16	3.2	1	3.20	79
5	805	21	4.2	1	4.20	59
5	826	21	4.2	1	4.20	59
5	836	10	2.0	1	2.00	100
5	868	32	6.4	1	6.40	37
5	886	18	3.6	1	3.60	70
5	906	20	4.0	1	4.00	62
5	934	28	5.6	1	5.60	42
5	953	19	3.8	1	3.80	65
5	974	21	4.2	1	4.20	59
5	999	25	5.0	1	5.00	48
5	1028	29	5.8	1	5.80	41
5	1058	30	6.0	1	6.00	39
10	1120	62	6.2	1	6.20	38
10	1159	39	3.9	1	3.90	64
10	1187	28	2.8	1	2.80	92
10	1210	23	2.3	1	2.30	100
10	1234	24	2.4	1	2.40	100
10	1256	22	2.2	1	2.20	100
10	1279	23	2.3	1	2.30	100
10	1301	22	2.2	1	2.20	100
10	1328	27	2.7	1	2.70	96
10	1365	37	3.7	1	3.70	67
10	1403	38	3.8	1	3.80	65
10	1430	27	2.7	1	2.70	96
10	1448	18	1.8	1	1.80	100
10	1462	14	1.4	1	1.40	100
10	1466	4	0.4	1	0.40	100
10	1481	15	1.5	1	1.50	100
10	1489	8	0.8	1	0.80	100
10	1497	8	0.8	1	0.80	100
10	1504	7	0.7	1	0.70	100
10	1510	6	0.6	1	0.60	100
10	1517	7	0.7	1	0.70	100
10	1523	6	0.6	1	0.60	100
10	1530	7	0.7	1	0.70	100
10	1537	7	0.7	1	0.70	100
10	1543	6	0.6	1	0.60	100
10	1548	5	0.5	1	0.50	100
10	1554	6	0.6	1	0.60	100
10	1557	3	0.3	1	0.30	100
10	1564	7	0.7	1	0.70	100
10	1566	2	0.2	1	0.20	100
10	1569	3	0.3	1	0.30	100
10	1573	4	0.4	1	0.40	100
10	1576	3	0.3	1	0.30	100
10	1581	5	0.5	1	0.50	100
10	1584	3	0.3	1	0.30	100
10	1588	4	0.4	1	0.40	100
10	1591	3	0.3	1	0.30	100

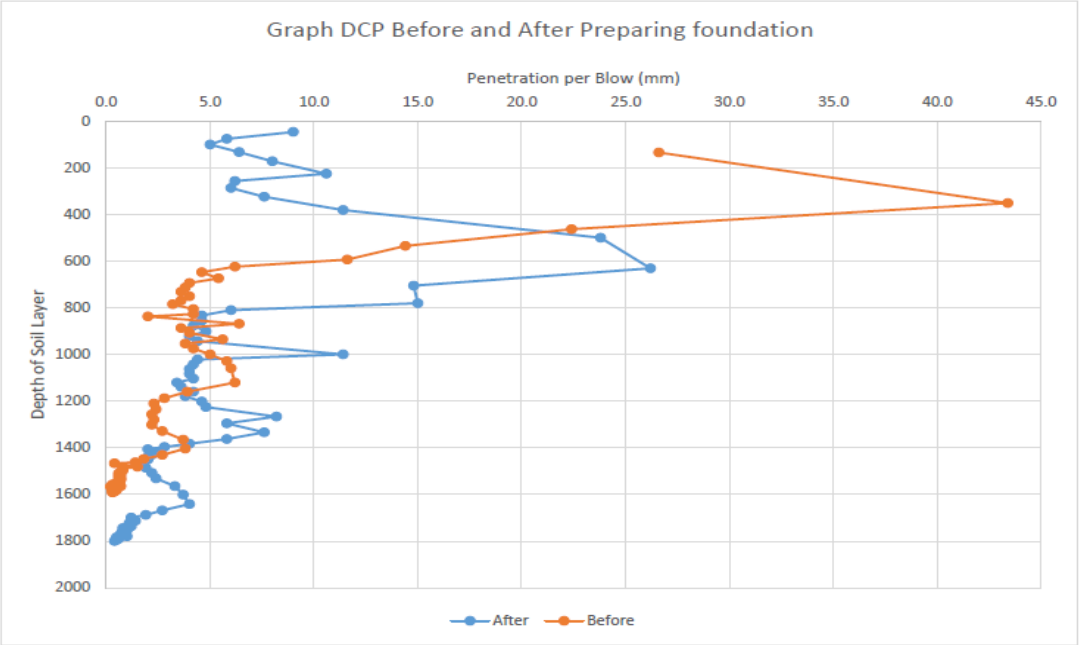
DCPT data before reinforcing foundation at NS4.1.7.6

តារាងទិន្នន័យពិសោធន៍សម្រុតកោនទីណាមិក (Dynamic Cone Penetration Test-DCPT)

គម្រោង: អភិរក្ស និងជួសជុលជណ្តើរបុរាណខាងជើងនៃប្រាសាទព្រះវិហារ
ទីតាំងពិសោធន៍: ថ្នាក់ទី៤ (គ្រឹះក្រោមថ្មកាំជណ្តើរទី៦ NS4.1.7.6)
ជម្រៅចំនុចសូន្យនៅក្រោមផ្ទៃ: 0.00m
កាលបរិច្ឆេទពិសោធន៍: 17/03/2021

ចំនួនដងនៃការទម្លាក់ញញួរ Number of Blow	កំណើនសម្រុត (mm) Cumulative Penetration (mm)	ប្រវែងសម្រុត(mm) Penetration Between Readings(mm)	សម្រុតតាមការទម្លាក់ញញួរ (mm) Pernetration per Blow (mm)	មេគុណញញួរ Hammer Factor	សន្ទស្សន៍ DCP(mm/blow) DCP Index(mm/blow)	តម្លៃ CBR(%)
0	0	-	-	-	-	
5	45	45	9.0	1	9	25
5	74	29	5.8	1	5.8	41
5	99	25	5.0	1	5	48
5	131	32	6.4	1	6.4	37
5	171	40	8.0	1	8	28
5	224	53	10.6	1	10.6	21
5	255	31	6.2	1	6.2	38
5	285	30	6.0	1	6	39
5	323	38	7.6	1	7.6	30
5	380	57	11.4	1	11.4	19
5	499	119	23.8	1	23.8	8
5	630	131	26.2	1	26.2	8
5	704	74	14.8	1	14.8	14
5	779	75	15.0	1	15	14
5	809	30	6.0	1	6	39
5	832	23	4.6	1	4.6	53
5	855	23	4.6	1	4.6	53
5	876	21	4.2	1	4.2	59
5	900	24	4.8	1	4.8	50
5	920	20	4.0	1	4	62
5	942	22	4.4	1	4.4	56
5	999	57	11.4	1	11.4	19
5	1021	22	4.4	1	4.4	56
5	1042	21	4.2	1	4.2	59
5	1062	20	4.0	1	4	100
5	1082	20	4.0	1	4	82
5	1103	21	4.2	1	4.2	100
5	1120	17	3.4	1	3.4	74
5	1138	18	3.6	1	3.6	70
5	1159	21	4.2	1	4.2	59
5	1178	19	3.8	1	3.8	65
5	1201	23	4.6	1	4.6	53
5	1225	24	4.8	1	4.8	50
5	1266	41	8.2	1	8.2	28
5	1295	29	5.8	1	5.8	41
5	1333	38	7.6	1	7.6	30
5	1362	29	5.8	1	5.8	41
5	1382	20	4.0	1	4	62
5	1396	14	2.8	1	2.8	92
5	1406	10	2.0	1	2	100
5	1418	12	2.4	1	2.4	100
5	1429	11	2.2	1	2.2	100
5	1439	10	2.0	1	2	100
5	1449	10	2.0	1	2	100
5	1458	9	1.8	1	1.8	100
5	1466	8	1.6	1	1.6	100
10	1485	19	1.9	1	1.9	100
10	1507	22	2.2	1	2.2	100
10	1531	24	2.4	1	2.4	100
10	1564	33	3.3	1	3.3	77
10	1601	37	3.7	1	3.7	67
10	1641	40	4.0	1	4	62
10	1668	27	2.7	1	2.7	96
10	1687	19	1.9	1	1.9	100
10	1699	12	1.2	1	1.2	100
10	1713	14	1.4	1	1.4	100
10	1724	11	1.1	1	1.1	100
10	1736	12	1.2	1	1.2	100
10	1744	8	0.8	1	0.8	100
10	1754	10	1.0	1	1	100
10	1762	8	0.8	1	0.8	100
10	1769	7	0.7	1	0.7	100
10	1779	10	1.0	1	1	100
10	1784	5	0.5	1	0.5	100
10	1790	6	0.6	1	0.6	100
10	1795	5	0.5	1	0.5	100
10	1799	4	0.4	1	0.4	100

DCPT data after reinforcing foundation at NS4.1.7.6



Graph DCP before and after reinforcing foundation at NS4.1.7.6

Foundation test at section 2

តារាងទិន្នន័យពិសោធន៍សម្រុតកោនឌីណាមិក (Dynamic Cone Penetration Test-DCPT)

គម្រោង: អភិរក្ស និងជួសជុលជណ្តើរបុរាណខាងជើងនៃប្រាសាទព្រះវិហារ
ទីតាំងពិសោធន៍: ថ្នាក់ទី២ (គ្រឹះក្រោមថ្មកាំជណ្តើរទីNS2.E.1.8)
ជម្រៅចំនុចសូន្យនៅក្រោមផ្ទៃ: 0.235m (ក្រោមកម្រាលថ្មកក់)
កាលបរិច្ឆេទពិសោធន៍: 06/05/2021 (មុនជួសជុល)
Material: Original Foundation: Soil organic(first layer) + Soil Compacted (Stone Chip, Gravel, Yellow Soil)

ចំនួនដងនៃការទម្លាក់ញញួរ Number of Blow	កំណើនសម្រុត (mm) Cumulative Penetration (mm)	ប្រវែងសម្រុត(mm) Penetration Between Readings(mm)	សម្រុតតាមការទម្លាក់ញញួរ (mm) Pernetration per Blow (mm)	មេគុណញញួរ Hammer Factor	សន្ទស្សន៍ DCP(mm/blow) DCP Index(mm/blow)	តម្លៃ CBR(%)
0	235	-	-	-	-	-
5	465	230	46.0	1	46	4
5	627	162	32.4	1	32.4	6
5	750	123	24.6	1	24.6	8
5	822	72	14.4	1	14.4	15
5	841	19	3.8	1	3.8	65
Bedrock						

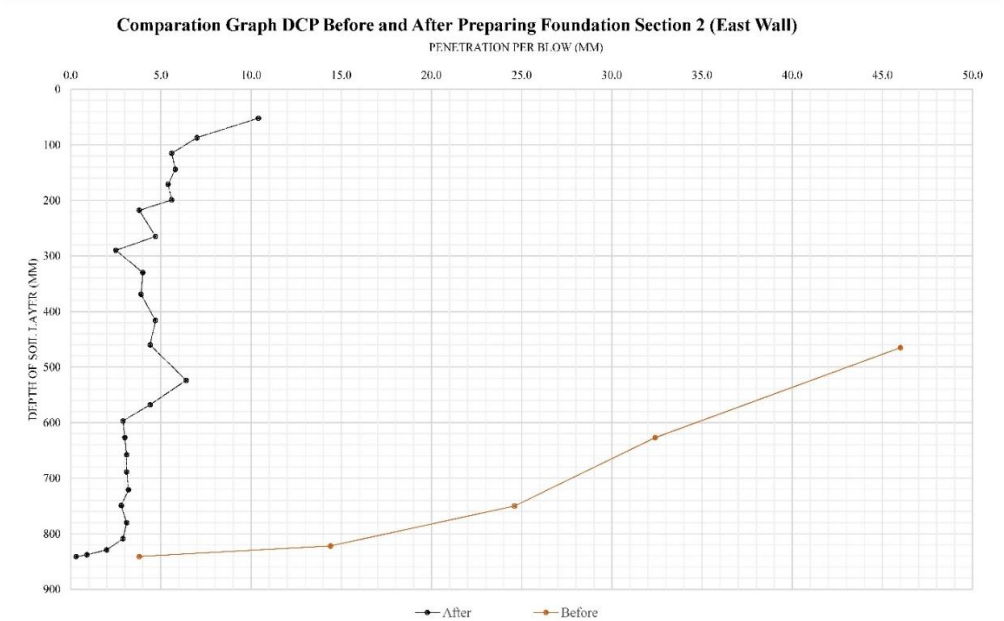
Table shows data of DCP test before foundation reinforcement of stair wall in the east NS2.E.1.9

តារាងទិន្នន័យពិសោធន៍សម្រុតកោនឌីណាមិក (Dynamic Cone Penetration Test-DCPT)

គម្រោង: អភិរក្ស និងជួសជុលជណ្តើរបុរាណខាងជើងនៃប្រាសាទព្រះវិហារ
ទីតាំងពិសោធន៍: ថ្នាក់ទី២ (គ្រឹះក្រោមថ្មកាំជណ្តើរទី៥ NS2.E1.9)
ជម្រៅចំនុចសូន្យនៅក្រោមផ្ទៃ: 0.00m (ក្រោមកម្រាលថ្មភក់)
កាលបរិច្ឆេទពិសោធន៍: 21/05/2021 (ក្រោយជួសជុល)
Material: Soil Compacted (Stone Chip, Gravel, Yellow Soil) + Lime stone powder

ចំនួនដងនៃការទម្លាក់ញញួរ Number of Blow	កំណើនសម្រុត (mm) Cumulative Penetration (mm)	ប្រវែងសម្រុត(mm) Penetration Between Readings(mm)	សម្រុតតាមការទម្លាក់ញញួរ (mm) Pernetration per Blow (mm)	មេគុណញញួរ Hammer Factor	សន្ទស្សន៍ DCP(mm/blow) DCP Index(mm/blow)	តម្លៃ CBR(%)
0	0	-	-	-	-	-
5	52	52	10.4	1	10.4	21
5	87	35	7.0	1	7	33
5	115	28	5.6	1	5.6	42
5	144	29	5.8	1	5.8	41
5	171	27	5.4	1	5.4	44
5	199	28	5.6	1	5.6	42
5	218	19	3.8	1	3.8	65
10	265	47	4.7	1	4.7	52
10	290	25	2.5	1	2.5	100
10	330	40	4.0	1	4	62
10	369	39	3.9	1	3.9	64
10	416	47	4.7	1	4.7	52
10	460	44	4.4	1	4.4	56
10	524	64	6.4	1	6.4	37
10	568	44	4.4	1	4.4	56
10	597	29	2.9	1	2.9	89
10	627	30	3.0	1	3	85
10	658	31	3.1	1	3.1	82
10	689	31	3.1	1	3.1	82
10	721	32	3.2	1	3.2	79
10	749	28	2.8	1	2.8	92
10	780	31	3.1	1	3.1	82
10	809	29	2.9	1	2.9	89
10	829	20	2.0	1	2	100
10	838	9	0.9	1	0.9	100
10	841	3	0.3	1	0.3	100
Bedrock						

Table shows data of DCP test after foundation reinforcement of stair wall in the east NS2.E.1.9



Graph shows penetration level of stair wall in the east before and after foundation restoration NS2.E.1.9

តារាងទិន្នន័យពិសោធន៍សម្រុតកោនឌីណាមិក (Dynamic Cone Penetration Test-DCPT)

គម្រោង: អភិរក្ស និងជួសជុលជណ្តើរបុរាណខាងជើងនៃប្រាសាទព្រះវិហារ
ទីតាំងពិសោធន៍: ថ្នាក់ទី២ (ត្រើះក្រោមថ្មកំពូលជណ្តើរទី NS2.W1.B)
ជម្រៅចំនុចសូន្យនៅក្រោមថ្ម: 0.208m (ក្រោមកម្រាលថ្មភក់)
កាលបរិច្ឆេទពិសោធន៍: 06/05/2021 (មុនពេលជួសជុល)
Material: Original Foundation: Soil organic(first layer) – Soil Compacted (Stone Chip, Gravel, Yellow Soil)

ចំនួនដងនៃការទម្លាក់ញញួរ Number of Blow	កំណើនសម្រុត (mm) Cumulative Penetration (mm)	ប្រវែងសម្រុត(mm) Penetration Between Readings(mm)	សម្រុតតាមការទម្លាក់ញញួរ (mm) Pernetration per Blow (mm)	មេគុណញញួរ Hammer Factor	សន្ទស្សន៍ DCP(mm/blow) DCP Index(mm/blow)	តម្លៃ CBR(%)
0	208	-	-	-	-	-
5	328	120	24.0	1	24	8
5	442	114	22.8	1	22.8	9
5	453	11	2.2	1	2.2	100
5	465	12	2.4	1	2.4	100
5	486	21	4.2	1	4.2	59
5	508	22	4.4	1	4.4	56
5	541	33	6.6	1	6.6	35
5	623	82	16.4	1	16.4	13
5	705	82	16.4	1	16.4	100
5	782	77	15.4	1	15.4	14
5	820	38	7.6	1	7.6	30
5	889	69	13.8	1	13.8	15
5	946	57	11.4	1	11.4	19
5	1011	65	13.0	1	13	17
5	1085	74	14.8	1	14.8	14
5	1180	95	19.0	1	19	11
5	1276	96	19.2	1	19.2	11
5	1288	12	2.4	1	2.4	100
5	1296	8	1.6	1	1.6	100
5	1304	8	1.6	1	1.6	100
5	1313	9	1.8	1	1.8	100
5	1322	9	1.8	1	1.8	100
5	1331	9	1.8	1	1.8	100
Bedrock						

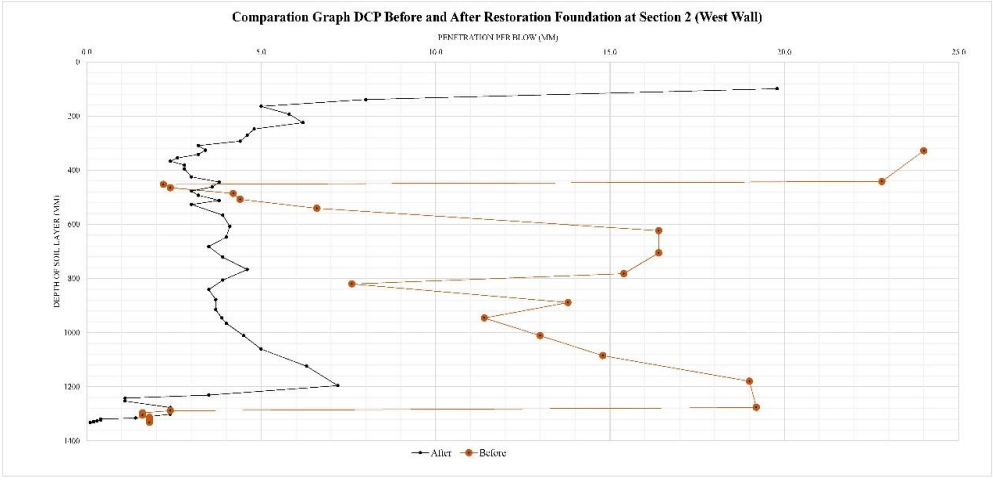
Table shows data of DCP test before foundation reinforcement of stair wall in the west NS2.W1.6

តារាងទិន្នន័យពិសោធន៍សម្រុតកោនឌីណាមិក (Dynamic Cone Penetration Test-DCPT)

គម្រោង: អភិរក្ស និងជួសជុលជណ្តើរបុរាណខាងជើងនៃប្រាសាទព្រះវិហារ
ទីតាំងពិសោធន៍: ថ្នាក់ទី២ (ត្រឹះក្រោមថ្មកាំជណ្តើរទី NS2.W1.8)
ជម្រៅចំនុចសូន្យនៅក្រោមថ្នៃ: 0.00m (ក្រោមកម្រាលថ្មកក់)
កាលបរិច្ឆេទពិសោធន៍: 16/06/2021 (ក្រោយពេលជួសជុល)
Material: Repaired Foundation:Soil Compacted (Good Quality Original soil foundation, Stone Chip, Gravel, Yellow Soil, Lime Powder, Water)

ចំនួនដងនៃការទម្លាក់ញញួរ Number of Blow	កំណើនសម្រុត (mm) Cumulative Penetration (mm)	ប្រវែងសម្រុត(mm) Penetration Between Readings(mm)	សម្រុតតាមការទម្លាក់ញញួរ (mm) Pernetration per Blow (mm)	មេគុណញញួរ Hammer Factor	សន្ទស្សន៍ DCP(mm/blow) DCP Index(mm/blow)	តម្លៃ CBR(%)
0	0	-	-	-	-	-
5	99	99	19.8	1	19.8	10
5	139	40	8.0	1	8	28
5	164	25	5.0	1	5	48
5	193	29	5.8	1	5.8	41
5	224	31	6.2	1	6.2	38
5	248	24	4.8	1	4.8	50
5	271	23	4.6	1	4.6	53
5	293	22	4.4	1	4.4	56
5	309	16	3.2	1	3.2	79
5	326	17	3.4	1	3.4	74
5	342	16	3.2	1	3.2	79
5	355	13	2.6	1	2.6	100
5	367	12	2.4	1	2.4	100
5	381	14	2.8	1	2.8	92
5	395	14	2.8	1	2.8	92
5	410	15	3.0	1	3	85
5	425	15	3.0	1	3	85
5	444	19	3.8	1	3.8	65
5	462	18	3.6	1	3.6	70
5	477	15	3.0	1	3	85
5	493	16	3.2	1	3.2	79
5	512	19	3.8	1	3.8	65
5	527	15	3.0	1	3	85
10	566	39	3.9	1	3.9	64
10	607	41	4.1	1	4.1	60
10	647	40	4.0	1	4	62
10	682	35	3.5	1	3.5	72
10	721	39	3.9	1	3.9	64
10	767	46	4.6	1	4.6	53
10	806	39	3.9	1	3.9	64
10	841	35	3.5	1	3.5	72
10	878	37	3.7	1	3.7	67
10	915	37	3.7	1	3.7	67
8	946	31	3.9	1	3.875	64
5	966	20	4.0	1	4	62
10	1011	45	4.5	1	4.5	54
10	1061	50	5.0	1	5	48
10	1124	63	6.3	1	6.3	37
10	1196	72	7.2	1	7.2	32
10	1231	35	3.5	1	3.5	72
10	1242	11	1.1	1	1.1	100
10	1253	11	1.1	1	1.1	100
10	1277	24	2.4	1	2.4	100
10	1301	24	2.4	1	2.4	100
10	1315	14	1.4	1	1.4	100
10	1319	4	0.4	1	0.4	100
10	1323	4	0.4	1	0.4	100
10	1326	3	0.3	1	0.3	100
10	1328	2	0.2	1	0.2	100
10	1330	2	0.2	1	0.2	100
10	1331	1	0.1	1	0.1	100

Table shows data of DCP test after foundation reinforcement of stair wall in the west NS2.W1.6



Graph shows penetration level of stair wall in the west before and after foundation

តារាងទិន្នន័យពិសោធន៍សម្រុតកោនឌីណាមិក (Dynamic Cone Penetration Test-DCPT)

គម្រោង: អភិរក្ស និងជួសជុលជណ្តើរបុរាណខាងជើងនៃប្រាសាទព្រះវិហារ
ទីតាំងពិសោធន៍: ថ្នាក់ទី២ (ត្រឹះក្រោមថ្មកាំជណ្តើរទីNS2.1.5.6)
ជម្រៅចំនុចសូន្យនៅក្រោមផ្ទៃ: 0.045m
កាលបរិច្ឆេទពិសោធន៍: 21/05/2021
Material : Organic Foundation: Compacted Soil (Sand Stone Chip, Yellow Soil)

ចំនួនដងនៃការទម្លាក់ញញួរ Number of Blow	កំណើនសម្រុត (mm) Cumulative Penetration (mm)	ប្រវែងសម្រុត(mm) Penetration Between Readings(mm)	សម្រុតតាមការទម្លាក់ញញួរ (mm) Pernetration per Blow (mm)	មេគុណញញួរ Hammer Factor	សន្ទស្សន៍ DCP(mm/blow) DCP Index(mm/blow)	តម្លៃ CBR(%)
0	45	-	-	-	-	-
5	197	152	30.4	1	30.4	6
5	280	83	16.6	1	16.6	13
5	356	76	15.2	1	15.2	14
5	425	69	13.8	1	13.8	15
5	459	34	6.8	1	6.8	34
5	494	35	7.0	1	7	33
5	543	49	9.8	1	9.8	23
5	585	42	8.4	1	8.4	27
5	597	12	2.4	1	2.4	100
5	609	12	2.4	1	2.4	100
5	619	10	2.0	1	2	100
5	625	6	1.2	1	1.2	100
5	631	6	1.2	1	1.2	100
5	635	4	0.8	1	0.8	100
5	637	2	0.4	1	0.4	100
5	638	1	0.2	1	0.2	100
Bedrock						

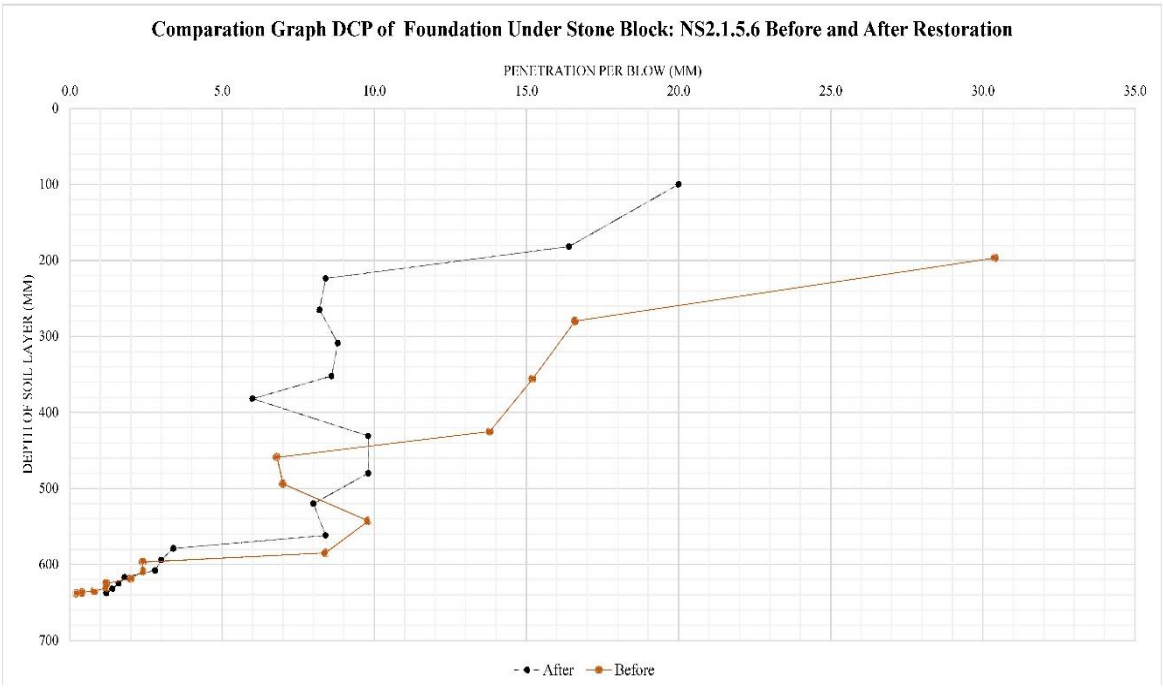
Table shows data of DCP test before foundation reinforcement of stair step NS2.1.5.6

តារាងទិន្នន័យពិសោធន៍សម្រុតកោនឌីណាមិក (Dynamic Cone Penetration Test-DCPT)

គម្រោង: អភិរក្ស និងជួសជុលជណ្តើរបុរាណខាងជើងនៃប្រាសាទព្រះវិហារ
ទីតាំងពិសោធន៍: ថ្នាក់ទី២ (ត្រឹះក្រោមថ្មកាំជណ្តើរទីNS2.1.5.6)
ជម្រៅចំនុចសូន្យនៅក្រោមផ្ទៃ: 0.00m
កាលបរិច្ឆេទពិសោធន៍: 23/06/2021
Material : Compacted Soil (Sand Stone Chip, Original Soil, Lime Powder)

ចំនួនដងនៃការទម្លាក់ញញួរNumber of Blow	កំណើនសម្រុត (mm) Cumulative Penetration (mm)	ប្រវែងសម្រុត(mm) Penetration Between Readings(mm)	សម្រុតតាមការទម្លាក់ញញួរ (mm) Pernetration per Blow (mm)	មេគុណញញួរ Hammer Factor	សន្ទស្សន៍ DCP(mm/blow) DCP Index(mm/blow)	តម្លៃ CBR(%)
0	0	-	-	-	-	-
5	100	100	20.0	1	20	10
5	182	82	16.4	1	16.4	13
5	224	42	8.4	1	8.4	27
5	265	41	8.2	1	8.2	28
5	309	44	8.8	1	8.8	26
5	352	43	8.6	1	8.6	26
5	382	30	6.0	1	6	39
5	431	49	9.8	1	9.8	23
5	480	49	9.8	1	9.8	23
5	520	40	8.0	1	8	28
5	562	42	8.4	1	8.4	27
5	579	17	3.4	1	3.4	74
5	594	15	3.0	1	3	85
5	608	14	2.8	1	2.8	92
5	617	9	1.8	1	1.8	100
5	625	8	1.6	1	1.6	100
5	632	7	1.4	1	1.4	100
5	638	6	1.2	1	1.2	100
Bedrock						

Table shows data of DCP test after foundation reinforcement of stair step NS2.1.5.6



Graph shows penetration level of stair step before and after foundation restoration NS2.1.5.6

Foundation test of western causeway

តារាងទិន្នន័យពីសោធន៍សម្រុតកោនឌីណាមិក(Dynamic Cone Penetration Test-DCPT)

គម្រោង: អភិរក្ស និងជួសជុលជណ្តើរបុរាណខាងជើងនៃប្រាសាទព្រះវិហារ
ទីតាំងពិសោធន៍: ស្ពានហាលខាងលិច (DCPT-01)
ជម្រៅចំនុចសូន្យនៅក្រោមផ្ទៃ: 0.000m (លើផ្ទៃស្ពានហាល)
កាលបរិច្ឆេទពិសោធន៍: 04/08/2021 (01:44PM)(មុនពេលជួសជុល)
Material: Disturbed Foundation

ចំនួនដងនៃការទម្លាក់ញញួរ Number of Blow	កំណើនសម្រុត (mm) Cumulative Penetration (mm)	ប្រវែងសម្រុត(mm) Penetration Between Readings(mm)	សម្រុតតាមការទម្លាក់ញញួរ (mm) Pernetration per Blow (mm)	មេគុណញញួរ Hammer Factor	សន្ទស្សន៍ DCP(mm/blow) DCP Index(mm/blow)	តម្លៃ CBR(%)
0	0	0	0	-	-	-
1	51	51	51	1	51	4
1	132	81	81	1	81	2
1	225	93	93	1	93	2
1	335	110	110	1	110	2
1	500	165	165	1	165	1
1	598	98	98	1	98	2
1	679	81	81	1	81	2
1	762	83	83	1	83	2
1	870	108	108	1	108	2
1	893	23	23	1	23	9
1	906	13	13	1	13	17
1	940	34	34	1	34	6
1	983	43	43	1	43	4
1	988	5	5	1	5	48
1	990	2	2	1	2	100
1	993	3	3	1	3	85

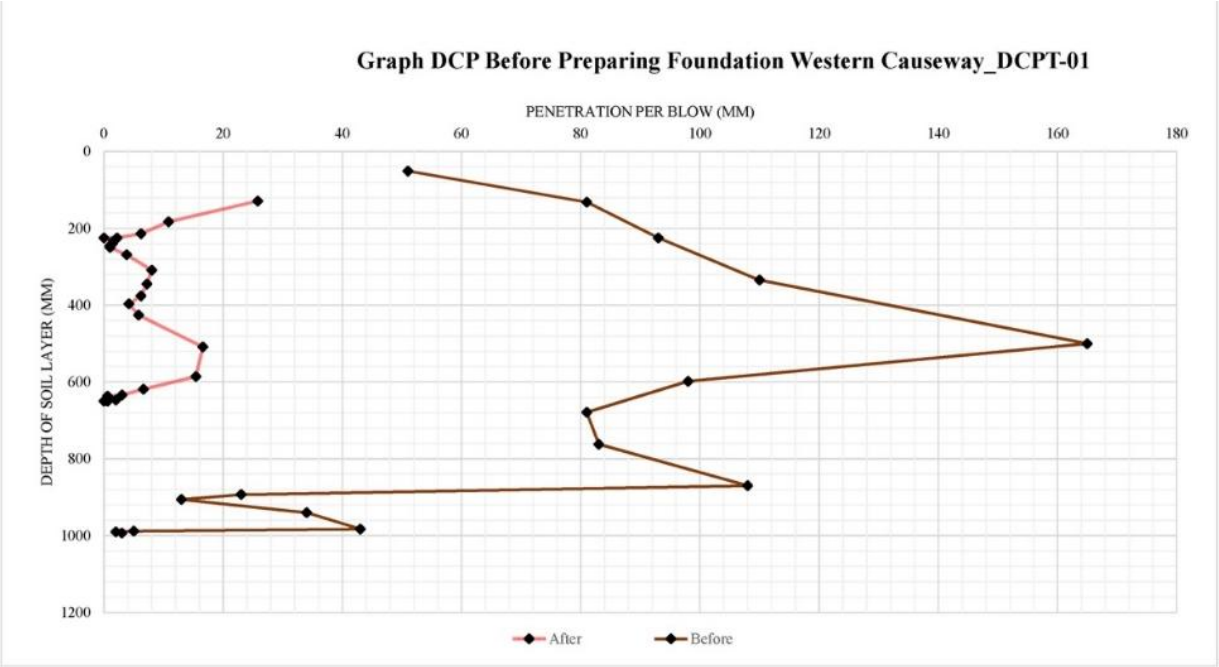
DCPT data before reinforcing foundation restoration (DCPT-01)

តារាងទិន្នន័យពិសោធន៍សម្រុតកោនឌីណាមិក(Dynamic Cone Penetration Test-DCPT)

គម្រោង: អភិរក្ស និងជួសជុលជណ្តើរបុរាណខាងជើងនៃប្រាសាទព្រះវិហារ
ទីតាំងពិសោធន៍: ស្ពានហាលខាងលិច **(DCPT-01)**
ជម្រៅចំនុចសូន្យនៅក្រោមផ្ទៃ: 0.000m (ចន្លោះដុំថ្មកម្រាលនៃស្ពានហាល)
កាលបរិច្ឆេទពិសោធន៍:29/10/2021(ក្រោយពេលជួសជុល)
Material: Compacted Foundation (Sandy clay soil + Stone Chip + Lime Powder + Water Content)

ចំនួនដងនៃការទម្លាក់ញញួរ Number of Blow	កំណើនសម្រុត (mm) Cumulative Penetration (mm)	ប្រវែងសម្រុត(mm) Penetration Between Readings(mm)	សម្រុតតាមការទម្លាក់ញញួរ (mm) Pernetration per Blow (mm)	មេគុណញញួរ Hammer Factor	សន្ទស្សន៍ DCP(mm/blow) DCP Index(mm/blow)	តម្លៃ CBR(%)
0	0	0	0	-	-	-
5	129	129	26	1	25.8	8
5	183	54	11	1	10.8	20
5	214	31	6	1	6.2	38
5	225	11	2	1	2.2	100
5	225	0	0	1	0	100
5	233	8	2	1	1.6	100
5	240	7	1	1	1.4	100
5	245	5	1	1	1	100
5	250	5	1	1	1	100
5	269	19	4	1	3.8	65
5	309	40	8	1	8	28
5	345	36	7	1	7.2	32
5	376	31	6	1	6.2	38
5	397	21	4	1	4.2	59
5	426	29	6	1	5.8	41
5	509	83	17	1	16.6	13
5	586	77	15	1	15.4	100
5	619	33	7	1	6.6	35
5	634	15	3	1	3	85
5	637	3	1	1	0.6	100
5	647	10	2	1	2	100
5	650	3	0.6	1	0.6	100
5	650	0	0	1	0	100

DCPT data after reinforcing foundation restoration (DCPT-01)



Graph shows penetration level of western causeway before foundation restoration (DCPT-01)

តារាងទិន្នន័យពិសោធន៍សម្រួតកោនឌីណាមិក (Dynamic Cone Penetration Test-DCPT)

គម្រោង: អភិរក្ស និងជួសជុលជណ្តើរបុរាណខាងជើងនៃប្រាសាទព្រះវិហារ
ទីតាំងពិសោធន៍: ស្ពានហាលខាងលិច (DCPT-02)
ជម្រៅចំនុចសូន្យនៅក្រោមថ្ម: 0.000m (លើផ្ទៃស្ពានហាល)
កាលបរិច្ឆេទពិសោធន៍: 04/08/2021 (01:56PM)(មុនពេលជួសជុល)
Material: Disturbed Foundation

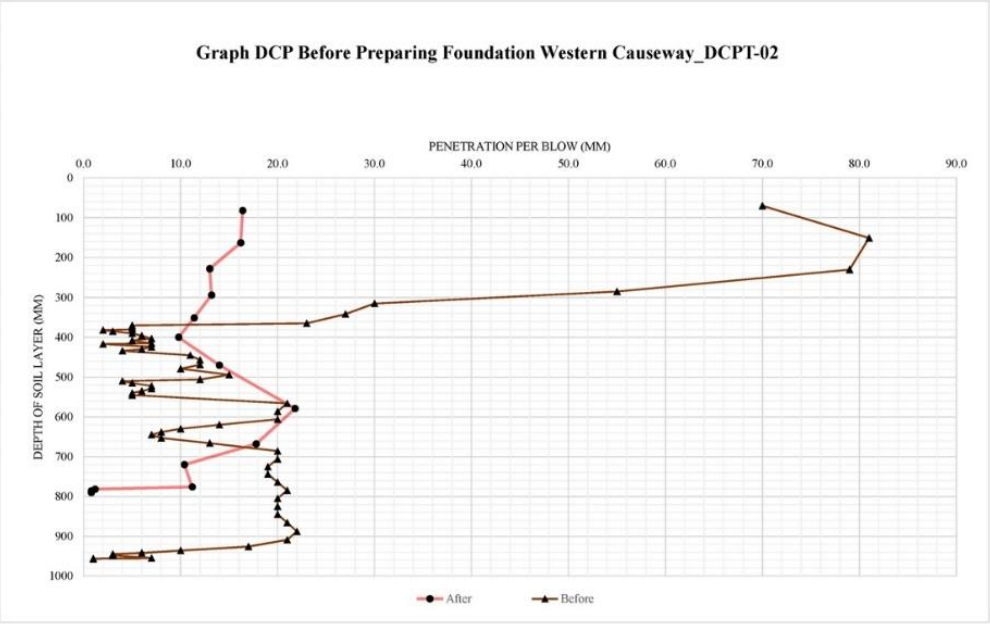
ចំនួនដងនៃការទម្លាក់ញញួរ Number of Blow	កំណើនសម្រួត (mm) Cumulative Penetration (mm)	ប្រវែងសម្រួត(mm) Penetration Between Readings(mm)	សម្រួតតាមការទម្លាក់ញញួរ (mm) Pernetration per Blow (mm)	មេគុណញញួរ Hammer Factor	សន្ទស្សន៍ DCP(mm/blow) DCP Index(mm/blow)	តម្លៃ CBR(%)
0	0	0	0	-	-	-
1	70	70	70.0	1	70	3
1	151	81	81.0	1	81	2
1	230	79	79.0	1	79	2
1	285	55	55.0	1	55	3
1	315	30	30.0	1	30	6
1	342	27	27.0	1	27	7
1	365	23	23.0	1	23	9
1	370	5	5.0	1	5	48
1	375	5	5.0	1	5	48
1	380	5	5.0	1	5	48
1	382	2	2.0	1	2	100
1	385	3	3.0	1	3	85
1	390	5	5.0	1	5	48
1	396	6	6.0	1	6	39
1	403	7	7.0	1	7	33
1	408	5	5.0	1	5	48
1	415	7	7.0	1	7	33
1	417	2	2.0	1	2	100
1	424	7	7.0	1	7	33
1	430	6	6.0	1	6	39
1	434	4	4.0	1	4	62
1	445	11	11.0	1	11	20
1	457	12	12.0	1	12	18
1	469	12	12.0	1	12	18
1	479	10	10.0	1	10	22
1	494	15	15.0	1	15	14
1	506	12	12.0	1	12	18
1	510	4	4.0	1	4	62
1	515	5	5.0	1	5	48
1	522	7	7.0	1	7	33
1	529	7	7.0	1	7	33
1	535	6	6.0	1	6	39
1	540	5	5.0	1	5	48
1	545	5	5.0	1	5	48
1	566	21	21.0	1	21	10
1	586	20	20.0	1	20	10
1	606	20	20.0	1	20	10
1	620	14	14.0	1	14	15
1	630	10	10.0	1	10	22
1	638	8	8.0	1	8	28
1	645	7	7.0	1	7	33
1	653	8	8.0	1	8	28
1	666	13	13.0	1	13	17
1	686	20	20.0	1	20	10
1	706	20	20.0	1	20	10
1	725	19	19.0	1	19	11
1	744	19	19.0	1	19	11
1	764	20	20.0	1	20	10
1	785	21	21.0	1	21	10
1	805	20	20.0	1	20	10
1	825	20	20.0	1	20	10
1	845	20	20.0	1	20	10
1	866	21	21.0	1	21	10
1	888	22	22.0	1	22	9
1	909	21	21.0	1	21	10
1	926	17	17.0	1	17	12
1	936	10	10.0	1	10	22
1	942	6	6.0	1	6	39
1	945	3	3.0	1	3	85
1	948	3	3.0	1	3	85
1	955	7	7.0	1	7	33
1	956	1	1.0	1	1	100
1	957	1	1.0	1	1	100

DCPT data before reinforcing foundation restoration (DCPT-02)

តារាងទិន្នន័យពិសោធន៍សម្រុតកោនឌីណាមិក (Dynamic Cone Penetration Test-DCPT)

គម្រោង: អភិរក្ស និងជួសជុលជណ្តើរបុរាណខាងជើងនៃប្រាសាទព្រះវិហារ
ទីតាំងពិសោធន៍: ស្ពានហាលខាងលិច (DCPT-02)
ជម្រៅចំនុចសូន្យនៅក្រោមផ្ទៃ: 0.000m (ចន្លោះជុំថ្មកម្រាលនៃស្ពានហាល)
កាលបរិច្ឆេទពិសោធន៍:29/10/2021(ក្រោយពេលជួសជុល)
Material: Compacted Foundation (Sandy clay soil + Stone Chip + Lime Powder + Water Content)

ចំនួនដងនៃការទម្លាក់ញញួរ Number of Blow	កំណើនសម្រុត (mm) Cumulative Penetration (mm)	ប្រវែងសម្រុត(mm) Penetration Between Readings(mm)	សម្រុតតាមការទម្លាក់ញញួរ (mm) Pernetration per Blow (mm)	មេគុណញញួរ Hammer Factor	សន្ទស្សន៍ DCP(mm/blow) DCP Index(mm/blow)	តម្លៃ CBR(%)
0	0	0	0	-	-	-
5	82	82	16.4	1	16.4	13
5	163	81	16.2	1	16.2	13
5	228	65	13.0	1	13	17
5	294	66	13.2	1	13.2	16
5	351	57	11.4	1	11.4	19
5	400	49	9.8	1	9.8	23
5	470	70	14.0	1	14	15
5	579	109	21.8	1	21.8	9
5	668	89	17.8	1	17.8	12
5	720	52	10.4	1	10.4	21
5	776	56	11.2	1	11.2	100
5	782	6	1.2	1	1.2	100
5	786	4	0.8	1	0.8	100
5	790	4	0.8	1	0.8	100



DCPT data after reinforcing foundation and graph shows penetration level of western causeway before foundation restoration (DCPT-02)

តារាងទិន្នន័យពិសោធន៍សម្រុតកោនឌីណាមិក (Dynamic Cone Penetration Test-DCPT)

គម្រោង: អភិរក្ស និងជួសជុលជណ្តើរឡុកណខាងជើងនៃប្រាសាទព្រះវិហារ

ទីតាំងពិសោធន៍: ស្ថានហាលខាងលិច (DCPT-03)

ជម្រៅចំនុចសូន្យនៅក្រោមមៀ: 0.000m (ក្រោមដុំថ្មរាយប៉ាយនៃស្ថានហាល)

កាលបរិច្ឆេទពិសោធន៍: 04/08/2021 (02:32PM)(មុនពេលជួសជុល)

Material: Original Foundation: Soil organic(first layer) + Soil Compacted (Stone Chip, Gravel, Cohesively Yellow Soil)

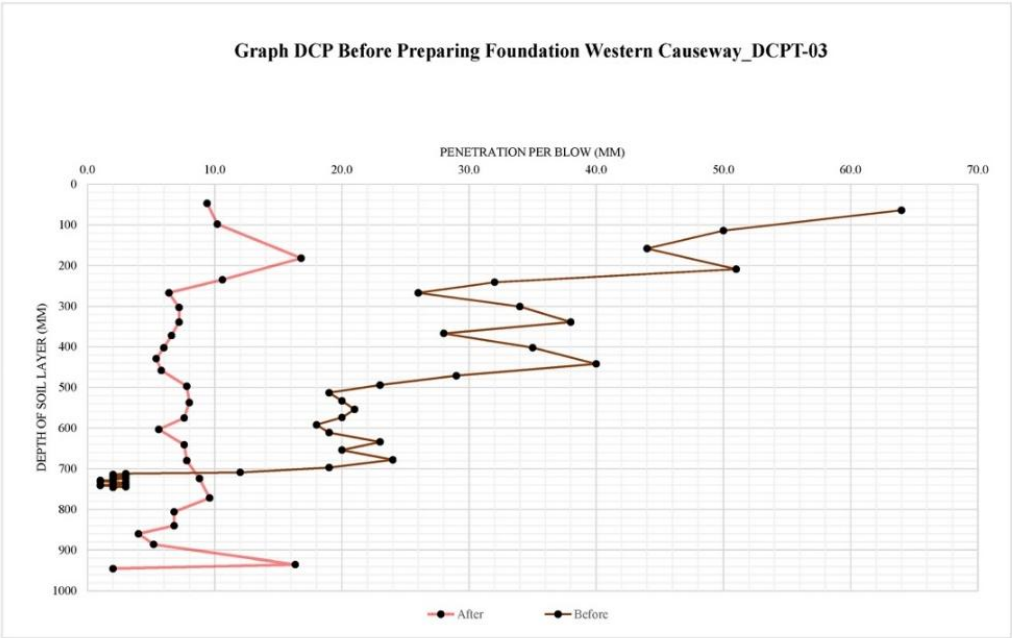
ចំនួនដងនៃការទម្លាក់ញញួរ Number of Blow	កំណើនសម្រុត (mm) Cumulative Penetration (mm)	ប្រវែងសម្រុត(mm) Penetration Between Readings(mm)	សម្រុតតាមការទម្លាក់ញញួរ (mm) Pernetration per Blow (mm)	មេគុណញញួរ Hammer Factor	សន្ទស្សន៍ DCP(mm/blow) DCP Index(mm/blow)	តម្លៃ CBR(%)
0	0	0	0	-	-	-
1	64	64	64.0	1	64	3
1	114	50	50.0	1	50	4
1	158	44	44.0	1	44	4
1	209	51	51.0	1	51	4
1	241	32	32.0	1	32	6
1	267	26	26.0	1	26	8
1	301	34	34.0	1	34	6
1	339	38	38.0	1	38	5
1	367	28	28.0	1	28	7
1	402	35	35.0	1	35	5
1	442	40	40.0	1	40	5
1	471	29	29.0	1	29	7
1	494	23	23.0	1	23	9
1	513	19	19.0	1	19	11
1	533	20	20.0	1	20	10
1	554	21	21.0	1	21	10
1	574	20	20.0	1	20	10
1	592	18	18.0	1	18	11
1	611	19	19.0	1	19	11
1	634	23	23.0	1	23	9
1	654	20	20.0	1	20	10
1	678	24	24.0	1	24	8
1	697	19	19.0	1	19	11
1	709	12	12.0	1	12	18
1	712	3	3.0	1	3	85
1	714	2	2.0	1	2	100
1	716	2	2.0	1	2	100
1	719	3	3.0	1	3	85
1	721	2	2.0	1	2	100
1	724	3	3.0	1	3	85
1	726	2	2.0	1	2	100
1	728	2	2.0	1	2	100
1	729	1	1.0	1	1	100
1	730	1	1.0	1	1	100
1	731	1	1.0	1	1	100
1	734	3	3.0	1	3	85
1	737	3	3.0	1	3	85
1	739	2	2.0	1	2	100
1	740	1	1.0	1	1	100
1	741	1	1.0	1	1	100
1	744	3	3.0	1	3	85
1	746	2	2.0	1	2	100

DCPT data before reinforcing foundation restoration (DCPT-03)

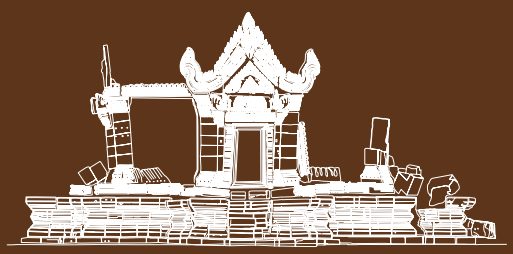
តារាងទិន្នន័យពិសោធន៍សម្រុតកោនឌីណាមិក (Dynamic Cone Penetration Test-DCPT)

គម្រោង: អភិរក្ស និងជួសជុលជណ្តើរបុរាណខាងជើងនៃប្រាសាទព្រះវិហារ
ទីតាំងពិសោធន៍: ស្ពានហាលខាងលិច **(DCPT-03)**
ជម្រៅចំនុចសូន្យនៅក្រោមផ្ទៃ: 0.000m (ចន្លោះជុំថ្មកម្រាលនៃស្ពានហាល)
កាលបរិច្ឆេទពិសោធន៍: 29/10/2021(ក្រោយពេលជួសជុល)
Material: Original Foundation: Soil Compacted (Stone Chip, Gravel, Cohesively Yellow Soil)

ចំនួនដងនៃការទម្លាក់ញញួរ Number of Blow	កំណើនសម្រុត (mm) Cumulative Penetration (mm)	ប្រវែងសម្រុត(mm) Penetration Between Readings(mm)	សម្រុតតាមការទម្លាក់ញញួរ (mm) Pernetration per Blow (mm)	មេគុណញញួរ Hammer Factor	សន្ទស្សន៍ DCP(mm/blow) DCP Index(mm/blow)	តម្លៃ CBR(%)
0	0	0	0	-	-	-
5	47	47	9.4	1	9.4	24
5	98	51	10.2	1	10.2	22
5	182	84	16.8	1	16.8	12
5	235	53	10.6	1	10.6	21
5	267	32	6.4	1	6.4	37
5	303	36	7.2	1	7.2	32
5	339	36	7.2	1	7.2	32
5	372	33	6.6	1	6.6	35
5	402	30	6.0	1	6	39
5	429	27	5.4	1	5.4	44
5	458	29	5.8	1	5.8	41
5	497	39	7.8	1	7.8	29
5	537	40	8.0	1	8	28
5	575	38	7.6	1	7.6	30
5	603	28	5.6	1	5.6	42
5	641	38	7.6	1	7.6	30
5	680	39	7.8	1	7.8	29
5	724	44	8.8	1	8.8	26
5	772	48	9.6	1	9.6	23
5	806	34	6.8	1	6.8	34
5	840	34	6.8	1	6.8	34
5	860	20	4.0	1	4	62
5	886	26	5.2	1	5.2	46
3	935	49	16.3	1	16.33	13
5	945	10	2.0	1	2	100



DCPT data after reinforcing foundation and graph shows penetration level of western causeway before foundation restoration (DCPT-03)

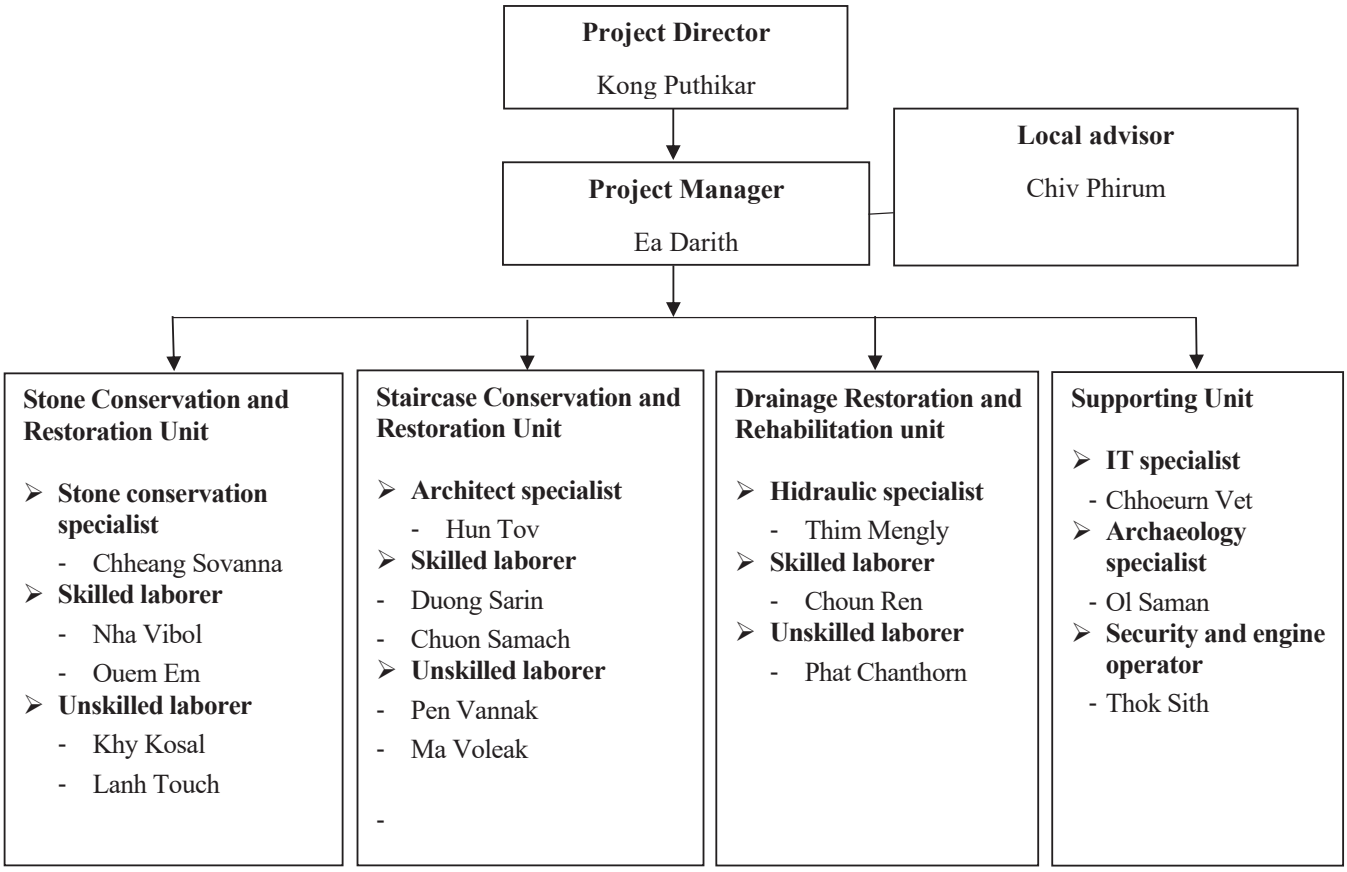


Phase III : 2021-2022

INDEX

ANNEX 1

Structure of Project Team



The structure of team work of a project for conservation and restoration of northern ancient staircase, Preah Vihear temple

ANNEX 2

Photos of the conservation and restoration activities at section 6 and section 7 of the northern ancient staircase, phase III

Building Project Team





Fig. 1: Project team meeting to define role of the project staff and laborers

Project Launching Ceremony



Fig. 2: Signing ceremony on grant agreement between H.E Dr. Phoeurng Sackona, Minister of Culture and Fine Arts and H.E W.Patrick Murphy, the U.S. Ambassador to Cambodia



Fig. 2: Group photo at the end of the event

Site preparation



Fig. 4: Shelter made of steel structure of 132 m2 with tarpaulin roof being installed at the restoration area



Fig. 5: Temporary steel-made bypass of 29.10 m long and 1.50 m wide from section 5 to section 10.



Fig. 6: Two storage yards set up with sizes 36 m2 and 24 m2 respectively to store new stone



Fig. 7: Rail of 99 m long and 1.24 m wide installed to connect from stone storage yard to section 7 where restoration is taken place in order to move stone for restoration

Archaeological Survey



Fig. 8: Drawing of plan survey and pictures of excavation trenches shown in red boxes

Excavation trench (NS7.WW) at the western stair wall of section 7

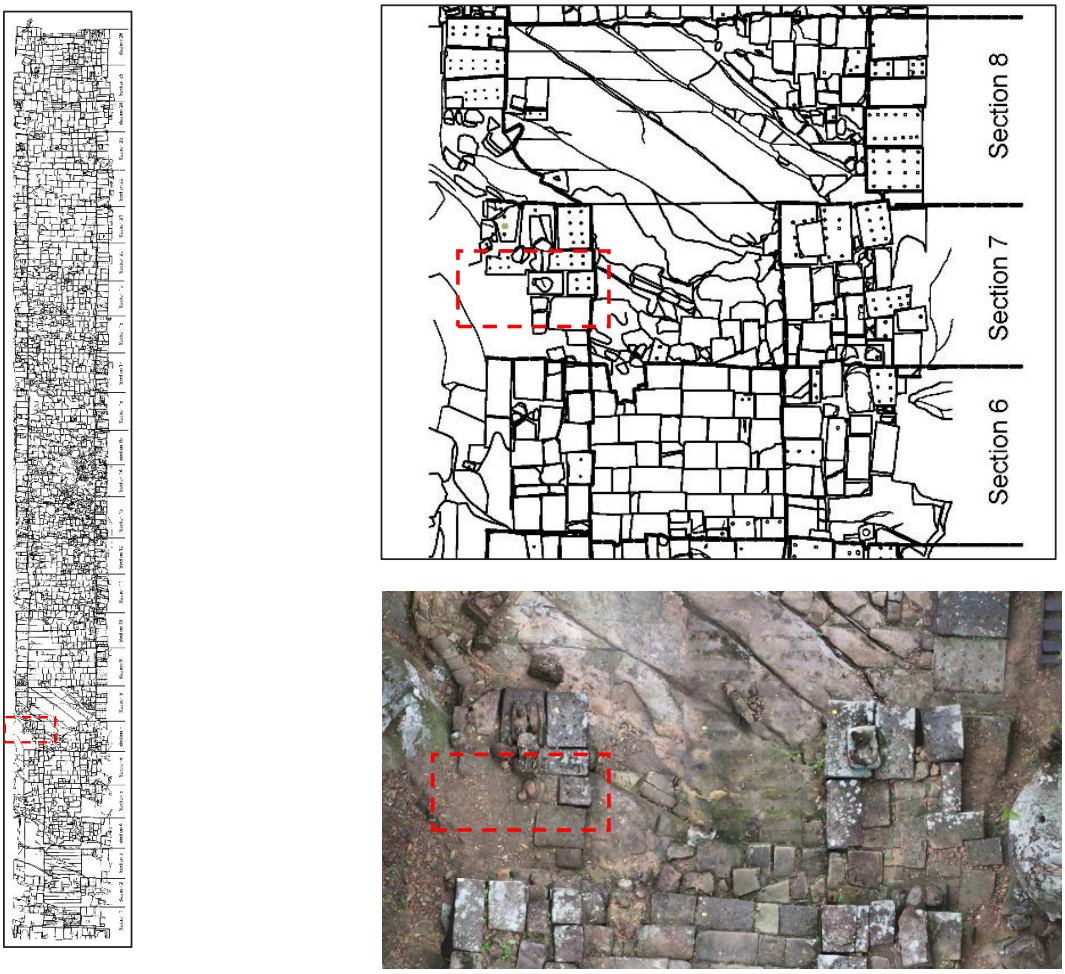


Fig. 9: Within red boxes are drawing of plan survey and picture of excavation trench at the western stair wall of section 7 (NS7.WW)



Fig. 10: Picture showing general condition of the excavation trench at the western stair wall of section 7 before excavated



Fig. 11: Picture showing general condition of excavation trench at the western stair wall of section 7 after excavated

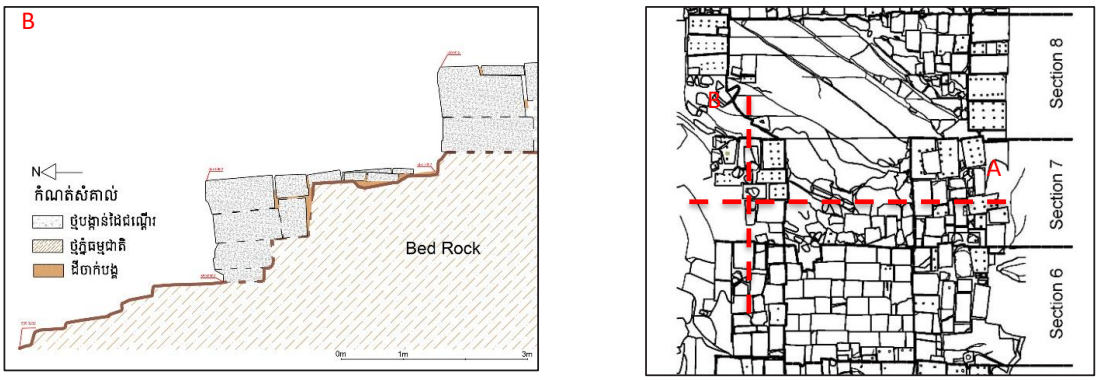


Fig. 12: Cross section at the western stair wall (west view) at the left hand, and floor plan at the right hand of section 7

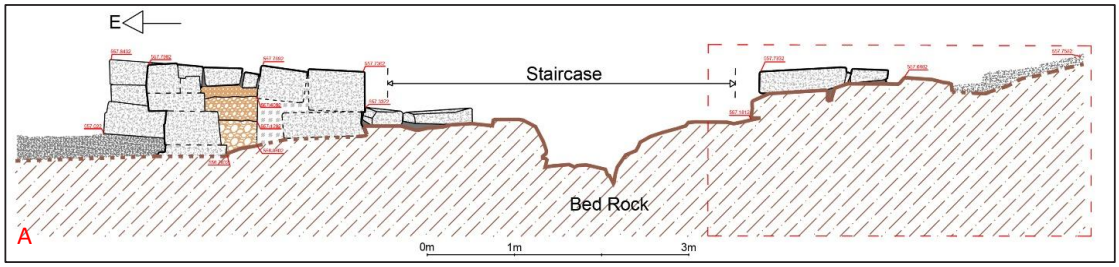


Fig. 13: Cross section plan survey of stair walls and stair step at section 7 (north view)



Fig. 14: Excavation trench showing condition of the western stair wall of section 7 after excavated (west view)

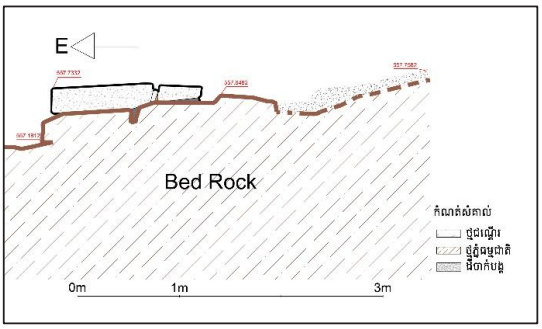


Fig. 15: Cross section plan survey at the western stair wall, section 7 (west view)

Excavation trench (NS7.WW) at the western stair wall of section 7

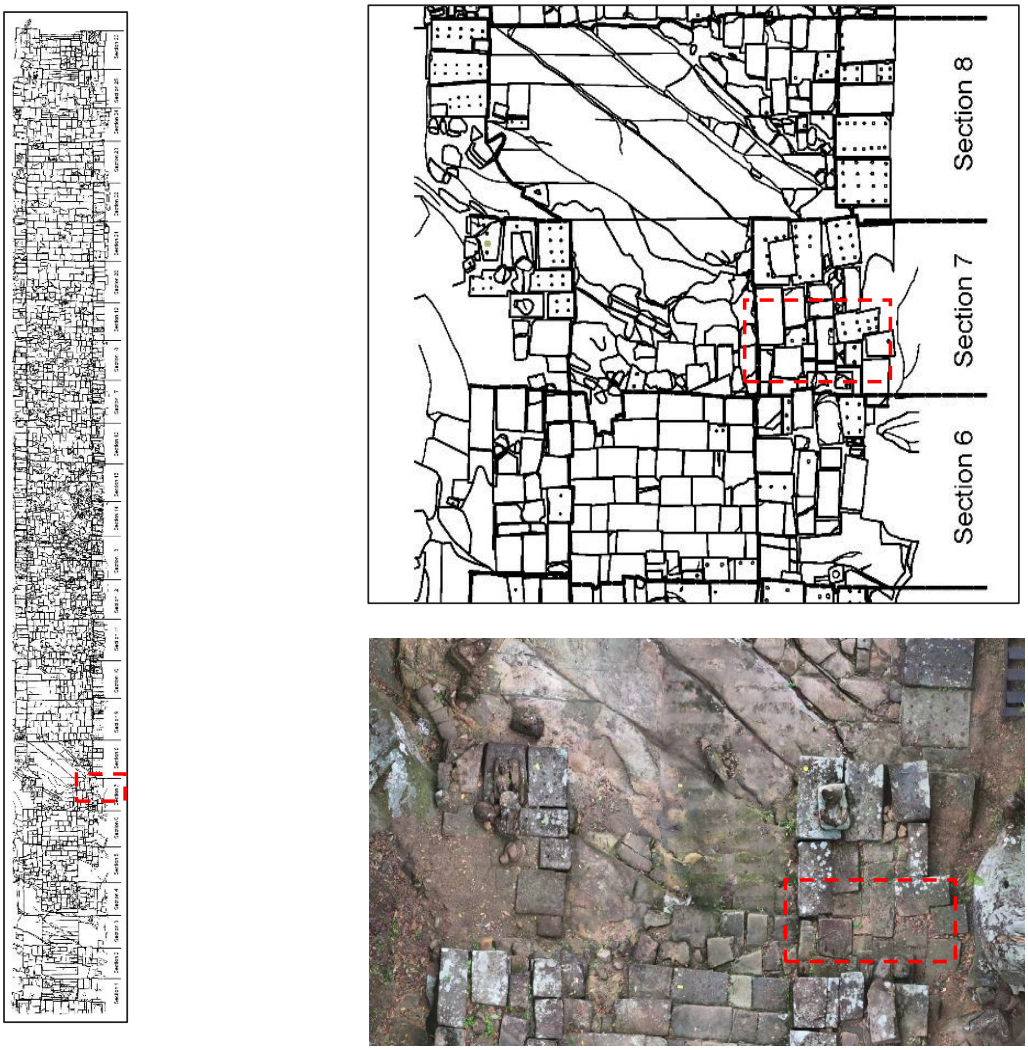


Fig. 16: In the red boxes are plan survey and picture of the excavation trench at the eastern stair wall, section 7 (NS7.EW)



Fig. 17: Condition of excavation trench at east staircase wall, section 7 before excavation (top view)



Fig. 18: Condition of excavation trench at east staircase wall, section 7 after excavation (top view)

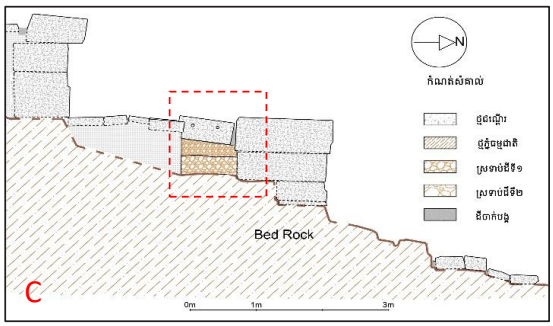


Fig. 19: Cross section C at the eastern stair wall of section 7

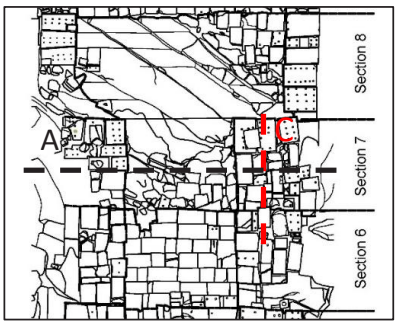


Fig. 20: Floor plan at the eastern stair wall of section 7

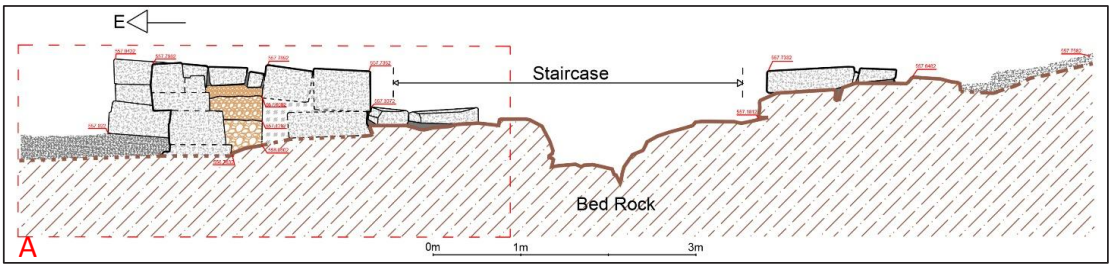


Fig. 21: Cross section A-A of the stair walls and stair step at section 7 (north view)

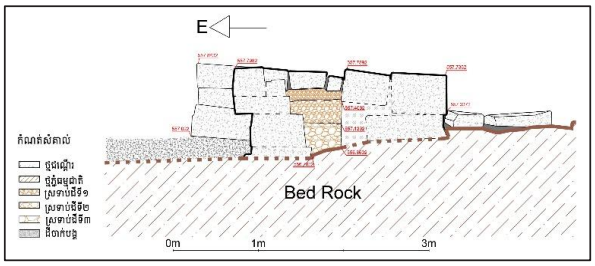


Fig. 22: Cross section A-A at the eastern stair wall of section 7 (North view)



Fig. 23: Excavation trench showing foundation condition at the eastern wall of section 7 after excavation



Fig. 24: Tree roots penetrating into staircase structure



Fig. 25: Foundation soil with a mixture of clay, sand and stone chip



Fig. 26: Excavation trench at the eastern stair wall of section 7 showing soil profile in the southern side (north view)



Fig. 27: Fragment of bedrock used for foundation compaction at the eastern stair wall of section 7

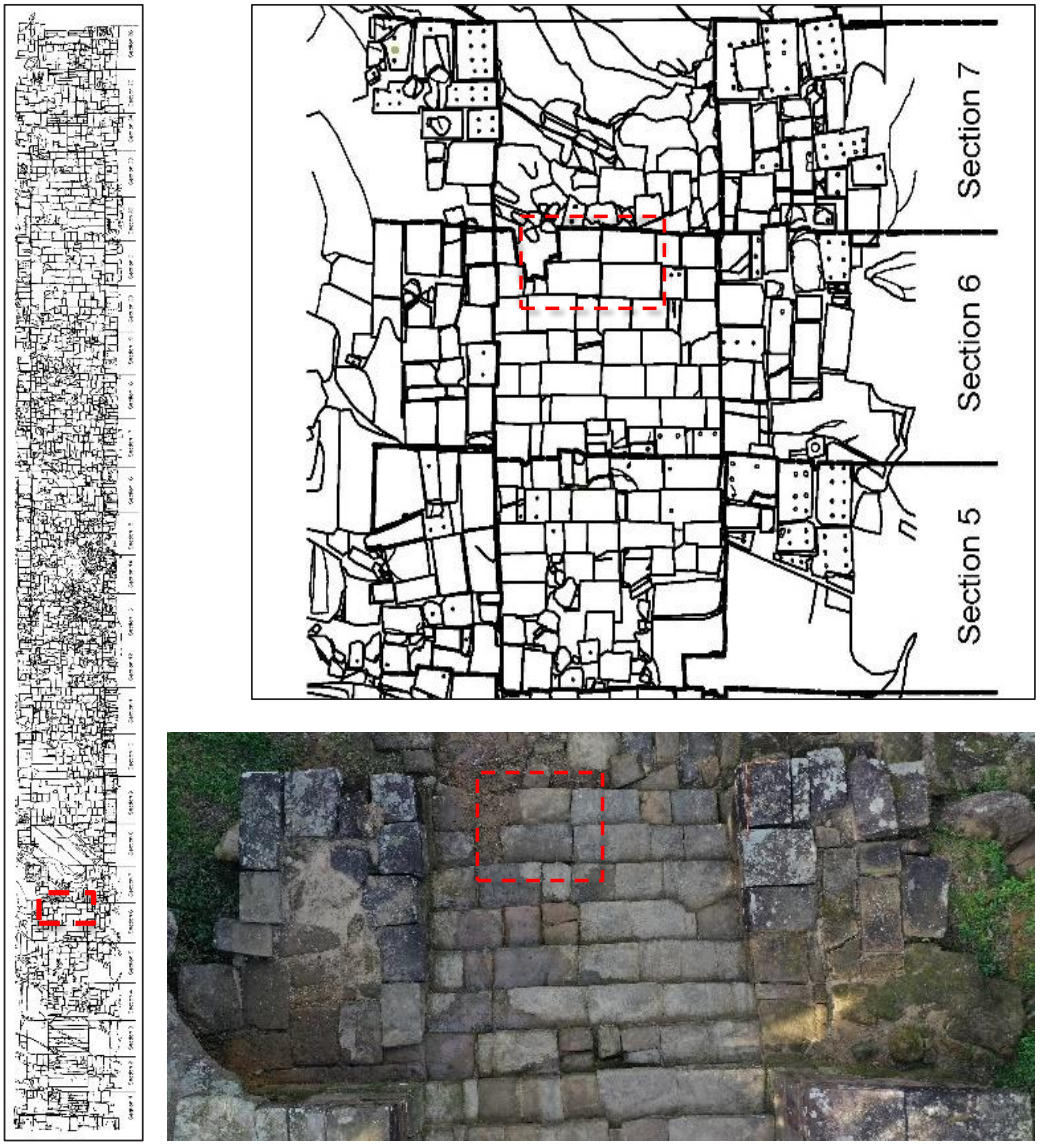


Fig. 28: In the red boxes are plan survey and picture of the excavation trench on stair step of section 6 (NS6.SC)



Fig. 29: Condition at the excavation trench on stair step of section 6 before excavation (top view)



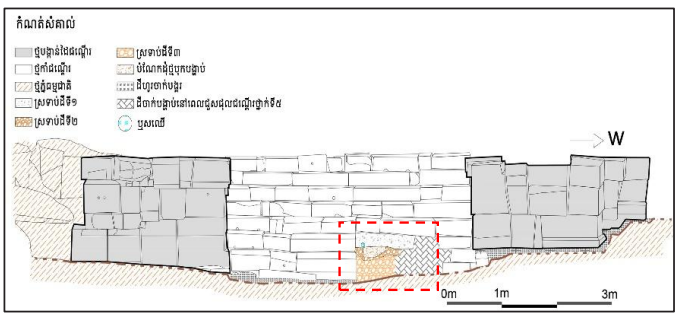
Fig. 30: Condition at the excavation trench on stair step of section 6 before excavation (east view)



Fig. 31: Stone slap being dismantled before excavation



Fig. 32: Tree roots found in the excavation trench after dismantling stone slap at section 6



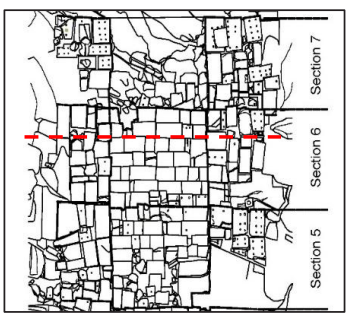
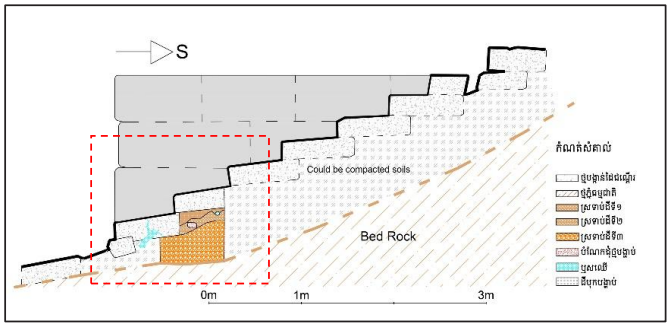


Fig. 33: Cross section A-A of stair step of section 6



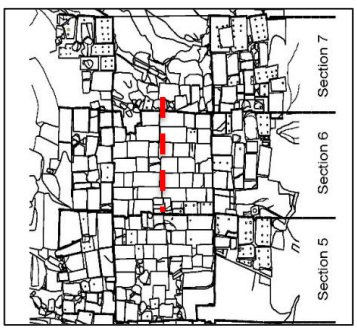


Fig. 34: Cross section at the eastern side of stair step's foundation at section 6

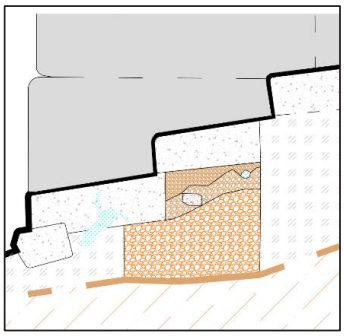


Fig. 35: Soil layer of stair step's foundation at section 6 (west view)



Fig. 36: Condition of foundation structure of stair step at section 6 (west view)

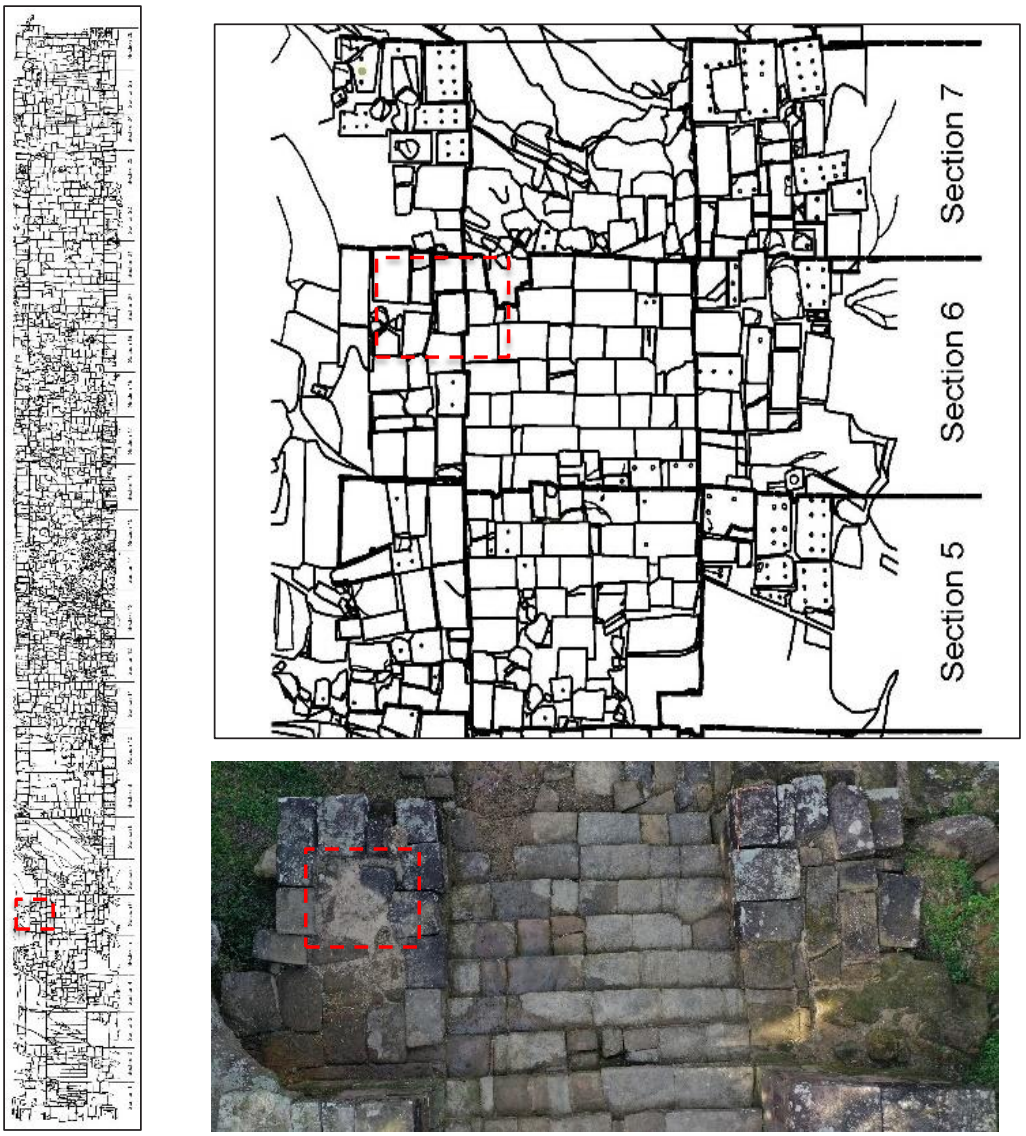


Fig. 37: In the red boxes are plan and picture of excavation trench at the western wall of section 6 (NS6.WW)



Fig. 38: Condition of the excavation trench at the western stair wall of section 6 before excavation (top view)



Fig. 39: Condition of the excavation trench at the western stair wall of section 6 after excavation (top view)

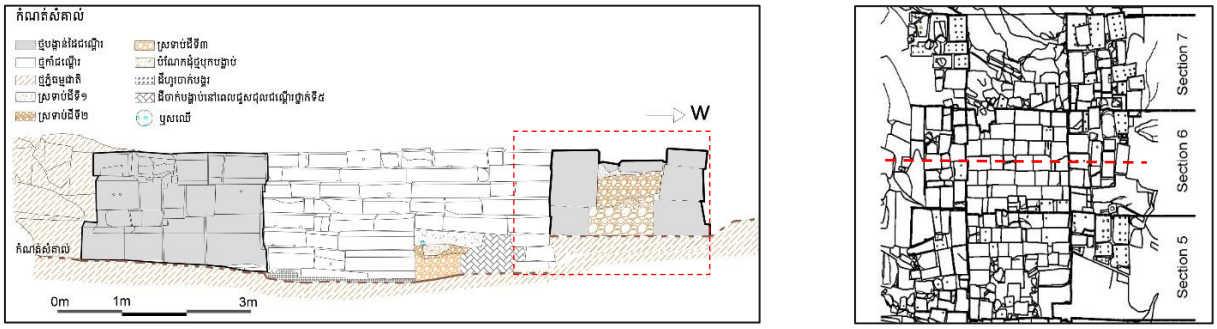


Fig. 40: Cross section (north view) of the excavation trench at the western stair wall of section 6

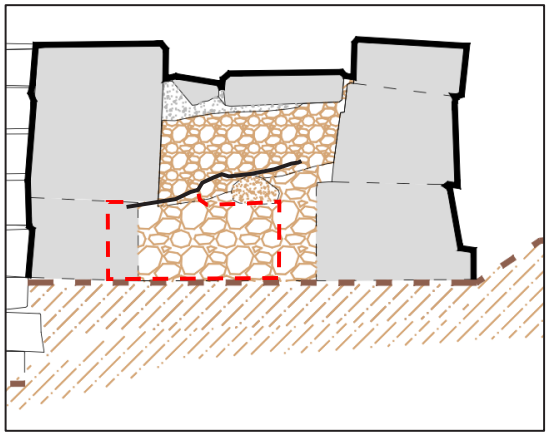


Fig. 41: Soil layer of foundation at the western stair wall of section 6 (north view)



Fig. 42: Condition of foundation structure at the western stair wall of section 6 (north view)



Fig. 43: Size of stone chunk used for foundation compaction found in layer 3 at the western stair wall of section 6 (NS6.WW).



Fig. 44: Composition used for foundation compaction was separated by layers and put into bags for reusing



Fig. 45: Condition of the excavation trench at the eastern stair wall of section 6 before excavation (top view)



Fig. 46: Condition of excavation trench at the eastern stair wall of section 6 after excavation (top view)

Restoration of lion sculptures

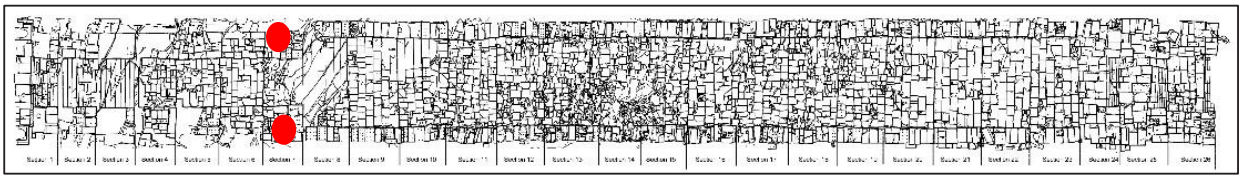


Figure 47: Red points on the plan show location of lion sculptures



Fig. 48: Pictures in red boxes show location of the two-lions sculptures



Fig. 49: Trial in reassembling stone fragment of lion sculptures



Fig. 50: Documentation of stone fragment of lion sculptures

Preah Vihear temple **Documentation and Inventory**												
Object: Lion												
Location: The northern ancient staircase, Section 7, Western wall												
Material: Sandstone	**Color:** Gray											
Code: PVH 2010.059												
Fragment: 3												
Side(cm): (H, L, W)	Body			Back leg, Right side								
	67	82	35	46	33	20						
Picture before restoration												
 Belly view				 Back view					 Right view			
Previous intervention: No												
Damages: • The lion sculpture was broken and remained only 3 pieces (The body, back leg at the right side and small piece • All fragments are in good quality • Back of lion sculpture at the right side is flaking, soiling and covered by moss, lichen and other unidentified biology												
Conservation and restoration proposal • Finding piece and cleaning necessary parts for conservation • Salt extraction and then consolidation of flaking area and reassembling stone pieces												
Record by: Ben Vannak, Lanh Toch							Date: 24/03/022					

Fig. 51: Documentation

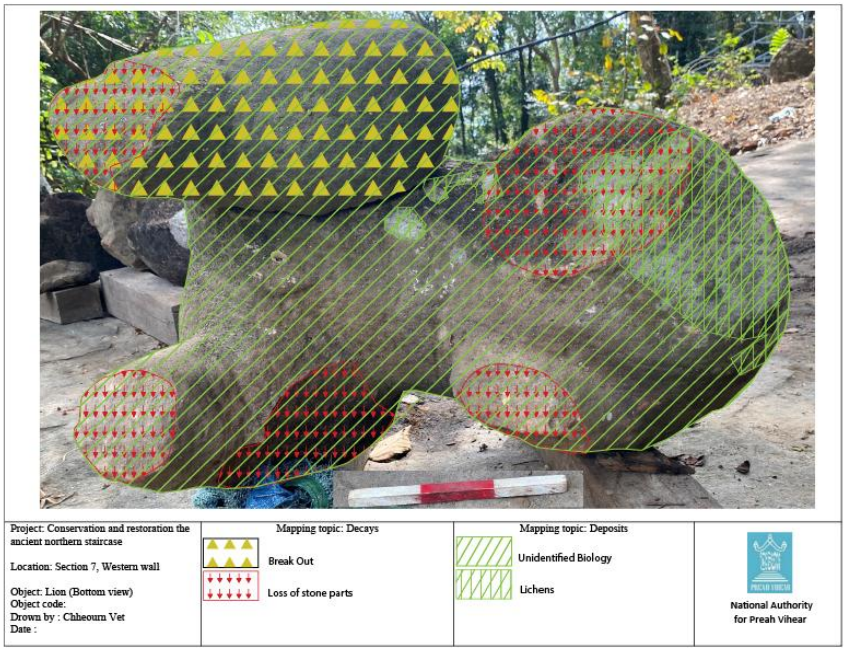


Fig. 52: Digital mapping of Lion code: PVH 2010.059

Preah Vihear temple **Documentation and Inventory**												
Object: Lion												
Location: The northern ancient staircase, Section 7, Western wall												
Material: Sandstone		**Color:** Gray										
Code: PVH 2010.059												
Fragment: 8												
Side(cm): (H, L, W)	Tail			Pedestal left side			Pedestal right side			Butt		
	9	22	7	37	70	30	27	70	20	31	42	23
	Jaw left side			Chest			Front neck			head		
	5	13	9	10	25	12	22	36	28	35	48	38

Picture before restoration:



Top view



Front view



Back view

Previous intervention: No

Damages:

- The lion was broken into many pieces, and remaining only 8 fragments, all of which are in good quality
- flaking, decays, soiling and covered by unidentified biology

Conservation and restoration proposal

- Finding pieces and cleaning necessary parts for conservation
- Salt extraction and then consolidation of flacking area and reassembling pieces

Record by: Ben Vannak, Lanh Toch | Date: 24/03/022

Fig. 53: Documentation

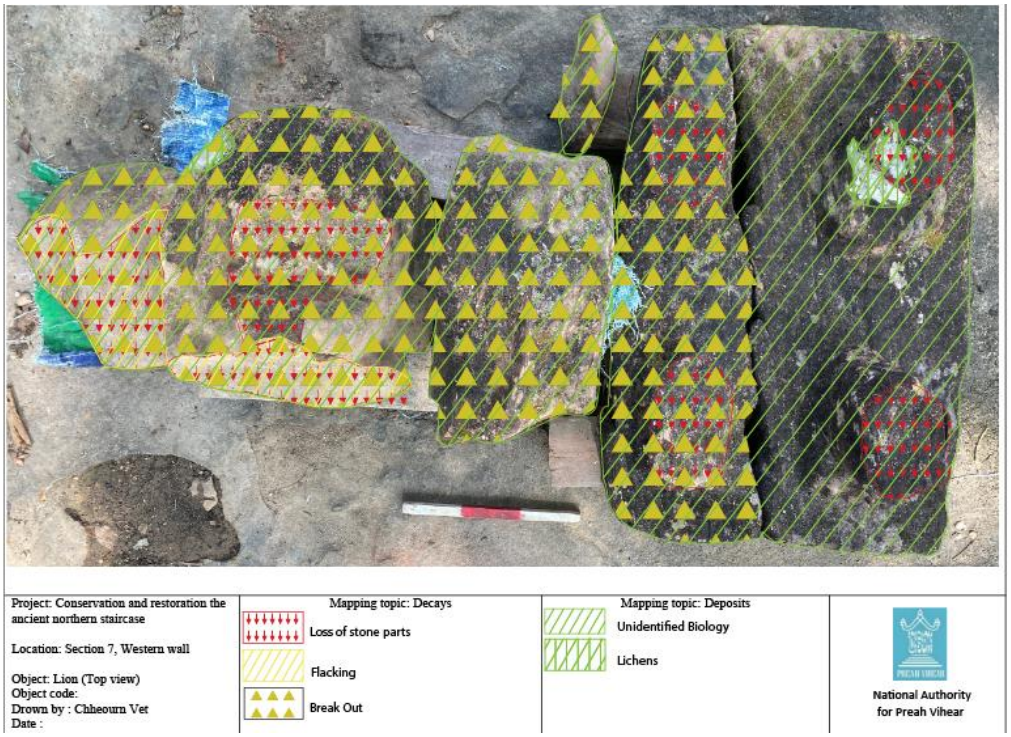


Fig. 54: Digital mapping of Lion code: PVH 2010.059

Preah Vihear temple **Documentation and Inventory**												
Object: Lion												
Location: The northern ancient staircase, Section 7, Western wall												
Material: Sandstone		**Color:** Gray										
Code: PVH 2010.059												
Fragment: 3												
Side(cm): (H, L, W)	Left ear			Right of head piece			Front leg					
	14	39	25	27	71	45	13	13	4			
Picture before restoration												
 Left view												
Previous intervention: No												
Damages: • The lion sculpture was broken into pieces and remaining only 3 pieces, all of which are in good condition • Flaking and covered by unidentified biology												
Conservation and Restoration proposal • Finding pieces and cleaning necessary parts for conservation • Salt extraction and then consolidation flaking area and reassembling pieces												
Record by: Ben Vannak, Lanh Toch							Date: 24/03/022					

Fig. 55: Documentation

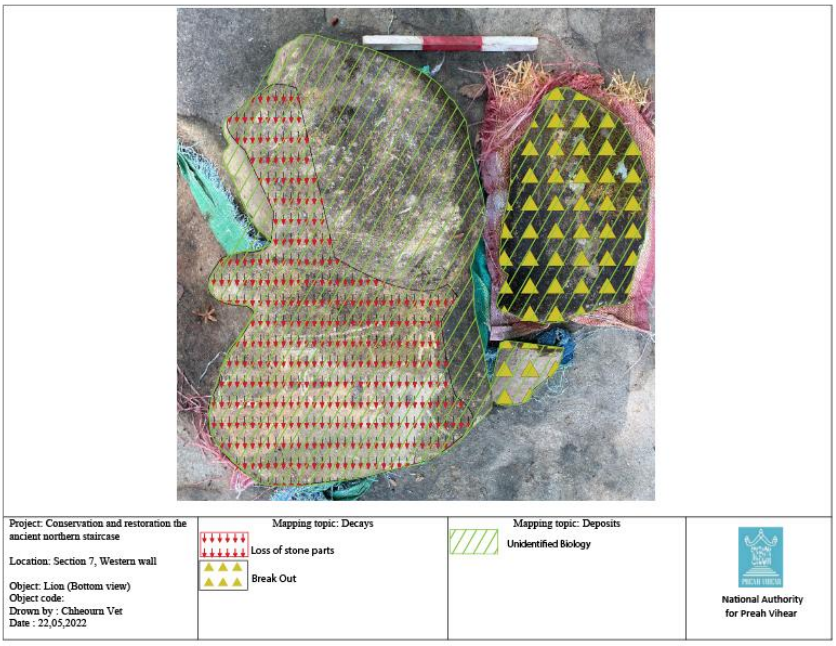


Fig. 56: Digital mapping of lion code: PVH 2010.059

Drainage system restoration and rehabilitation

Preparing a new small drainage system for diverting water from the staircase at section 7 (Recommendation c.)

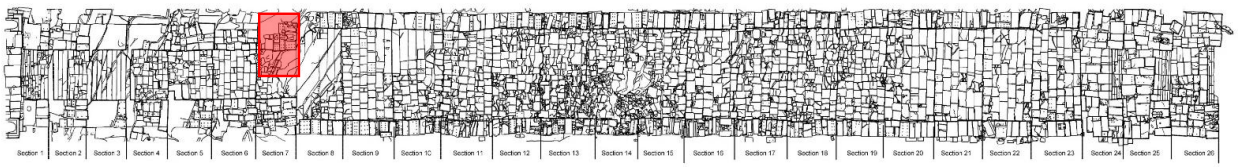


Fig. 57: In red box shows location of drainage system being created



Fig. 58: Rain water flows on bedrock of foundation at section 7 (Top view)



Fig. 59: Rain water flows on bedrock of foundation at Section 7 (North view)



Fig. 60: Blue line shows location of channel under stone slabs of stair step at Section 7 (Top view)

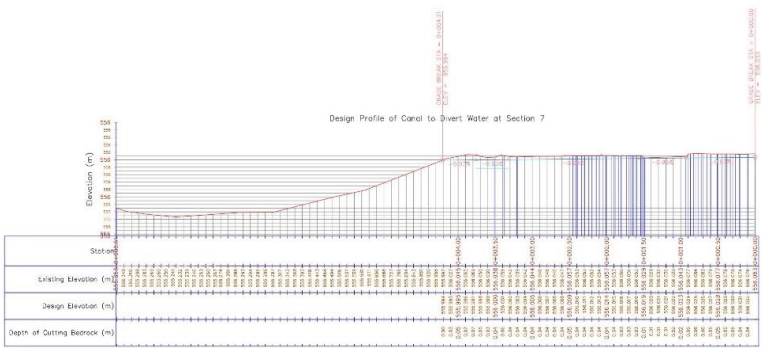


Fig. 61: Red line shows surface profile of bedrock, and blue line shows channel bed under stone slab of stair step at Section 7



Fig. 62: Elevation survey of channel bed before carving bedrock



Fig. 63: Carving bedrock into small channel under stone slab



Fig. 64: Red line shows small channel under stone slab of stair step after carving (Top View)

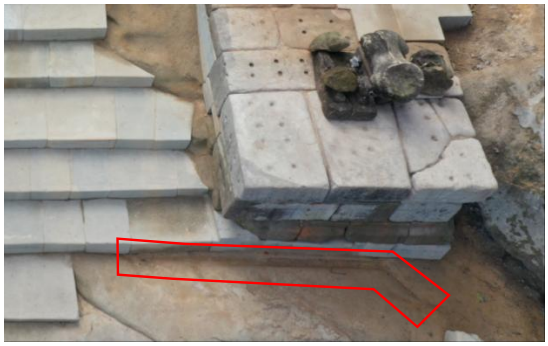


Fig. 65: Small water channel on bedrock

Creating a new small drainage system for diverting water from the staircase at section 9 (Recommendation c.)

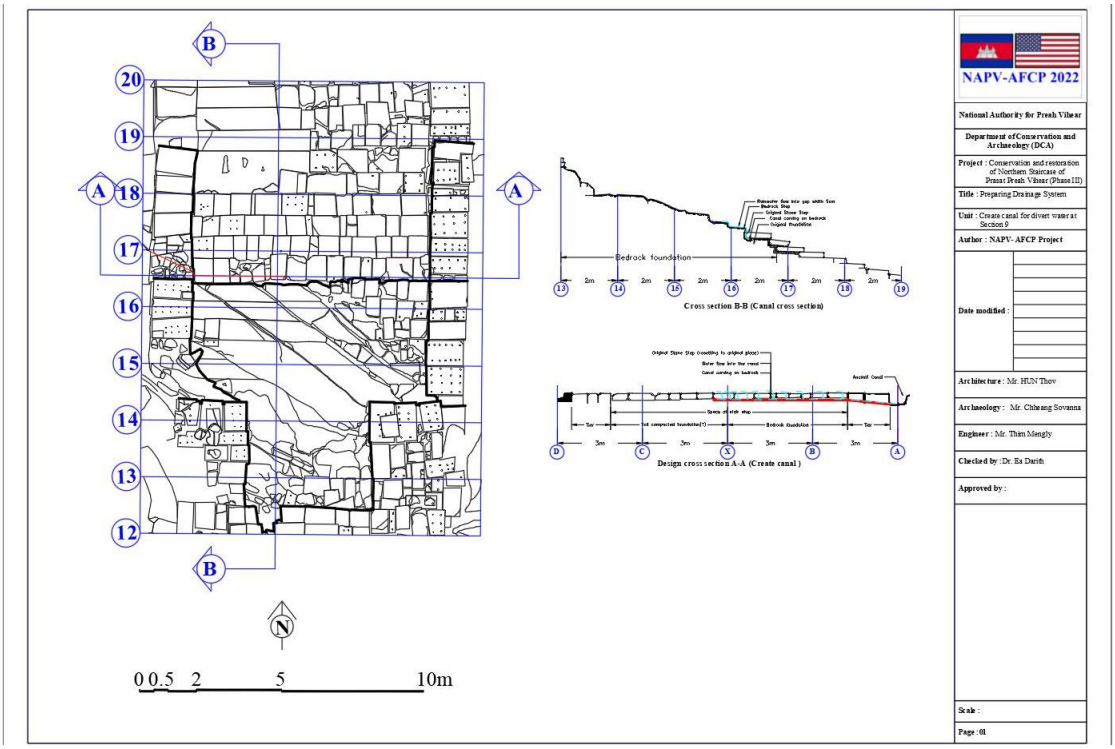


Fig. 66: Plan design of a new water channel at section 9



Fig. 67: Blue line shows location of water channel under stone slab at Section 9 (Top view)

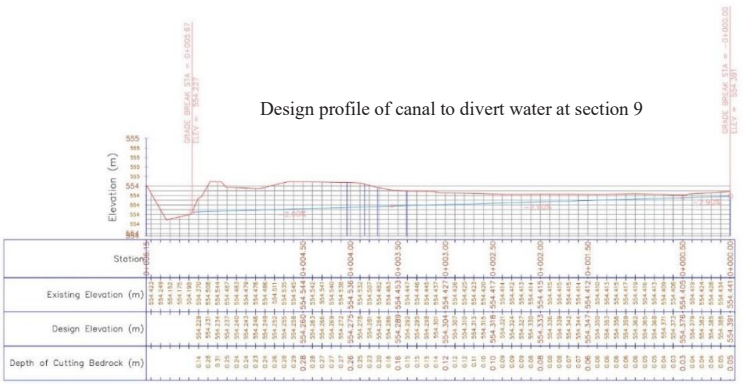


Fig. 68: Red line shows surface profile of bedrock, and blue line shows channel bed with slope 2.9%



Fig. 69: Bedrock carving activities to create water channel for water diversion

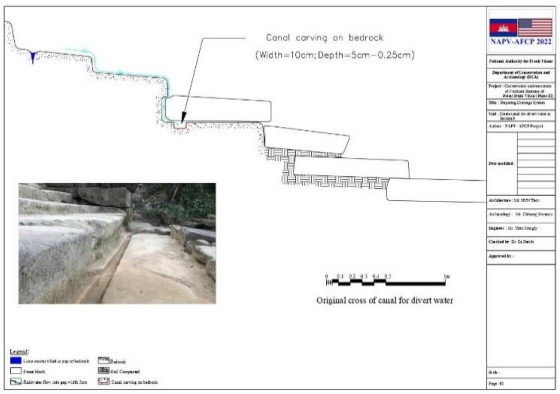


Fig. 70: Cross section of water channel under first stone slab of stair step at section 9



Fig. 71: Red line on bedrock surface under stone slab at first step of section 9 shows location to be created a water channel

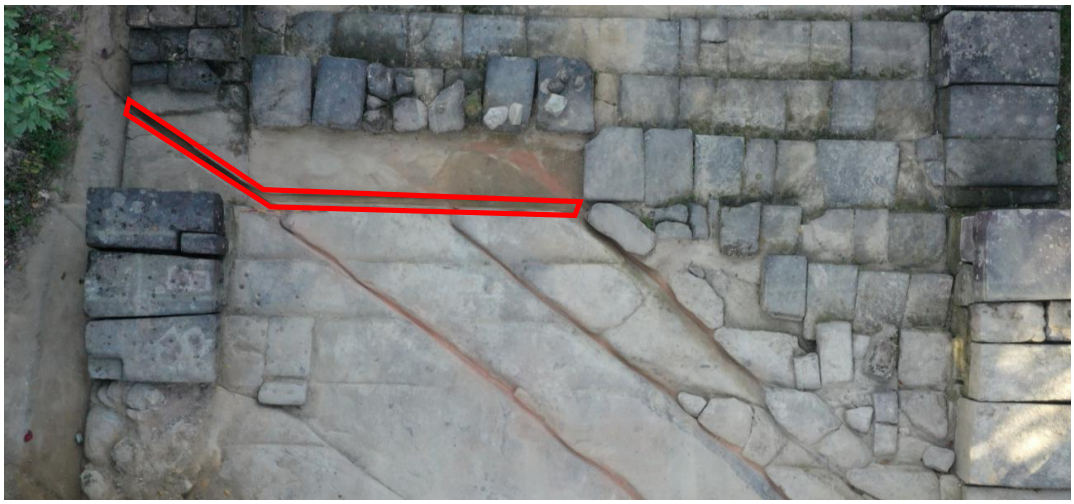


Fig. 72: Red line shows water channel being created on bedrock

Conservation and Restoration of the Northern Staircase

Location

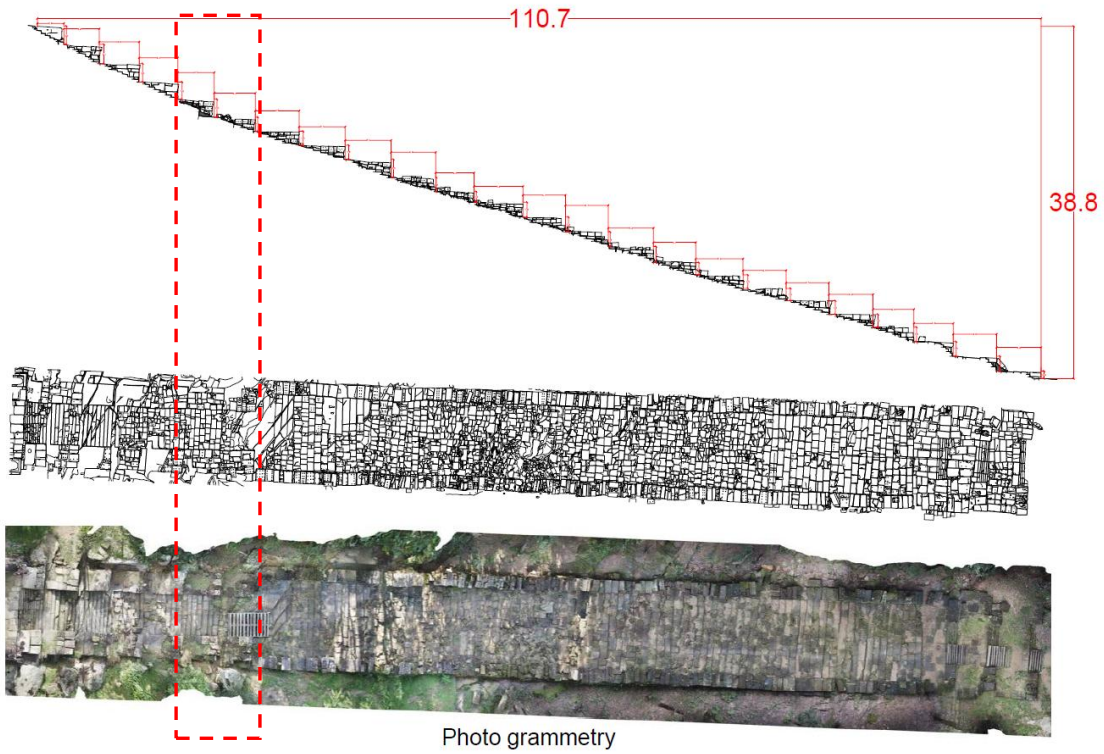


Fig. 73: Plan and elevation of the northern ancient staircase, and restoration part of sections 6-7 in red box

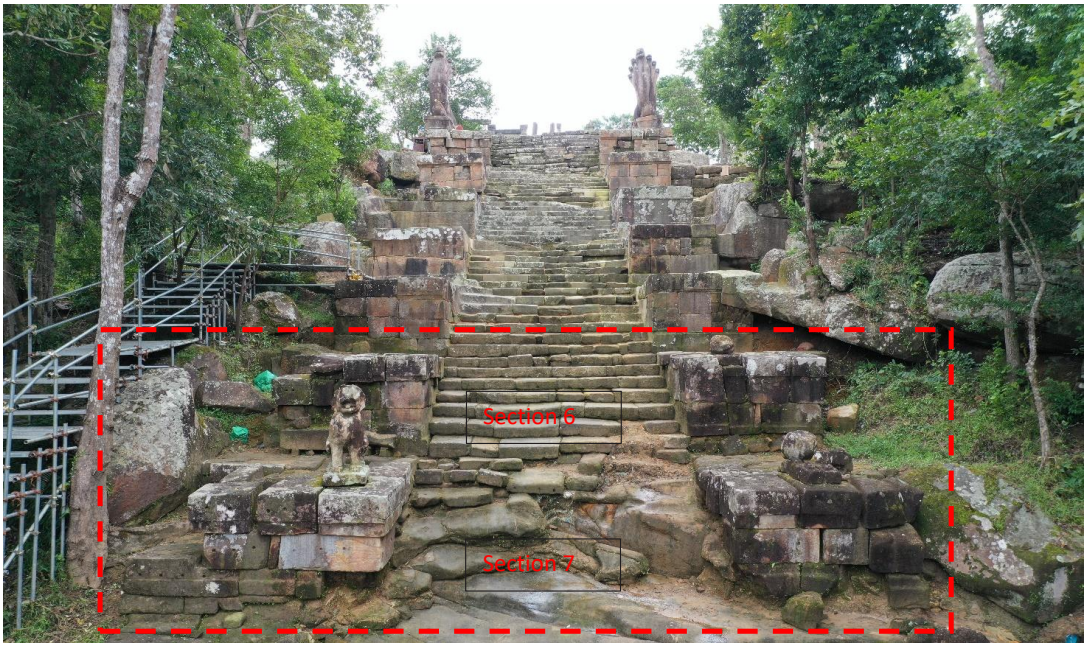
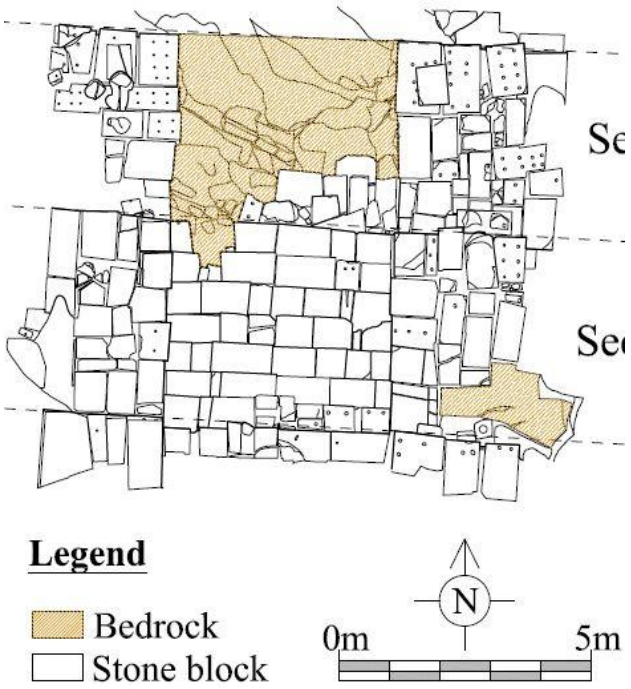


Fig. 74: Red line shows the location and condition of staircase at sections 6-7



Fig. 75: General condition and existing plan at sections 6-7 before restoration



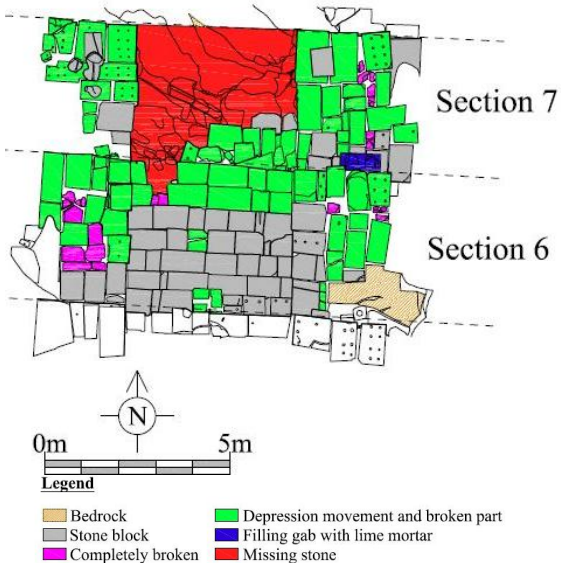


Fig. 76: Risk analysis of the staircase structure at sections 6-7

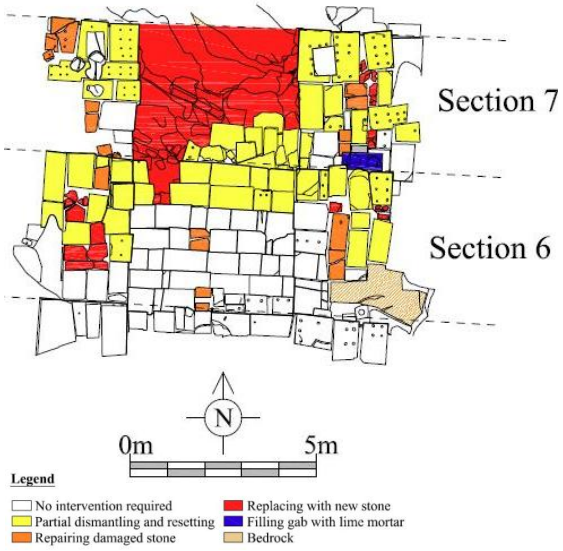


Fig. 77: Typology of intervention for restoration and conservation



Fig. 78: Condition of staircase at section 7 before restoration (Top view)



Fig. 79: Foundation of the eastern stair wall at section 7 not stable and loss of some stone blocks



Fig. 80: Movement of stone blocks from their original positions at the western stair wall causing to settlement and damage



Fig. 81: Stone blocks dismantled in the eastern wall of section 7



Fig. 82: Stone blocks dismantled in the western wall section 7



Fig. 83: Removing soil, tree roots and debris at the eastern wall of section 7



Fig. 84: Removing deteriorated bedrock of foundation in the western stair wall

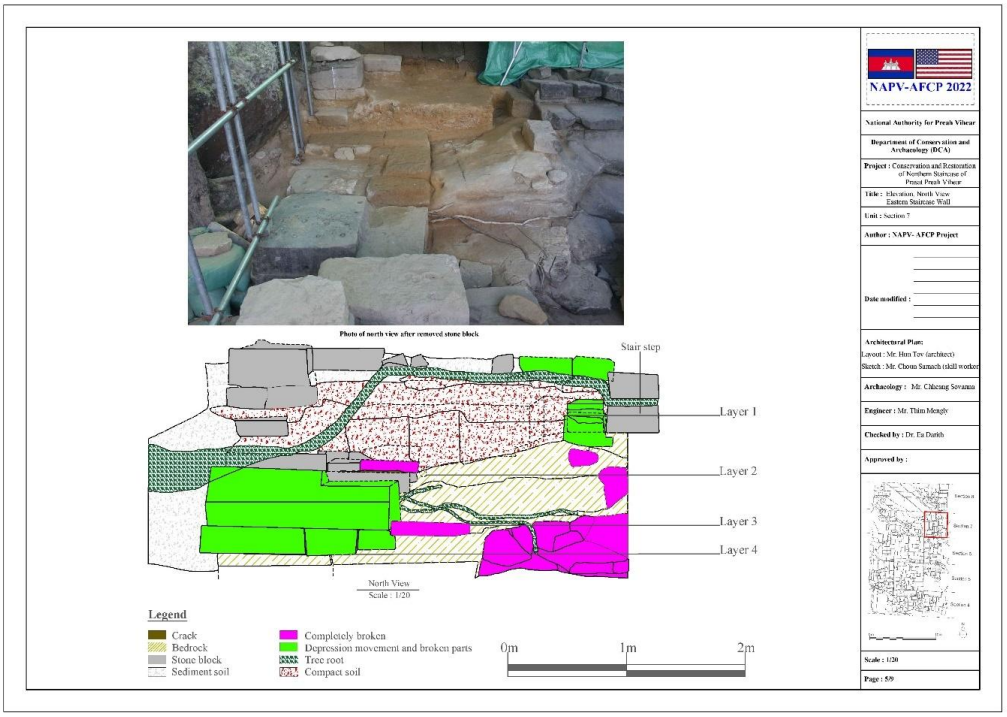


Fig. 85: Typology of risk analysis at the eastern stair wall, showing high risk at the 4th layer, section 7

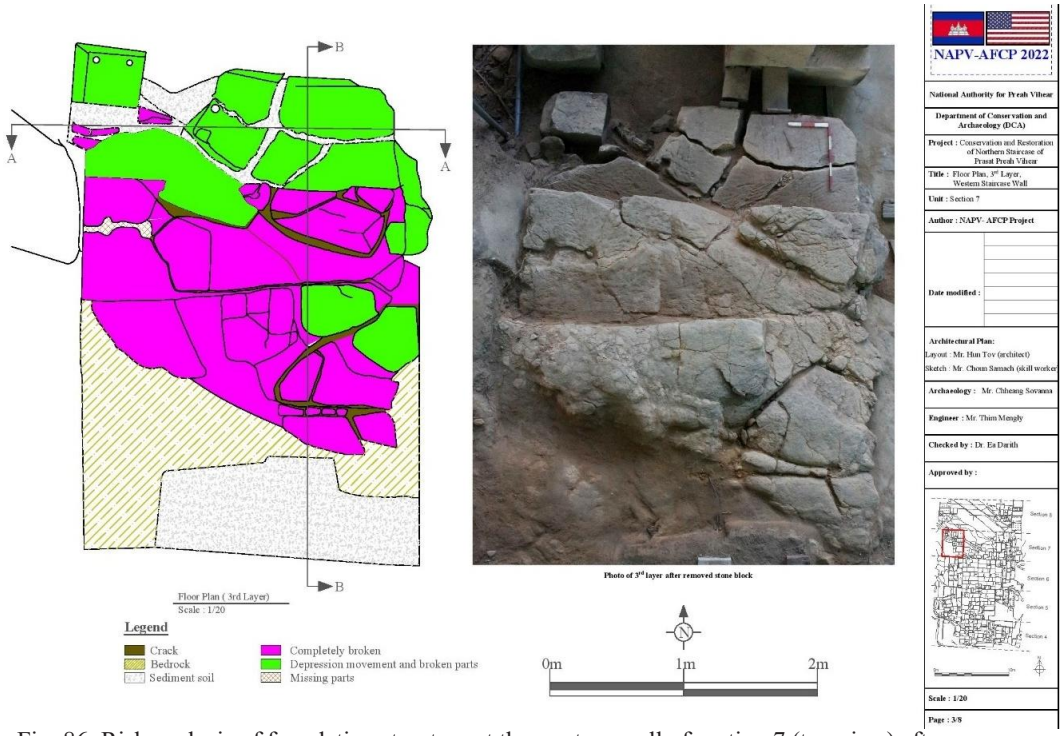


Fig. 86: Risk analysis of foundation structure at the western wall of section 7 (top view) after dismantled



Fig. 87: Risk analysis of staircase structure at section 7 (front view) after stone blocks were dismantled

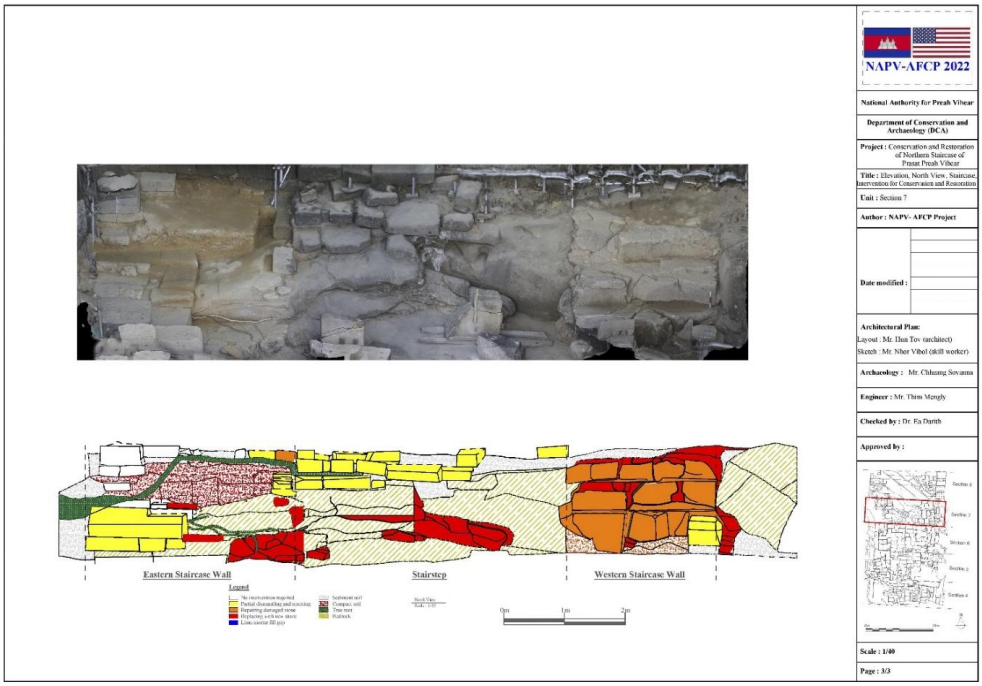


Fig. 88: Typology of intervention for restoration and conservation at section 7 (front view) after stone slabs and stone blocks were dismantled


Fig. 89: Restoration of bedrock foundation at section 7



Fig. 90: Core drilling on bedrock to reinforce with stainless steel and Epoxy Sikadur at section 7

conservation and restoration ancient northern staircase Preah Vihear temple, Phase III, 2021-2022

The list of securing bedrock foundation of section 7

No	Bore hole code	Type	Typology	Risk	Condition	Core drilling size	Condition during drilled	Restoration	length of dowel	Others
1	BH.NS7.W.O1	Bedrock	wall	Meduim	scale	Φ 22mm= 132 cm	.00cm - 75cm the stone poor condition .76cm - 132cm the stone good condition	Drilling holl to put stainless steel dowell with Epoxy Sikadur Resin 52 TH	Φ 20mm= 100 cm	
2	BH.NS7.W.O2	Bedrock	wall	Meduim	scale	Φ 22mm= 111 cm	.00cm- 55cm the stone poor condition(scale) .56cm-111cm the stone good condition	Drilling holl to put stainless steel dowell with Epoxy Sikadur Resin 52 TH	Φ 20mm= 100 cm	
3	BH.NS7.W.O3	Bedrock	wall	Meduim	scale	Φ 22mm= 120 cm	.00cm - 75cm the stone poor condition .76cm - 120cm the stone good condition	Drilling holl to put stainless steel dowell with Epoxy Sikadur Resin 52 TH	Φ 20mm= 100 cm	
4	BH.NS7.W.O4	Bedrock	wall	Hight	cracking	Φ 22mm= 105 cm	.00cm - 39cm the stone poor condition(scale) .40cm - 53cm the stone poor condition(scale) .54cm - 105cm the stone good condition	Drilling holl to put stainless steel dowell with Epoxy Sikadur Resin 52 TH	Φ 20mm= 100 cm	
5	BH.NS7.W.O5	Bedrock	wall	Meduim	cracking	Φ 22mm= 118 cm	.00cm - 40cm the stone poor condition .41cm - 118cm the stone good condition	Drilling holl to put stainless steel dowell with Epoxy Sikadur Resin 52 TH	Φ 20mm= 100 cm	
6	BH.NS7.W.O6	Bedrock	wall	Meduim	cracking	Φ 22mm= 104 cm	.00cm - 44cm the stone poor condition(scale) .45cm - 69cm the stone poor condition(scale) .70cm - 104cm the stone good condition	Drilling holl to put stainless steel dowell with Epoxy Sikadur Resin 52 TH	Φ 20mm= 100 cm	
7	BH.NS7.W.O7	Bedrock	wall	Meduim	scale	Φ 22mm= 127 cm	.00 cm - 50cm the stone poor condition . 51cm - 127cm the stone good condition	Drilling holl to put stainless steel dowell with Epoxy Sikadur Resin 52 TH	Φ 20mm= 120cm	
8	BH.NS7.W.O8	Bedrock	wall	Meduim	cracking	Φ 22mm= 113 cm	.00 cm - 45cm the stone poor condition .46cm - 113cm the stone good condition	Drilling holl to put stainless steel dowell with Epoxy Sikadur Resin 52 TH	Φ 20mm= 100 cm	
9	BH.NS7.W.O9	Bedrock	wall	Meduim	cracking	Φ 22mm= 110 cm	.00 cm - 42cm the stone poor condition(scale) .43cm - 75cm the stone poor condition(scale) .76cm - 110cm the stone good condition	Drilling holl to put stainless steel dowell with Epoxy Sikadur Resin 52 TH	Φ 20mm= 100 cm	
10	BH.NS7.S.01	Bedrock	step	Hight	cracking	Φ 22mm= 123 cm	.00cm - 54cm the stone poor condition .55cm - 123cm the stone good condition	Drilling holl to put stainless steel dowell with Epoxy Sikadur Resin 52 TH	Φ 20mm= 120cm	
11	BH.NS7.S.02	Bedrock	step	Hight	cracking	Φ 22mm= 105 cm	.00 cm - 38cm the stone poor condition . 39cm - 47cm the stone is poor condition(Scale) . 48cm- 105cm stone is good condition	Drilling holl to put stainless steel dowell with Epoxy Sikadur Resin 52 TH	Φ 20mm= 100 cm	
12	BH.NS7.S.03	Bedrock	step	Hight	cracking	Φ 22mm= 107 cm	.00 cm - 30cm the stone poor condition . 31cm - 107cm the stone good condition	Drilling holl to put stainless steel dowell with Epoxy Sikadur Resin 52 TH	Φ 20mm= 100 cm	

Fig. 91: The list of core drilling into bedrock foundation at section 7



Fig 92: Fixing broken stone blocks by drilling holes, inserting Fiberglass and injecting Epoxy Sikadur resin 52 TH



Fig. 93: Foundation compaction in the eastern stair wall of section 7



Fig. 94: Reassembling stone blocks to original position at the eastern stair wall of section 7



Fig. 95: Restoration of stair wall and stair step at section 7



Fig. 96: Plan showing locations of foundation where test was applied

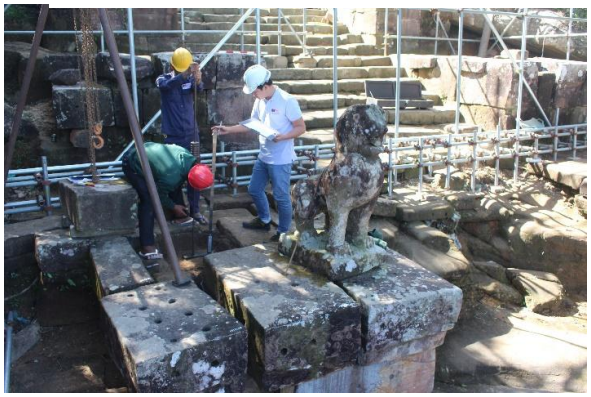


Fig. 97: Apply DCPT cone tip to test foundation -bearing capacity in the eastern wall before removal of original soil



Fig. 98: Apply DCPT cone tip to test foundation-bearing capacity in the eastern wall after foundation was compacted

Table 2: List of stone slabs, stone blocks and bedrock being carried out treatment

No	Stone code	Type	Typology	Risk	Condition	Restoration	Dowell	Others
1	NS7.E.1.1	Sandstone	East Wall	Meduim	Break Out	Drilling holl to put fiberglass dowell with Epoxy Sikadur Resin 752 TH	Φ=8 mm, 16 cm	
2	NS7.E.1.2	Sandstone	East Wall	Meduim	Break Out		Φ=6 mm, 29 cm Φ=6 mm, 29 cm Φ=6 mm, 29 cm	
3	NS7.E.1.3	Sandstone	East Wall	Meduim	Break Out		Φ=12 mm, 8 cm Φ=16 mm, 15.5cm	
4	NS7.E.E1.10	Sandstone	East Wall	Meduim	Break Out		Φ=10 mm, 15 cm Φ=10 mm, 15 cm Φ=6 mm, 19 cm	
5	NS7.E.1.11	Sandstone	East Wall	Meduim	Break Out		Φ=6 mm, 29 cm Φ=6 mm, 29 cm	
6	NS7.E.2.5	Sandstone	East Wall	Meduim	Break Out		Φ=12 mm, 18cm Φ=12 mm, 15cm	
7	NS7.E.2.15	Sandstone	East Wall	Meduim	Break Out		Φ=6 mm, 24 cm Φ=6 mm, 24 cm	
8	NS7.E.2.12	Sandstone	East Wall	Meduim	Break Out		Φ=10 mm, 18 cm Φ=10 mm, 18cm	
9	NS7.E.3.15	Sandstone	East Wall	Meduim	Break Out		Φ=10 mm, 20 cm Φ=10 mm, 20cm	
10	NS7.E.3.16	Sandstone	East Wall	Meduim	Break Out		Φ=6 mm, 20 cm Φ=10 mm, 20 cm Φ=10 mm, 20 cm Φ=10 mm, 20 cm	
11	NS7.W.1.2	Sandstone	West wall	Meduim	Break Out		Φ=10 mm, 20 cm Φ=10mm, 20 cm	
12	NS7.W.1.9/3	Sandstone	West wall	Meduim	Break Out		Φ=16 mm, 19 cm Φ=16 mm, 19 cm	
	NS7.W.1.9/1	Sandstone	West wall	Meduim	Break Out		Φ=16 mm, 28 cm Φ=16 mm, 31 cm Φ=16 mm, 29 cm	
13	NS7.S.1.6	Sandstone	Stair step		Break Out		Φ=16 mm, 28 cm Φ=16 mm, 28 cm Φ=16 mm, 28 cm	
14	NS7.S.2.4	Sandstone	Stair step		Break Out		Φ=12 mm, 20cm	

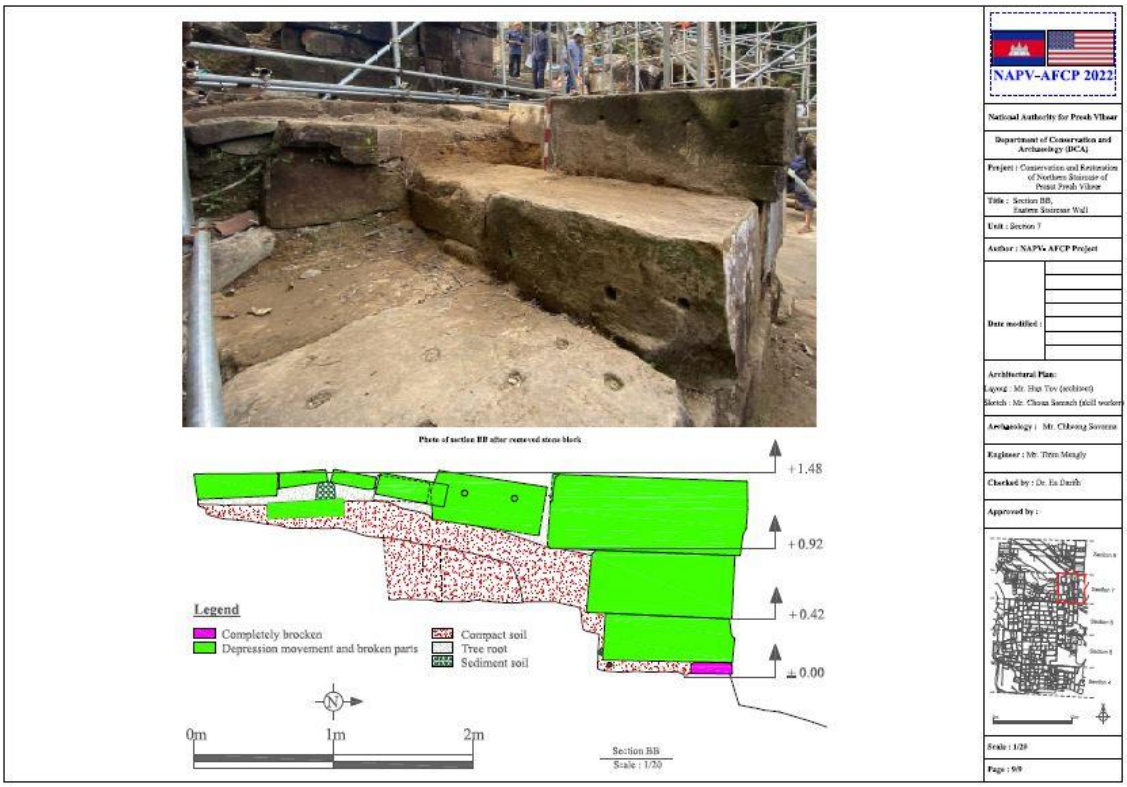


Fig. 99: Picture and plan of cross section in the eastern wall before restoration

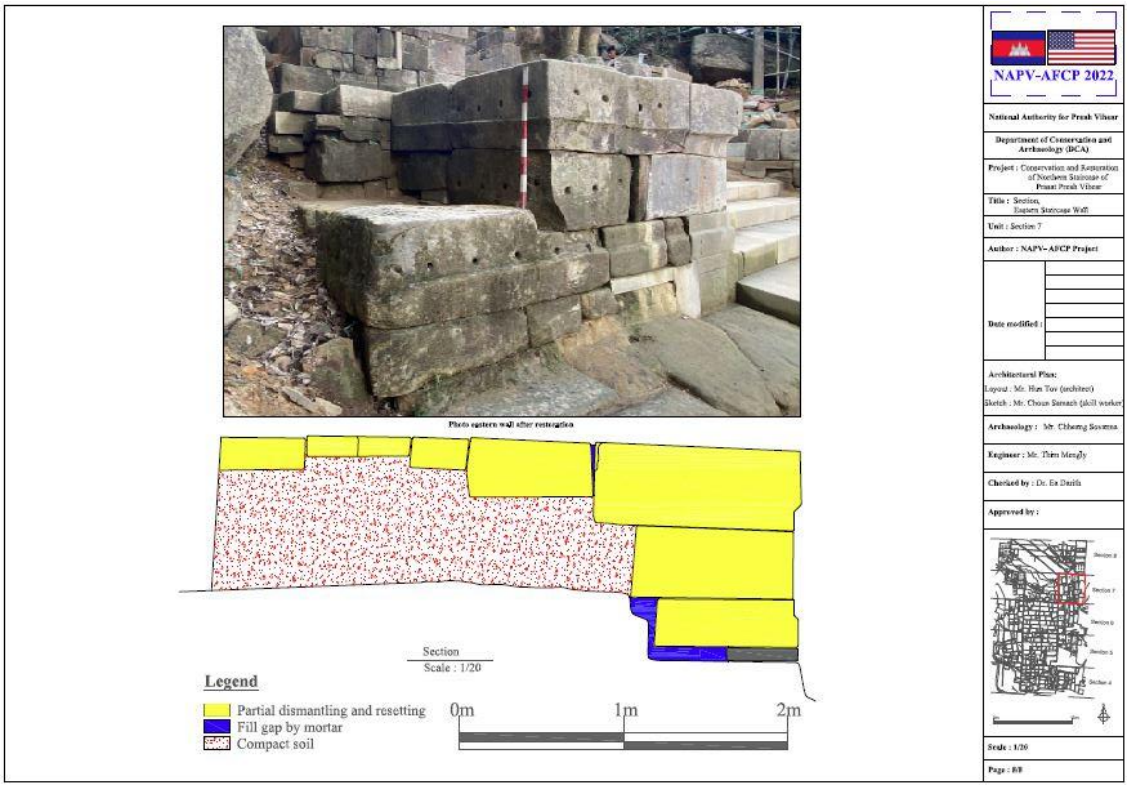


Fig. 100: Picture and plan of cross section at the eastern wall after restoration



Fig. 101: Picture and plan of the northern staircase at section 7 before restoration

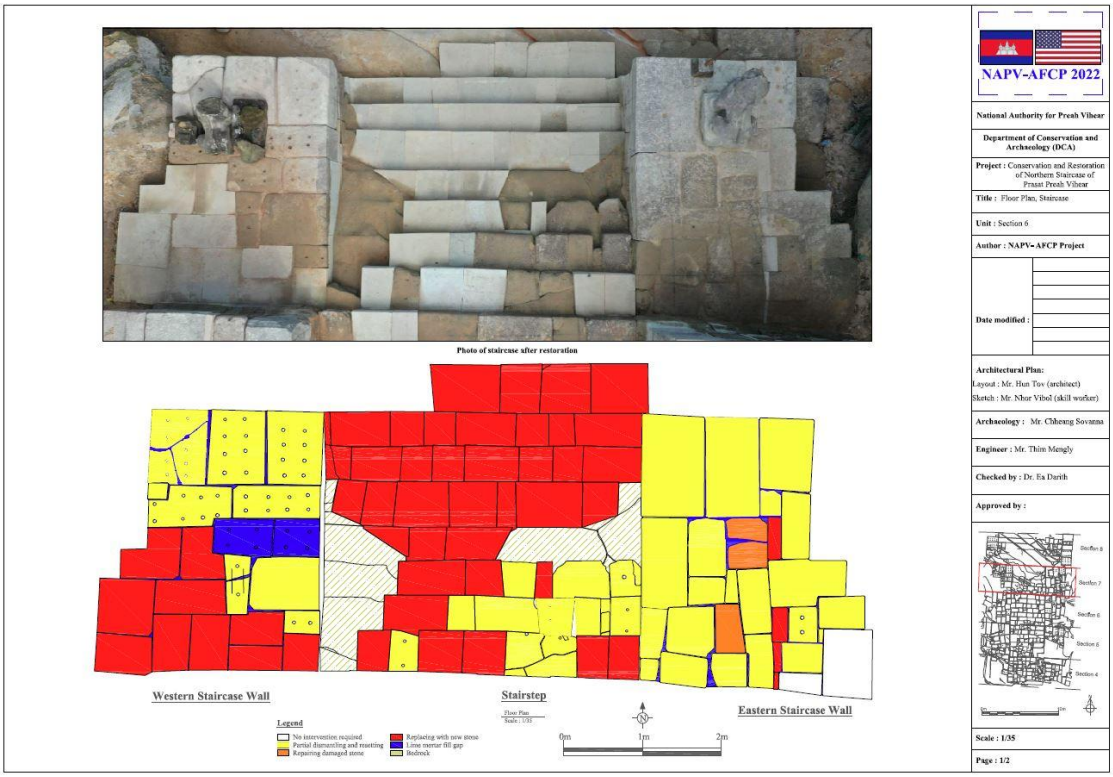


Fig. 102: Picture and plan of the northern staircase at section 7 after restoration (top view)

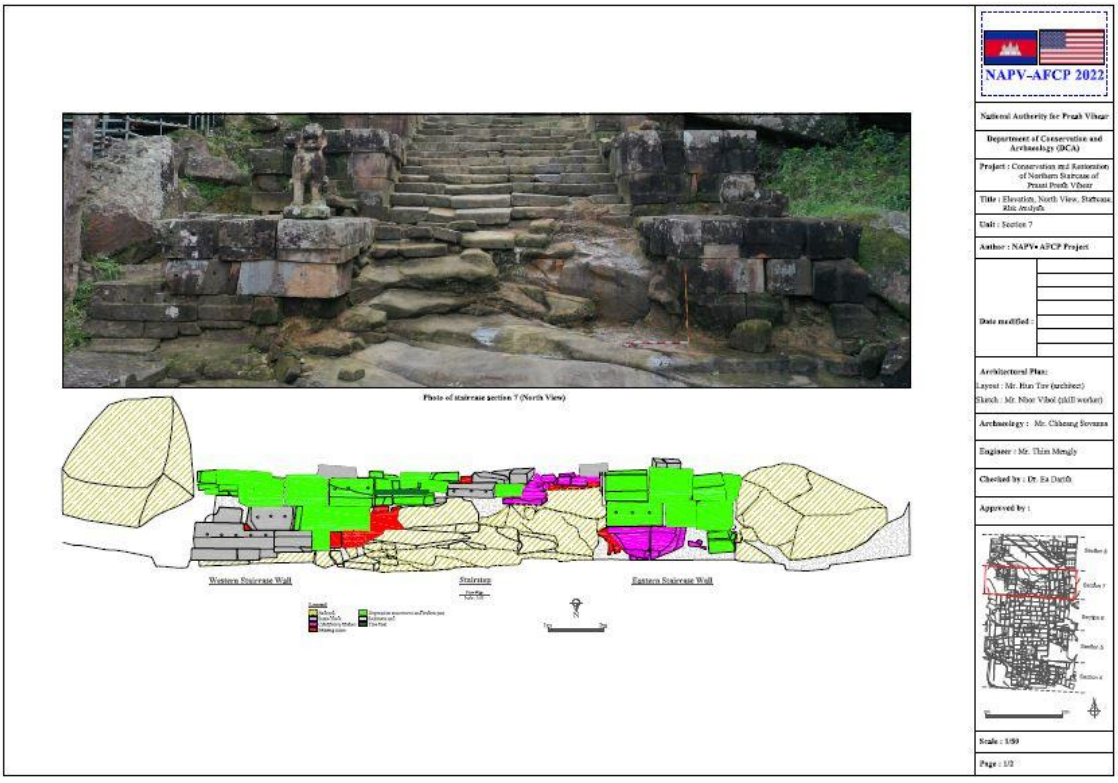


Fig. 103: Picture and plan of the northern staircase at section 7 after restoration (front view)



Fig. 104: Picture and plan of the northern staircase at section 7 after restoration (front view)

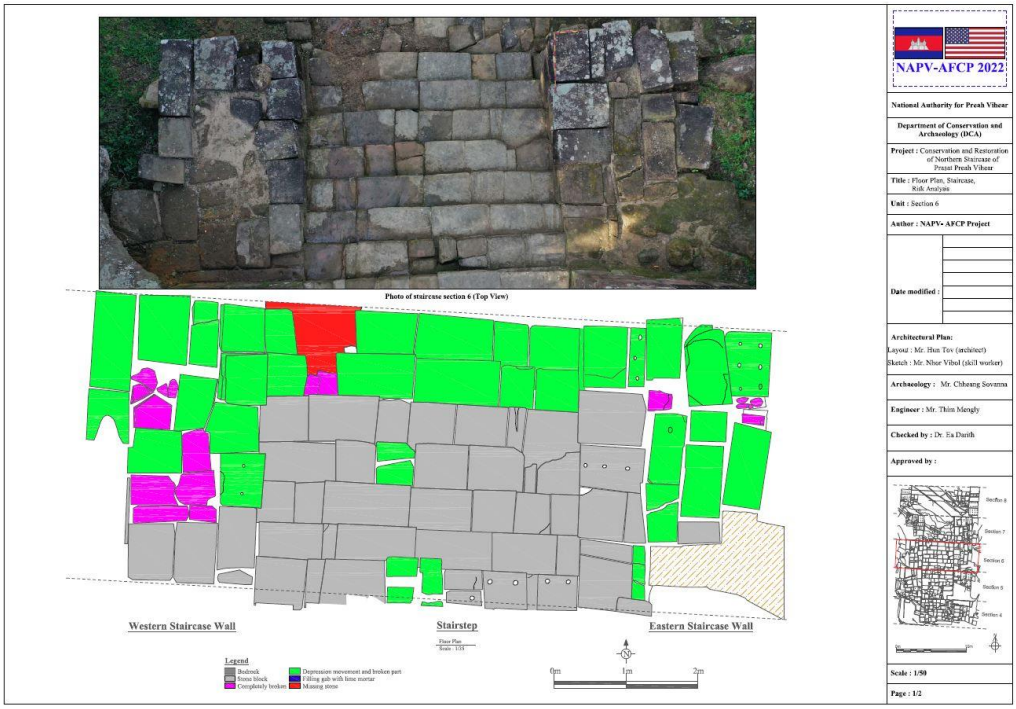


Fig. 105: Risk typology of stone steps at section 6 before restoration (Top view)



Fig. 106: Movement of stone blocks at the eastern wall of section 6



Fig. 107: Movement of stone blocks at the western wall and missing stone slabs on stair step of section 6



Fig. 108: Dismantled stone blocks at the eastern wall of section 6



Fig. 109: Removed debris and soil sediment at the eastern wall of section 6



Fig. 110: Compaction of foundation at the western stair wall



Fig. 111: Compaction of foundation at the eastern wall.



Fig. 110: Reassembling stone blocks to their original positions at the eastern



Fig. 111: Compaction of foundation at the eastern wall.

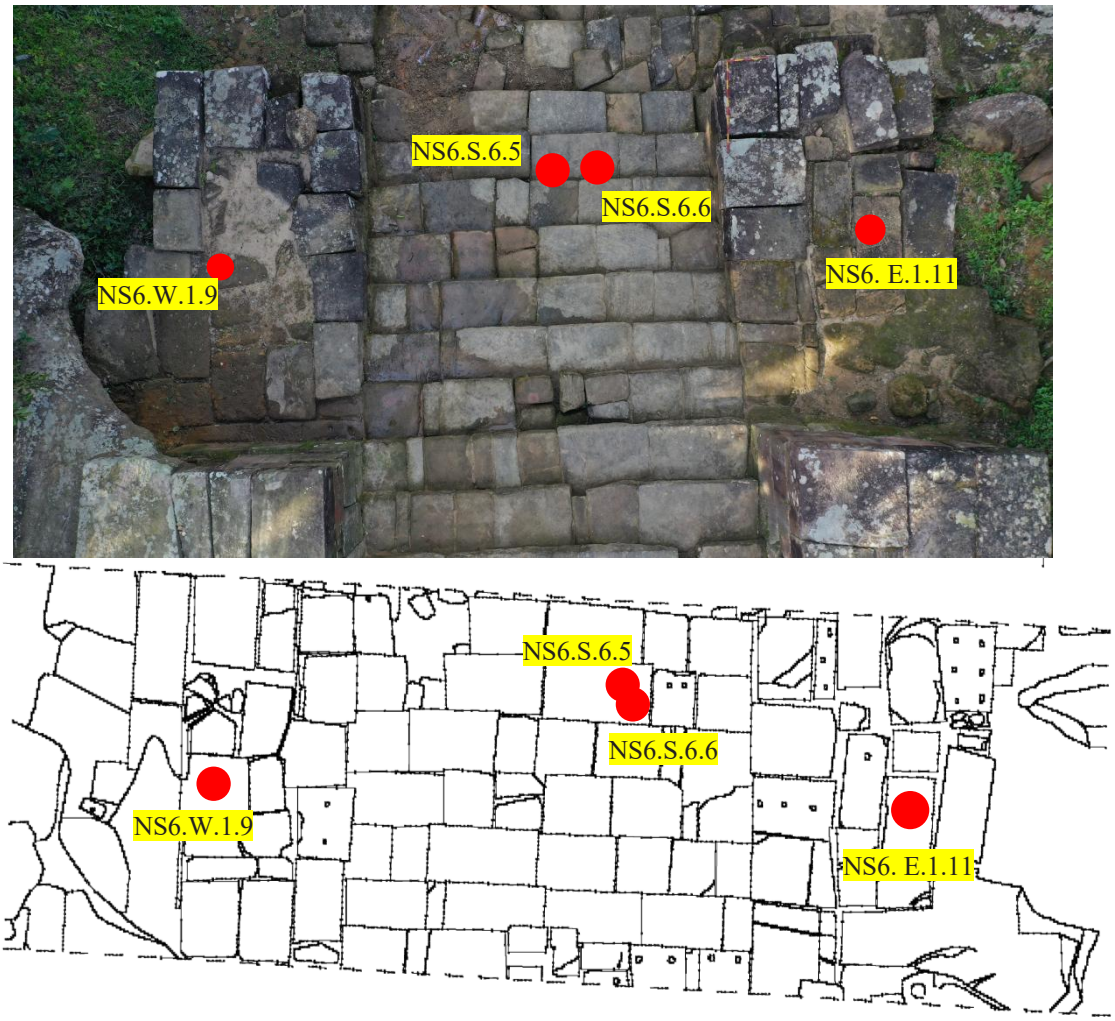


Fig. 114: Red points on the plan show location of foundation test

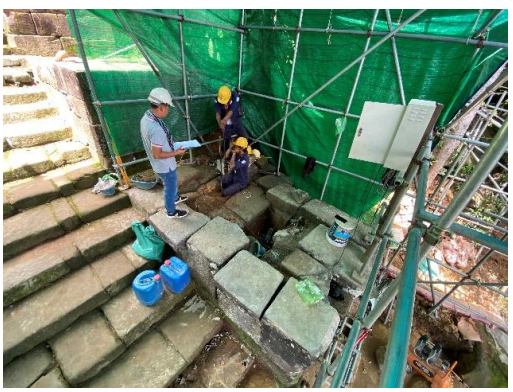


Fig. 115: Apply DCPT cone tip to test foundation-bearing capacity at the western wall before removal of original soil



Fig. 116: Apply DCPT cone tip to test foundation-bearing capacity in the western wall after foundation is recompacted with new mixture

Conservation and treatment stone list at section 6 of Northern Staircase of Preah Vihear temple Phase III

No	Stone code	Type	Typology	Risk	Condition	Restoration	Fiberglass	Others
1	NS6.E.1.6	Sandstone	East Wall	Meduim	Breakage	Drilling holl to put fiberglass dowell with Epoxy Sikadur Resin 752 TH	Φ=12 mm, 20cm Φ=12 mm, 20cm	
2	NS6.E.1.9	Sandstone	East Wall	Meduim	Crack		Φ=12 mm, 39cm Φ=12 mm, 39cm	
3	NS6.E.2.1	Sandstone	East Wall	Meduim	Breakage		Φ=12 mm, 16cm Φ=12 mm, 15cm Φ=12 mm, 10cm	
4	NS6.W.1.30	Sandstone	West Wall	Meduim	Break Out		Φ=12 mm, 30cm Φ=12 mm, 30cm	
5	NS6.S.4.3	Sandstone	Stair step	Meduim	Break Out		Φ=12 mm, 28cm Φ=12 mm, 28cm	

Table 3: List of stone slabs, stone blocks and bedrock being carried out treatment

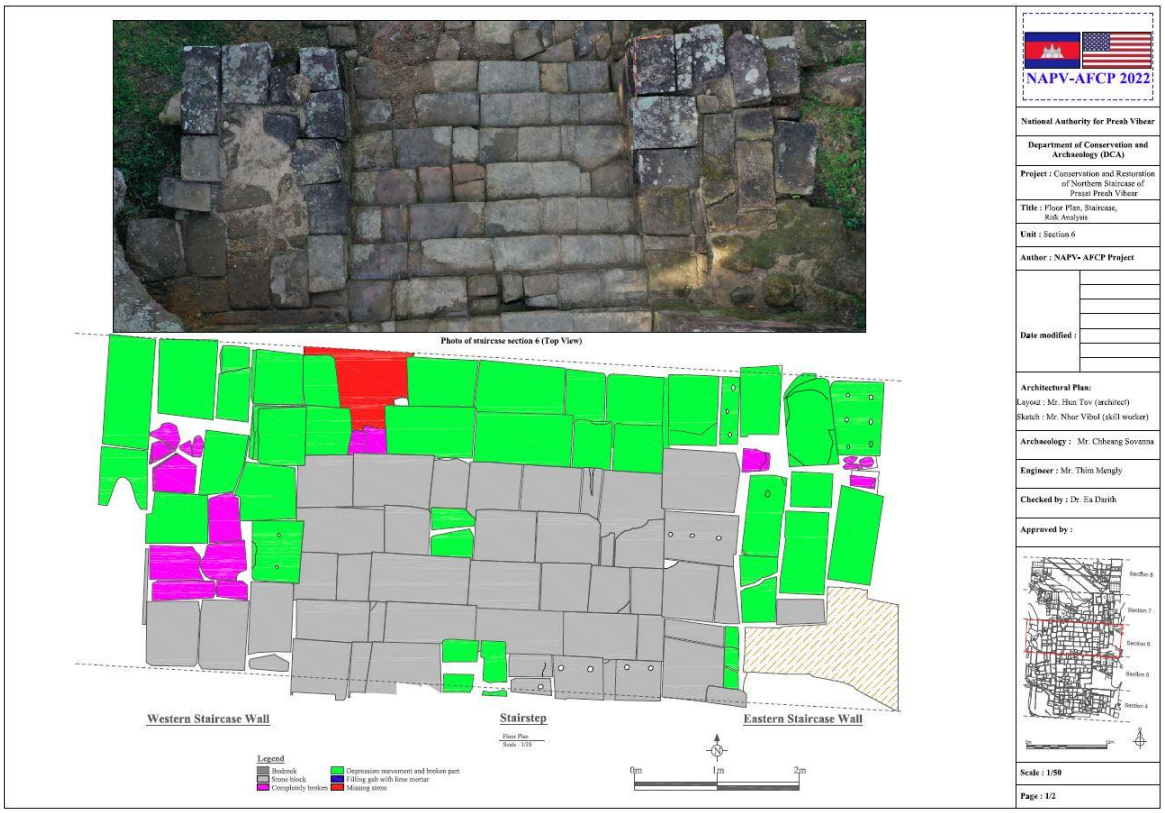


Fig. 117: Picture and floor plan of the staircase at section 6 before restoration (Top view)

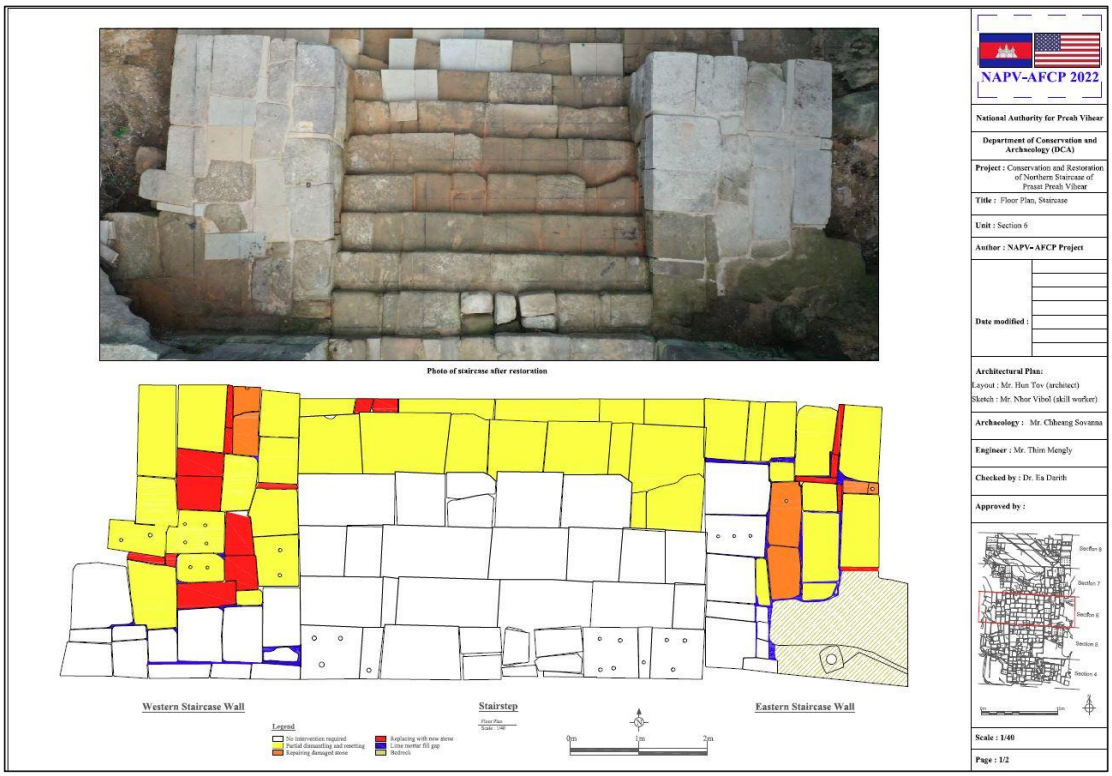


Fig. 118: Picture and floor plan of the staircase at section 6 after restoration (Top view)



Fig. 119: Picture and elevation plan of the staircase at section 6 before restoration (front view)

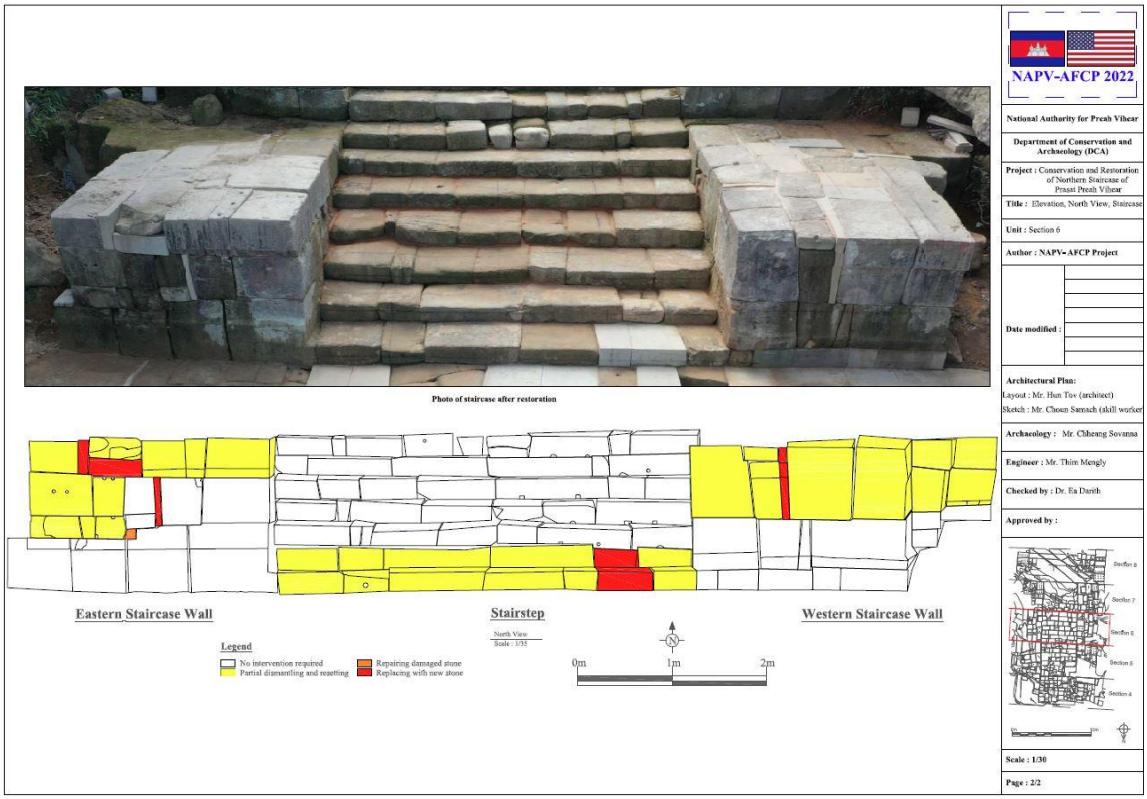


Fig. 120: Picture and elevation plan of the staircase at section 6 after restoration (front view)

Database of stone blocks/slabs, section 6 and section 7

Section	Position	Layer/ Step	Total of stone blocks/slabs before restoration	Broken stones were restored	Broken and Unused stones	Total new restored stone blocks/slabs	Total of stone blocks/slabs after restoration
7	East wall	4	65	10	9	21	77
	West wall	2	15	2		29	44
	Step	7	15	2	5	85	95
Total			95	14	14	135	216
Size of staircase, section 7: Length= 4.39 m, Width=10.17 m, Height= 1.78 m (Total= 44.6 m2)							
6	East wall	3	52	3	1	10	61
	West wall	2	41	1	4	16	53
	Step	7	48	1		2	50
Total			141	5	5	28	164
Size of section 6 length= 4.20 m, Width=11.25 m, and Height=1.65 m (Total=47.25 m2)							
Total of stone number (Section 6+section 7)			236	19	19	163	380



Fig. 121: Condition of the northern staircase at sections 6-7 before restoration



Fig. 122: Condition of the northern staircase at sections 6-7 after restoration

Outreach Program



Fig. 122: Presentation about heritage, and conservation and restoration of the northern staircase



Fig. 123: Onsite practical session at the restoration site



Fig. 124: Onsite lecture about history and temple



Fig. 125: Coloring the heritage by students

ANNEX 3
DATA of DCP TEST

Foundation test at section 7 (DCPT)

Dynamic Cone Penetration Test-DCPT

Project: Conservation and Restoration of the Ancient Northern Staircase of Preah Vihear Temple, phase III
Test location: Section 7 in the east (Under stone NS7.E.2.1.20)
Zero from ground level: 0.000m
Test date: 29/10/2021(Before restoration)
Composition: Ancient compacted foundation (Yellow clay and sand + stone chip)

Table 1: Data of DCPT before foundation restoration in the eastern wall under stone code NS7.E.2.1.20

Number of Blow	Cumulative Penetration (mm)	Penetration Between Readings(mm)	Penetration per Blow (mm)	Hammer Factor	(mm/blow) DCP Index (mm/blow)	CBR (%)
0	0	0	0	-	-	-
1	80	80	80	1	80	2
1	140	60	60	1	60	3
1	181	41	41	1	41	5
1	227	46	46	1	46	4
1	251	24	24	1	24	8
1	280	29	29	1	29	7
1	302	22	22	1	22	9
1	325	23	23	1	23	9
1	345	20	20	1	20	10
1	365	20	20	1	20	10
1	385	20	20	1	20	10
1	410	25	25	1	25	8
1	428	18	18	1	18	11
1	449	21	21	1	21	10
1	470	21	21	1	21	10
1	478	8	8	1	8	28
1	487	9	9	1	9	25
1	493	6	6	1	6	39
1	500	7	7	1	7	33
1	509	9	9	1	9	25
1	530	21	21	1	21	10
1	557	27	27	1	27	7
1	580	23	23	1	23	9
1	600	20	20	1	20	10
1	632	32	32	1	32	6
1	681	49	49	1	49	4
1	700	19	19	1	19	11
1	711	11	11	1	11	20
1	718	7	7	1	7	33
1	722	4	4	1	4	62
1	725	3	3	1	3	85
1	732	7	7	1	7	33
1	736	4	4	1	4	62
1	741	5	5	1	5	48

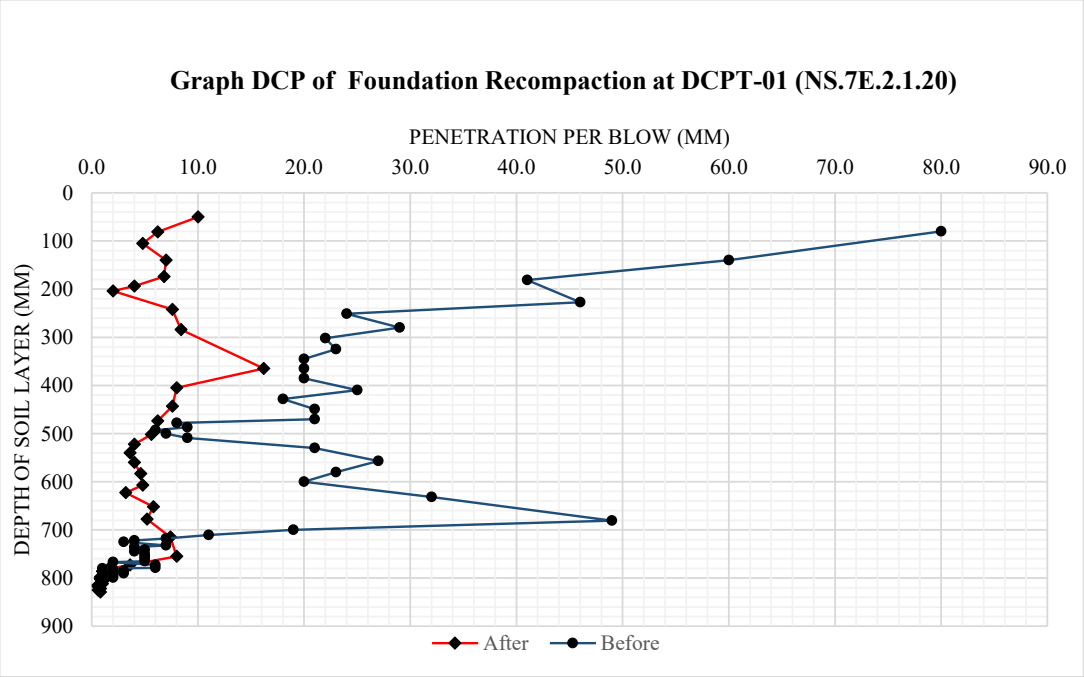
1	745	4	4	1	4	62
1	750	5	5	1	5	48
1	755	5	5	1	5	48
1	760	5	5	1	5	48
1	765	5	5	1	5	48
1	767	2	2	1	2	100
1	773	6	6	1	6	39
1	779	6	6	1	6	39
1	780	1	1	1	1	100
1	782	2	2	1	2	100
1	785	3	3	1	3	85
1	787	2	2	1	2	100
1	790	3	3	1	3	85
1	792	2	2	1	2	100
1	794	2	2	1	2	100
1	796	2	2	1	2	100
1	797	1	1	1	1	100
1	799	2	2	1	2	100
1	800	1	1	1	1	100

Project: Conservation and Restoration of the Ancient Northern Staircase of Preah Vihear Temple, phase III
Test location: Section 7 in the east (Under stone NS7.E.2.1.21)
Zero from ground level: 0.000m
Test date: 26/04/2022(After restoration)
Composition: Foundation after re-compaction (Yellow clay and sand + stone chip + Lime powder)

Table 2: Data of DCPT after foundation restoration in the eastern wall under stone code NS7. E.2.1.21

Number of Blow	Cumulative Penetration (mm)	Penetration Between Readings(mm)	Penetration per Blow (mm)	Hammer Factor	(mm/blow) DCP Index (mm/blow)	CBR (%)
0	0	0	0	-	-	-
5	50	50	10.0	1	10	22
5	81	31	6.2	1	6.2	38
5	105	24	4.8	1	4.8	50
5	140	35	7.0	1	7	33
5	174	34	6.8	1	6.8	34
5	194	20	4.0	1	4	62
5	204	10	2.0	1	2	100
5	242	38	7.6	1	7.6	30
5	284	42	8.4	1	8.4	27
5	365	81	16.2	1	16.2	13
5	405	40	8.0	1	8	28
5	443	38	7.6	1	7.6	30
5	474	31	6.2	1	6.2	38
5	502	28	5.6	1	5.6	42
5	522	20	4.0	1	4	62
5	540	18	3.6	1	3.6	70
5	560	20	4.0	1	4	62
5	583	23	4.6	1	4.6	53
5	607	24	4.8	1	4.8	50
5	623	16	3.2	1	3.2	79
5	652	29	5.8	1	5.8	41
5	678	26	5.2	1	5.2	46
5	715	37	7.4	1	7.4	31

5	755	40	8.0	1	8	28
5	773	18	3.6	1	3.6	100
5	781	8	1.6	1	1.6	100
5	786	5	1.0	1	1	100
5	794	8	1.6	1	1.6	100
5	798	4	0.8	2	1.6	100
5	802	4	0.8	3	2.4	100
5	807	5	1.0	4	4	100
5	812	5	1.0	5	5	100
5	815	3	0.6	6	3.6	100
5	818	3	0.6	7	4.2	100
5	822	4	0.8	8	6.4	100
5	825	3	0.6	9	5.4	100
5	829	4	0.8	10	8	100



Graph shows penetration level of stair wall in the east before and after foundation

Project: Conservation and Restoration of the Ancient Northern Staircase of Preah Vihear Temple, phase III
Test location: Section 7 in the east (Under stone NS7.E.2.5)
Zero from ground level: 0.000m
Test date: 24/12/2021(Before restoration)
Composition: Ancient compacted foundation (Yellow clay and sand + stone chip)

Table 3: Data of DCPT before foundation restoration in the Eastern wall under stone code NS7.E.2.5

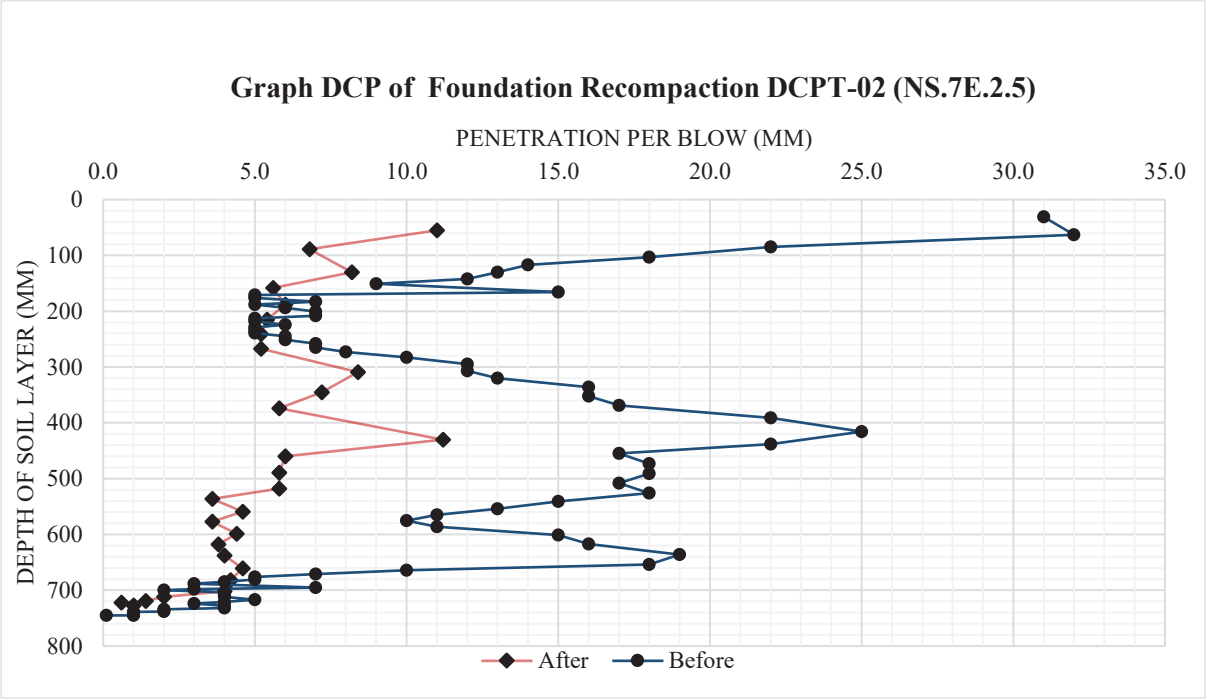
Number of Blow	Cumulative Penetration (mm)	Penetration Between Readings(mm)	Penetration per Blow (mm)	Hammer Factor	DCP Index(mm/blow)	CBR (%)
0	0	0	0	-	-	-
1	31	31	31.0	1	31	6
1	63	32	32.0	1	32	6
1	85	22	22.0	1	22	9
1	103	18	18.0	1	18	11
1	117	14	14.0	1	14	15
1	130	13	13.0	1	13	17
1	142	12	12.0	1	12	18
1	151	9	9.0	1	9	25
1	166	15	15.0	1	15	14
1	171	5	5.0	1	5	48
1	176	5	5.0	1	5	48
1	183	7	7.0	1	7	33
1	188	5	5.0	1	5	48
1	194	6	6.0	1	6	39
1	201	7	7.0	1	7	33
1	208	7	7.0	1	7	33
1	213	5	5.0	1	5	48
1	218	5	5.0	1	5	48
1	224	6	6.0	1	6	39
1	229	5	5.0	1	5	48
1	234	5	5.0	1	5	48
1	239	5	5.0	1	5	48
1	245	6	6.0	1	6	39
1	251	6	6.0	1	6	39
1	258	7	7.0	1	7	33
1	265	7	7.0	1	7	33
1	273	8	8.0	1	8	28
1	283	10	10.0	1	10	22
1	295	12	12.0	1	12	18
1	307	12	12.0	1	12	18
1	320	13	13.0	1	13	17
1	336	16	16.0	1	16	13
1	352	16	16.0	1	16	13
1	369	17	17.0	1	17	12
1	391	22	22.0	1	22	9
1	416	25	25.0	1	25	8
1	438	22	22.0	1	22	9

1	455	17	17.0	1	17	12
1	473	18	18.0	1	18	11
1	491	18	18.0	1	18	11
1	508	17	17.0	1	17	12
1	526	18	18.0	1	18	11
1	541	15	15.0	1	15	14
1	554	13	13.0	1	13	17
1	565	11	11.0	1	11	20
1	575	10	10.0	1	10	22
1	586	11	11.0	1	11	20
1	601	15	15.0	1	15	14
1	617	16	16.0	1	16	13
1	636	19	19.0	1	19	11
1	654	18	18.0	1	18	11
1	664	10	10.0	1	10	22
1	671	7	7.0	1	7	33
1	676	5	5.0	1	5	48
1	681	5	5.0	1	5	48
1	685	4	4.0	1	4	62
1	688	3	3.0	1	3	85
1	695	7	7.0	1	7	33
1	698	3	3.0	1	3	85
1	700	2	2.0	1	2	100
1	704	4	4.0	1	4	62
1	708	4	4.0	1	4	62
1	712	4	4.0	1	4	62
1	717	5	5.0	1	5	48
1	721	4	4.0	1	4	62
1	724	3	3.0	1	3	85
1	728	4	4.0	1	4	62
1	732	4	4.0	1	4	62
1	734	2	2.0	1	2	100
1	736	2	2.0	1	2	100
1	738	2	2.0	1	2	100
1	739	1	1.0	1	1	100
1	740	1	1.0	1	1	100
1	741	1	1.0	1	1	100
1	742	1	1.0	1	1	100
1	743	1	1.0	1	1	100
1	744	1	1.0	1	1	100
1	745	1	1.0	1	1	100
1	745.1	0.1	0.1	1	0.1	100

Project: Conservation and Restoration of the Ancient Northern Staircase of Preah Vihear Temple, phase III
Test location: Section 7 in the east (Under stone NS7.E.2.5)
Zero from ground level: 0.000m
Test date: 26/04/2022(After restoration)
Composition: Ancient compacted foundation (Yellow clay and sand + stone chip)

Table 4: Data of DCPT after foundation restoration in the Eastern wall under stone code NS7.E.2.5

Number of Blow	Cumulative Penetration (mm)	Penetration Between Readings(mm)	Penetration per Blow (mm)	Hammer Factor	DCP Index(mm/blow)	CBR (%)
0	0	0	0	-	-	-
5	55	55	11	1	11	20
5	89	34	6.8	1	6.8	34
5	130	41	8.2	1	8.2	28
5	158	28	5.6	1	5.6	42
5	188	30	6	1	6	39
5	215	27	5.4	1	5.4	44
5	241	26	5.2	1	5.2	46
5	267	26	5.2	1	5.2	46
5	309	42	8.4	1	8.4	27
5	345	36	7.2	1	7.2	32
5	374	29	5.8	1	5.8	41
5	430	56	11.2	1	11.2	20
5	460	30	6	1	6	39
5	489	29	5.8	1	5.8	41
5	518	29	5.8	1	5.8	41
5	536	18	3.6	1	3.6	70
5	559	23	4.6	1	4.6	53
5	577	18	3.6	1	3.6	70
5	599	22	4.4	1	4.4	56
5	618	19	3.8	1	3.8	65
5	638	20	4	1	4	62
5	661	23	4.6	1	4.6	53
5	682	21	4.2	1	4.2	59
5	702	20	4	1	4	62
5	712	10	2	1	2	100
5	719	7	1.4	1	1.4	100
5	722	3	0.6	1	0.6	100
5	727	5	1	1	1	100



Graph shows penetration level of stair wall in the east before and after foundation

Foundation test section 6 (DCPT)

Dynamic Cone Penetration Test-DCPT

Project: Conservation and Restoration of the Ancient Northern Staircase of Preah Vihear Temple, phase III
Test location: Section 7 in the east (Under stone NS6.W.1.9)
Zero from ground level: 0.000m
Test date: 01/06/2022(Before restoration)
Composition: Ancient compacted foundation (Yellow clay and sand + stone chip)

Table 5: Data of DCPT before foundation restoration in the western wall under stone code NS6. W.1.9

Number of Blow	Cumulative Penetration (mm)	Penetration Between Readings(mm)	Penetration per Blow (mm)	Hammer Factor	DCP Index (mm/blow)	CBR(%)
0	0	0	0	-	-	-
1	117	117	117	1	117	1
1	140	23	23	1	23	9
1	157	17	17	1	17	12
1	185	28	28	1	28	7
1	197	12	12	1	12	18
1	210	13	13	1	13	17
1	234	24	24	1	24	8
1	275	41	41	1	41	5
1	311	36	36	1	36	5
1	337	26	26	1	26	8
1	375	38	38	1	38	5
1	412	37	37	1	37	5
1	456	44	44	1	44	4
1	488	32	32	1	32	6
1	520	32	32	1	32	6
1	545	25	25	1	25	8
1	568	23	23	1	23	9
1	587	19	19	1	19	11
1	606	19	19	1	19	11
1	624	18	18	1	18	11
1	646	22	22	1	22	9
1	666	20	20	1	20	10
1	678	12	12	1	12	18
1	686	8	8	1	8	28
1	693	7	7	1	7	33
1	701	8	8	1	8	28
1	704	3	3	1	3	85
1	711	7	7	1	7	33
1	718	7	7	1	7	33
1	723	5	5	1	5	48
1	729	6	6	1	6	39
1	734	5	5	1	5	48
1	740	6	6	1	6	39
1	746	6	6	1	6	39
1	752	6	6	1	6	39

1	759	7	7	1	7	33
1	764	5	5	1	5	48
1	770	6	6	1	6	39
1	774	4	4	1	4	62
1	778	4	4	1	4	62
1	782	4	4	1	4	62
1	787	5	5	1	5	48
1	792	5	5	1	5	48
1	796	4	4	1	4	62
1	800	4	4	1	4	62
1	806	6	6	1	6	39
1	810	4	4	1	4	62
1	814	4	4	1	4	62
1	818	4	4	1	4	62
1	822	4	4	1	4	62
1	825	3	3	1	3	85
1	827	2	2	1	2	100
1	830	3	3	1	3	85
1	834	4	4	1	4	62
1	836	2	2	1	2	100
1	839	3	3	1	3	85
1	842	3	3	1	3	85
1	844	2	2	1	2	100
1	846	2	2	1	2	100
1	849	3	3	1	3	85
1	851	2	2	1	2	100
1	853	2	2	1	2	100
1	855	2	2	1	2	100
1	858	3	3	1	3	85
1	860	2	2	1	2	100
1	862	2	2	1	2	100
1	863	1	1	1	1	100
1	864	1	1	1	1	100
1	868	4	4	1	4	62
1	870	2	2	1	2	100
1	872	2	2	1	2	100
1	874	2	2	1	2	100
1	876	2	2	1	2	100
1	878	2	2	1	2	100
1	879	1	1	1	1	100
1	880	1	1	1	1	100
1	882	2	2	1	2	100
1	884	2	2	1	2	100
1	886	2	2	1	2	100
1	888	2	2	1	2	100
1	890	2	2	1	2	100
1	892	2	2	1	2	100

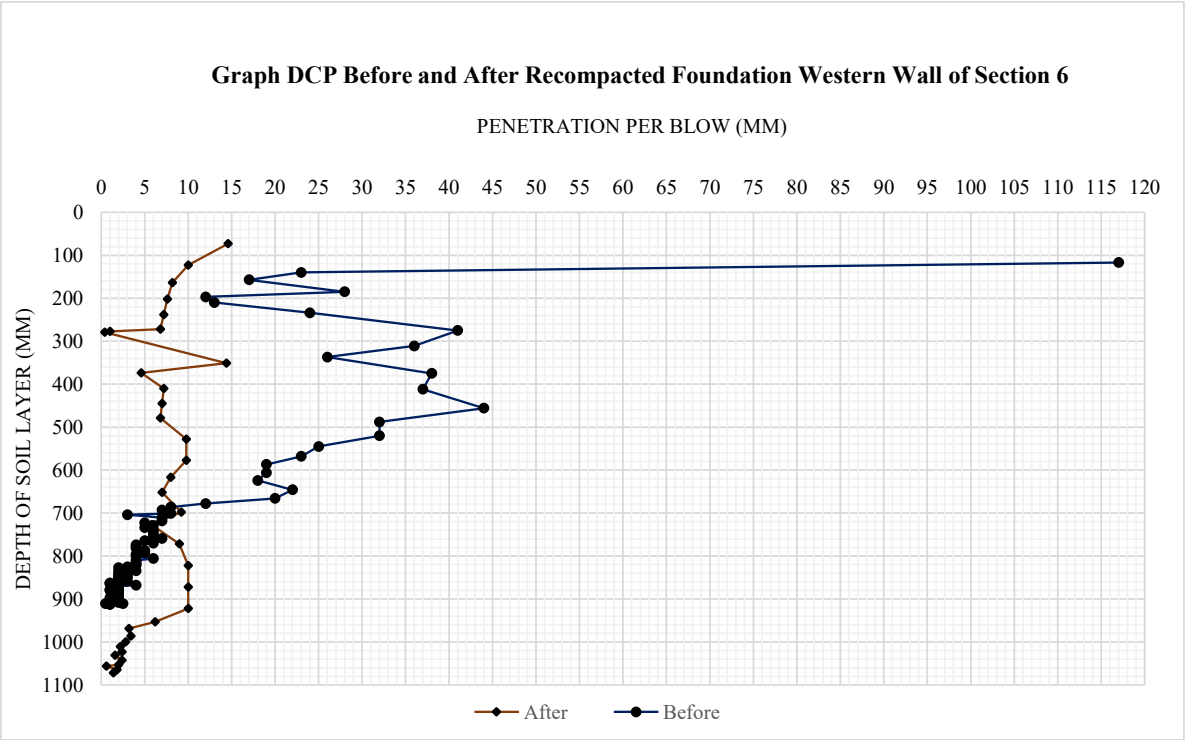
1	894	2	2	1	2	100
1	896	2	2	1	2	100
1	897	1	1	1	1	100
1	899	2	2	1	2	100
1	901	2	2	1	2	100
1	902	1	1	1	1	100
1	904	2	2	1	2	100
1	905	1	1	1	1	100
1	906	1	1	1	1	100
1	908	2	2	1	2	100
1	910.5	2.5	3	1	2.5	100
1	911	0.5	1	1	0.5	100
1	912	1	1	1	1	100
1	913	1	1	1	1	100

Project: Conservation and Restoration of the Ancient Northern Staircase of Preah Vihear Temple, phase III
Test location: Section 6 in the west (Under stone NS6.W.1.9)
Zero from ground level: 0.000m
Test date: 29/07/2022(After restoration)
Composition: Re-compacted Foundation (Ancient Yellow Sandy clay soil + Lime powder+ Stone Chip) Ancient compacted foundation (Yellow clay and sand + stone chip)

Table 6: Data of DCPT after foundation restoration in the western wall under stone code NS6. W.1.9

Number of Blow	Cumulative Penetration (mm)	Penetration Between Readings(mm)	Penetration per Blow (mm)	Hammer Factor	DCP Index (mm/blow)	CBR (%)
0	0	0	0	-	-	-
5	73	73	15	1	14.6	14
5	123	50	10	1	10	22
5	164	41	8	1	8.2	28
5	202	38	8	1	7.6	30
5	238	36	7	1	7.2	32
5	272	34	7	1	6.8	34
5	277	5	1	1	1	100
5	279	2	0	1	0.4	100
5	351	72	14	1	14.4	15
5	374	23	5	1	4.6	53
5	410	36	7	1	7.2	32
5	445	35	7	1	7	33
5	479	34	7	1	6.8	34
5	528	49	10	1	9.8	23
5	577	49	10	1	9.8	23
5	617	40	8	1	8	28
5	652	35	7	1	7	33
5	698	46	9	1	9.2	24
5	727	29	6	1	5.8	41
5	772	45	9	1	9	25
5	822	50	10	1	10	22

5	872	50	10	1	10	22
5	922	50	10	1	10	22
5	953	31	6	1	6.2	38
5	969	16	3	1	3.2	79
5	986	17	3	1	3.4	74
5	1000	14	3	1	2.8	92
5	1011	11	2	1	2.2	100
5	1023	12	2	1	2.4	100
5	1031	8	2	1	1.6	100
5	1043	12	2	1	2.4	100
5	1053	10	2	1	2	100
5	1056	3	1	1	0.6	100
5	1065	9	2	1	1.8	100
5	1072	7	1	1	1.4	100



Graph shows penetration level of stair wall in the west before and after foundation

Project: Conservation and Restoration of the Ancient Northern Staircase of Preah Vihear Temple, phase III
Test location: Section 6 in the east (Under stone NS6.E.1.11)
Zero from ground level: 0.000m
Test date: 01/06/2022(Before restoration)
Composition: Ancient compacted Foundation (Yellow Sandy clay soil + stone chip)

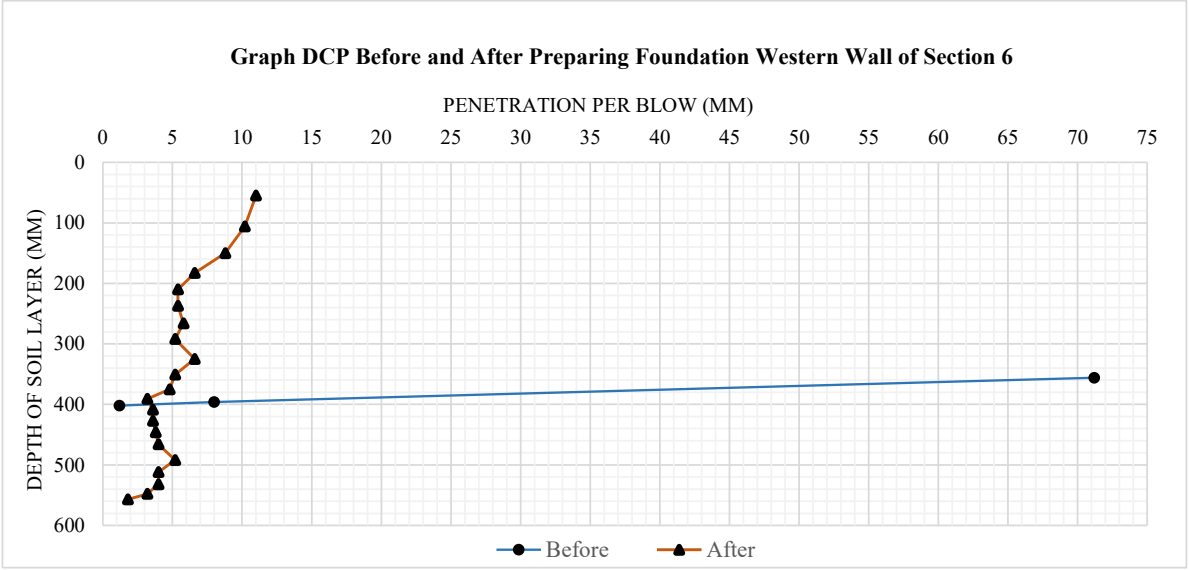
Table 7: Data of DCPT before foundation restoration in the Eastern wall under stone code NS6. E.1.11

Number of Blow	Cumulative Penetration (mm)	Penetration Between Readings(mm)	Penetration per Blow (mm)	Hammer Factor	DCP Index (mm/blow)	CBR(%)
0	0	0	0	-	-	-
5	356	356	71	1	71.2	2
5	396	40	8	1	8	28
5	402	6	1	1	1.2	100

Project: Conservation and Restoration of the Ancient Northern Staircase of Preah Vihear Temple, phase III
Test location: Section 6 in the east (Under stone NS6.E.1.11)
Zero from ground level: 0.000m
Test date: 13/06/2022 (After restoration)
Composition: Re-compacted Foundation (Yellow Sandy clay soil + stone chip)

Table 8: Data of DCPT after foundation restoration in the Eastern wall under stone code NS6. E.1.11

Number of Blow	Cumulative Penetration (mm)	Penetration Between Readings(mm)	Penetration per Blow (mm)	Hammer Factor	DCP Index (mm/blow)	CBR (%)
0	0	0	0	-	-	-
5	55	55	11	1	11	20
5	106	51	10	1	10.2	22
5	150	44	9	1	8.8	26
5	183	33	7	1	6.6	35
5	210	27	5	1	5.4	44
5	237	27	5	1	5.4	44
5	266	29	6	1	5.8	41
5	292	26	5	1	5.2	46
5	325	33	7	1	6.6	35
5	351	26	5	1	5.2	46
5	375	24	5	1	4.8	50
5	391	16	3	1	3.2	79
5	409	18	4	1	3.6	70
5	427	18	4	1	3.6	70
5	446	19	4	1	3.8	65
5	466	20	4	1	4	62
5	492	26	5	1	5.2	46
5	512	20	4	1	4	62
5	532	20	4	1	4	62
5	548	16	3	1	3.2	79
5	557	9	2	1	1.80	100



Graph shows penetration level of stair wall in the east before and after foundation

Dynamic Cone Penetration Test-DCPT

Project: Conservation and Restoration of the Ancient Northern Staircase of Preah Vihear Temple, phase III
Test location: Section 6 of the stair step (Under stone slabs NS.6.1.6.6)
Zero from ground level: 0.000m (Under stone step)
Test date: 12/10/2022 (Before restoration)
Composition: Ancient Foundation (Yellow Sandy clay soil + stone chip)

Table 9: Data of DCPT before foundation restoration at step under stone code NS.6.1.6.6

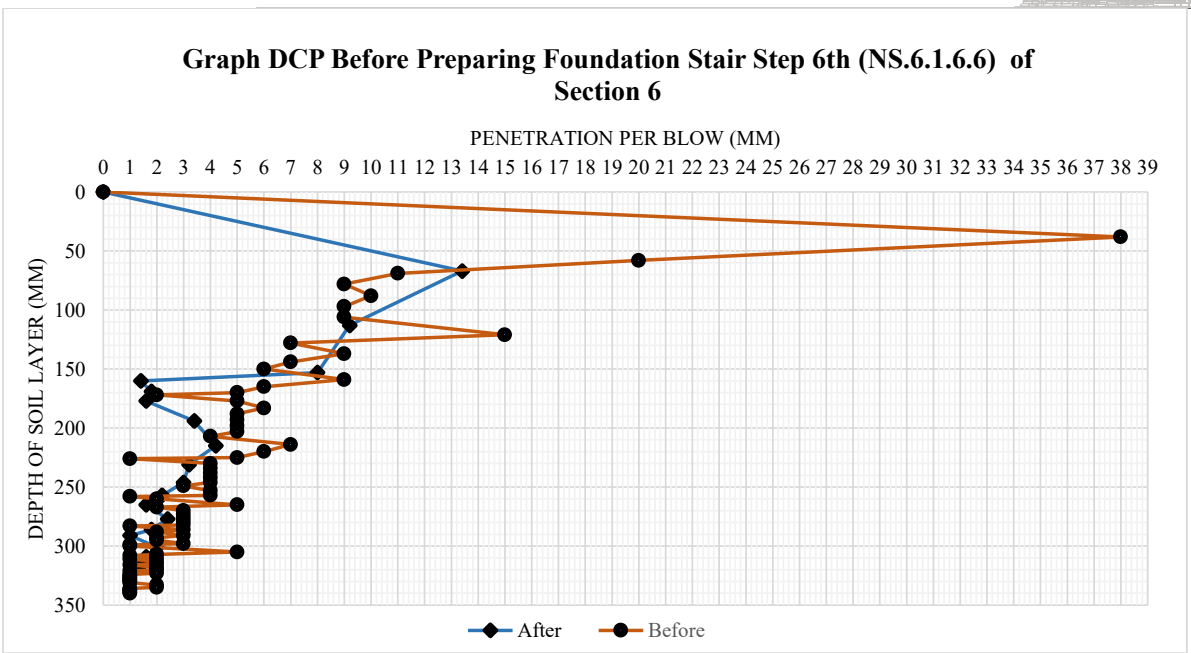
Number of Blow	Cumulative Penetration (mm)	Penetration Between Readings(mm)	Penetration per Blow (mm)	Hammer Factor	DCP Index (mm/blow)	CBR (%)
0	0	0	0	0	0	0
1	38	38	38	1	38	5
1	58	20	20	1	20	10
1	69	11	11	1	11	20
1	78	9	9	1	9	25
1	88	10	10	1	10	22
1	97	9	9	1	9	25
1	106	9	9	1	9	25
1	121	15	15	1	15	14
1	128	7	7	1	7	33
1	137	9	9	1	9	25
1	144	7	7	1	7	33
1	150	6	6	1	6	39
1	159	9	9	1	9	25
1	165	6	6	1	6	39
1	170	5	5	1	5	48
1	172	2	2	1	2	100
1	177	5	5	1	5	48
1	183	6	6	1	6	39
1	188	5	5	1	5	48
1	193	5	5	1	5	48
1	198	5	5	1	5	48
1	203	5	5	1	5	48
1	207	4	4	1	4	62
1	214	7	7	1	7	33
1	220	6	6	1	6	39
1	225	5	5	1	5	48
1	226	1	1	1	1	100
1	230	4	4	1	4	62
1	234	4	4	1	4	62
1	238	4	4	1	4	62
1	242	4	4	1	4	62
1	246	4	4	1	4	62
1	249	3	3	1	3	85
1	253	4	4	1	4	62
1	257	4	4	1	4	62

1	258	1	1	1	1	100
1	260	2	2	1	2	100
1	265	5	5	1	5	48
1	267	2	2	1	2	100
1	270	3	3	1	3	85
1	273	3	3	1	3	85
1	276	3	3	1	3	85
1	279	3	3	1	3	85
1	282	3	3	1	3	85
1	283	1	1	1	1	100
1	286	3	3	1	3	85
1	288	2	2	1	2	100
1	291	3	3	1	3	85
1	293	2	2	1	2	100
1	295	2	2	1	2	100
1	298	3	3	1	3	100
1	299	1	1	1	1	100
1	300	1	1	1	1	100
1	305	5	5	1	5	100
1	307	2	2	1	2	100
1	308	1	1	1	1	100
1	310	2	2	1	2	100
1	311	1	1	1	1	100
1	313	2	2	1	2	100
1	315	2	2	1	2	100
1	316	1	1	1	1	100
1	318	2	2	1	2	100
1	320	2	2	1	2	100
1	321	1	1	1	1	100
1	323	2	2	1	2	100
1	324	1	1	1	1	100
1	325	1	1	1	1	100
1	326	1	1	1	1	100
1	327	1	1	1	1	100
1	328	1	1	1	1	100
1	329	1	1	1	1	100
1	330	1	1	1	1	100
1	331	1	1	1	1	100
1	333	2	2	1	2	100
1	335	2	2	1	2	100
1	336	1	1	1	1	100
1	337	1	1	1	1	100
1	338	1	1	1	1	100
1	339	1	1	1	1	100
1	340	1	1	1	1	100

Project: Conservation and Restoration of the Ancient Northern Staircase of Preah Vihear Temple, phase III
Test location: Section 6 of the stair step 6 (Under stone slabs NS.6.1.6.6)
Zero from ground level: 0.000m (Under stone step)
Test date: 16/11/2022 (After restoration)
Composition: Ancient Foundation (Yellow Sandy clay soil + stone chip)

Table 10: Data of DCPT after foundation restoration of stair step under stone code NS.6.1.6.6

Number of Blow	Cumulative Penetration (mm)	Penetration Between Readings(mm)	Penetration per Blow (mm)	Hammer Factor	DCP Index (mm/blow)	CBR (%)
0	0	0	0	-	-	-
5	67	67	13	1	13.4	16
5	113	46	9	1	9.2	24
5	153	40	8	1	8	28
5	160	7	1	1	1.4	100
5	169	9	2	1	1.8	100
5	177	8	2	1	1.6	100
5	194	17	3	1	3.4	74
5	215	21	4	1	4.2	59
5	231	16	3	1	3.2	79
5	246	15	3	1	3	85
5	257	11	2	1	2.2	100
5	265	8	2	1	1.6	100
5	277	12	2	1	2.4	100
5	286	9	2	1	1.8	100
5	291	5	1	1	1	100
5	301	10	2	1	2	100
5	309	8	2	1	1.6	100
5	316	7	1	1	1.4	100



Graph shows penetration level of stair step before and after foundation

Project: Conservation and Restoration of the Ancient Northern Staircase of Preah Vihear Temple, phase III
Test location: Section 6 of the stair step 6 (Under stone slabs NS.6.1.6.5)
Zero from ground level: 0.000m (Under stone step)
Test date: 12/10/2022 (Before restoration)
Composition: Ancient Foundation (Yellow Sandy clay soil + stone chip)

Table 11: Data of DCPT before foundation restoration of stair step under stone code NS.6.1.6.5

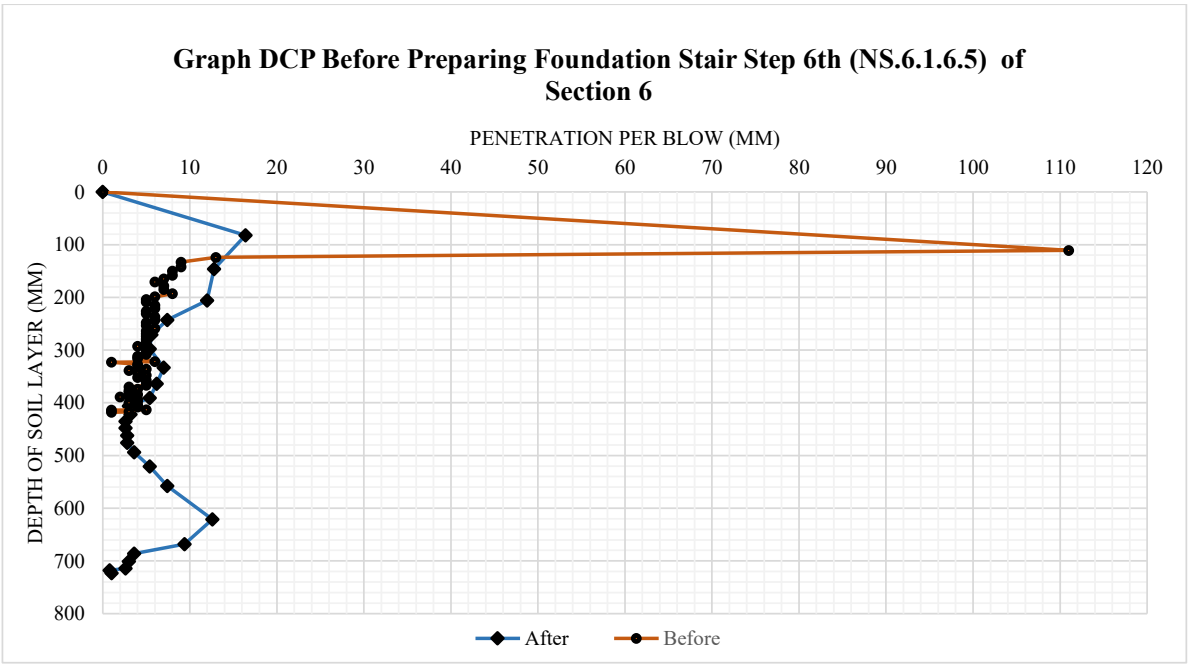
Number of Blow	Cumulative Penetration (mm)	Penetration Between Readings(mm)	Penetration per Blow (mm)	Hammer Factor	DCP Index (mm/blow)	CBR (%)
0	0	0	0	0	0	0
1	111	111	111	1	111	1
1	124	13	13	1	13	17
1	133	9	9	1	9	25
1	142	9	9	1	9	25
1	150	8	8	1	8	28
1	158	8	8	1	8	28
1	165	7	7	1	7	33
1	171	6	6	1	6	39
1	178	7	7	1	7	33
1	185	7	7	1	7	33
1	193	8	8	1	8	28
1	199	6	6	1	6	39
1	204	5	5	1	5	48
1	209	5	5	1	5	48
1	215	6	6	1	6	39
1	221	6	6	1	6	39
1	226	5	5	1	5	48

1	231	5	5	1	5	48
1	237	6	6	1	6	39
1	243	6	6	1	6	39
1	248	5	5	1	5	48
1	253	5	5	1	5	48
1	259	6	6	1	6	39
1	264	5	5	1	5	48
1	269	5	5	1	5	48
1	274	5	5	1	5	48
1	279	5	5	1	5	48
1	284	5	5	1	5	48
1	289	5	5	1	5	48
1	293	4	4	1	4	62
1	298	5	5	1	5	48
1	303	5	5	1	5	48
1	308	5	5	1	5	48
1	312	4	4	1	4	62
1	316	4	4	1	4	62
1	322	6	6	1	6	39
1	323	1	1	1	1	100
1	327	4	4	1	4	62
1	331	4	4	1	4	62
1	336	5	5	1	5	48
1	339	3	3	1	3	85
1	343	4	4	1	4	62
1	348	5	5	1	5	48
1	352	4	4	1	4	62
1	357	5	5	1	5	48
1	362	5	5	1	5	48
1	367	5	5	1	5	48
1	370	3	3	1	3	85
1	374	4	4	1	4	62
1	377	3	3	1	3	85
1	380	3	3	1	3	85
1	384	4	4	1	4	62
1	387	3	3	1	3	85
1	389	2	2	1	2	100
1	393	4	4	1	4	62
1	397	4	4	1	4	62
1	400	3	3	1	3	85
1	404	4	4	1	4	62
1	408	4	4	1	4	62
1	413	5	5	1	5	48
1	414	1	1	1	1	100
1	417	3	3	1	3	85
1	418	1	1	1	1	100

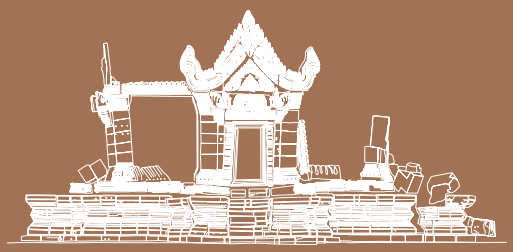
Project: Conservation and Restoration of the Ancient Northern Staircase of Preah Vihear Temple, phase III
Test location: Section 6 of the stair step 6 (Under stone slabs NS.6.1.6.5)
Zero from ground level: 0.000m (Under stone step)
Test date: 16/11/2022 (After restoration)
Composition: Recompacted Foundation (Yellow Sandy clay soil + stone chip)

Table 12: Data of DCPT after foundation restoration of stair step under stone code NS.6.1.6.5

Number of Blow	Cumulative Penetration (mm)	Penetration Between Readings(mm)	Penetration per Blow (mm)	Hammer Factor	DCP Index (mm/blow)	CBR (%)
0	0	0	0	-	-	-
5	82	82	16	1	16.4	13
5	146	64	13	1	12.8	17
5	206	60	12	1	12	18
5	243	37	7	1	7.4	31
5	271	28	6	1	5.6	42
5	298	27	5	1	5.4	44
5	333	35	7	1	7	33
5	364	31	6	1	6.2	38
5	391	27	5	1	5.4	44
5	406	15	3	1	3	85
5	422	16	3	1	3.2	79
5	435	13	3	1	2.6	100
5	448	13	3	1	2.6	100
5	462	14	3	1	2.8	92
5	476	14	3	1	2.8	92
5	494	18	4	1	3.6	100
5	521	27	5	1	5.4	44
5	558	37	7	1	7.4	31
5	621	63	13	1	12.6	17
5	668	47	9	1	9.4	24
5	686	18	4	1	3.6	70
5	701	15	3	1	3	85
5	714	13	3	1	2.6	100
5	718	4	1	1	0.8	100
5	723	5	1	1	1	100



Graph shows penetration level of stair step before and after foundation



Phase IV : 2022-2024

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Annex 1: Project management

1. Meeting with technical team led by NAPV Director General and project director




Fig. 1: Meeting the project team and to define role of the project staff and laborer

2. Role and Responsibilities of the project staff

The followings are role and responsibilities of each project staff and laborer in charge of different units, including stone conservation unit, staircase restoration unit and drainage and archaeological unit.

1. Architect

- Conduct architectural plan survey, analyze risk on structure of the ancient staircase and intervention for conservation and restoration
- Design plan at the conservation restoration site to install restoration shelter, ground yard for stone storage and workshop, rail to move stone and bypass to safeguard
- Develop conservation and restoration plan, and prepare list of materials
- Lead related assignment at the restoration site such as architectural plan survey, dismantling and reassembling the staircase structure
- Provide comment and prepare intervention and restoration plan
- Work with archaeologist, engineer, stone conservationist, IT and photographer in preparing document

2. Archaeologist

- Conduct archaeological research to understand about original structure, foundation construction and drainage relating to the restoring sections
- Work with other staff members to develop study plan and list necessary materials
- Document the result of archaeological research and provide comment for conservation and restoration of the northern staircase to assure its authenticity

3. Engineer

- Study its strength and impact on ancient structure such as stone arrangement, and foundation of the staircase
- Restore ancient hydraulic system and create channel as necessary to reduce impact on foundation and ancient structure
- Conduct foundation test of the staircase
- Work with other project staff to develop conservation and restoration plan
- Prepare document relating to engineering for conservation and restoration

4. Stone conservationist

- Conduct study on ancient stone condition
- Conduct stone mapping for restoration
- Restore broken part of stone and damaged bedrock on stair structure
- Lead laborers to cut new stone and replace ancient broken stone
- Dismantle and reassemble stone of the staircase structure
- Restore lion sculptures
- Prepare restoration site (shelter, rail, bypass)

5. IT and database management staff

- Collate and document all data into database system
- Write monthly, quarter, semester and final report

6. Site manager

- Gather plan provided by technical staff to manage and direct conservation and restoration work
- Manage materials and equipment kept at a warehouse and materials taken outside for restoration purpose
- Monitor daily restoration activities to assure effectiveness of the work
- Hold meeting with laborers, collect data and report to the project team daily
- Report to the project team immediately for any technical issues

7. Skilled laborer/team leader

- Lead unskilled laborers to implement the work effectively
- Report to the project team immediately for any technical issues
- Work with project staff of different fields
- Report daily output
- Report every week at the weekly meetings

8. Photographer and Video for dissemination

- Develop plan for photographing and video on activities being implemented at the site for documentation
- Classify photos and video by activities and date
- Document video for the project by phase and disseminate

9. Security staff

- Take care the site to safeguard for tourists
- Instruct tourists visiting nearby the restoration site
- Report to site manager if any issue encountered
- Check and care restoration materials

10. Generator and electricity system staff

- Operate generator
- Check, care and fix generator
- Install electricity network at the site
- Fix electric materials and other electronic devices

Annex 2: Site preparation

1. Site Preparation

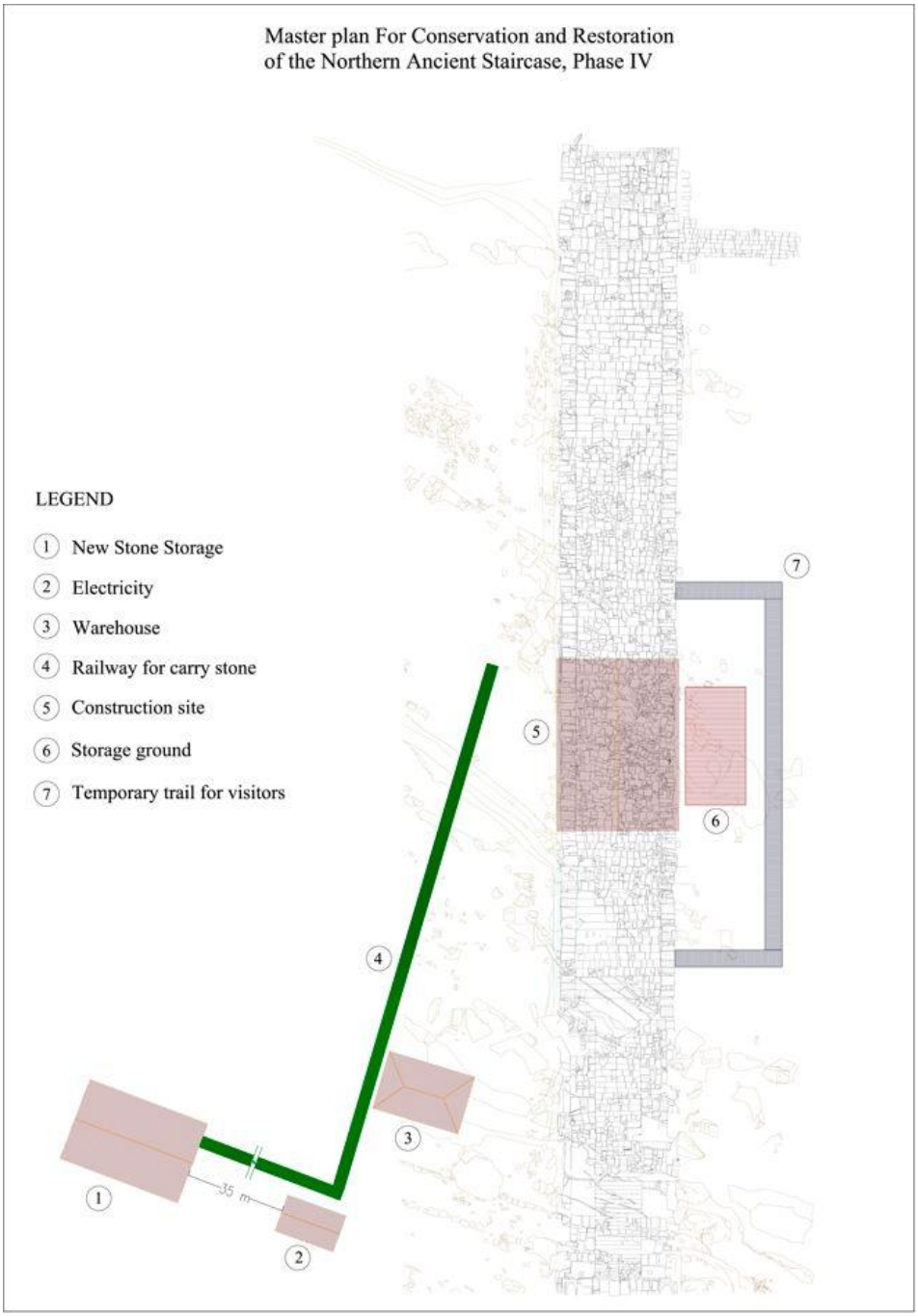


Figure 2: Master plan showing overall view of site preparation at the northern staircase.

a. Preparation activities of stone workshop and ground yard of stone storage



Figure 3: Activities of new stone workshop set up



Figure 4: General view of a new stone workshop shelter after completion of construction

b. Constructing rail to move new stones to sections 14-13

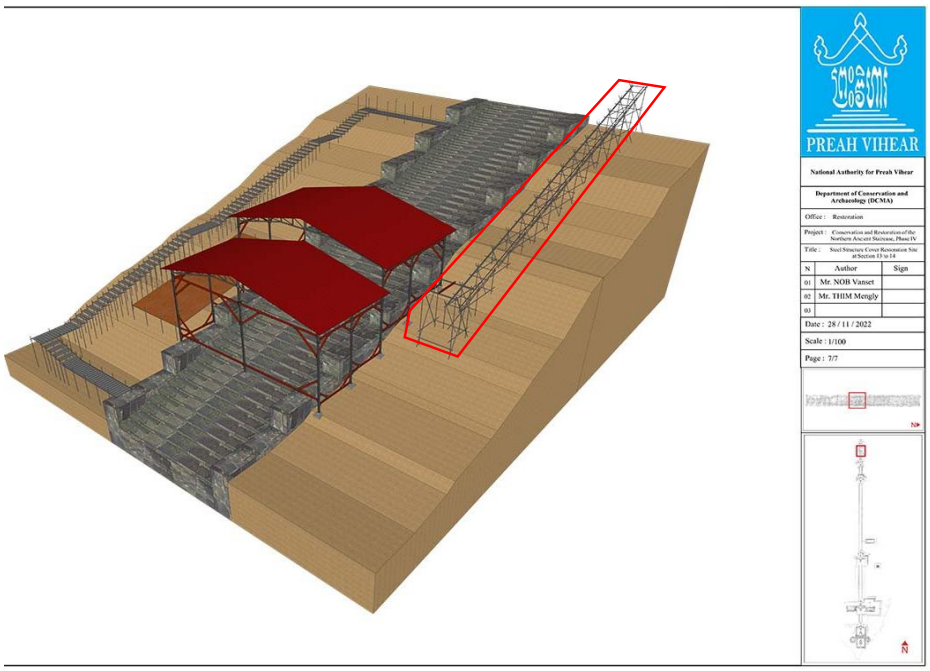


Figure 5: The rectangular red box beside shelter is a design of 96 m rail long to transport stone from the stone workshop to restoration sections



Figure 6: Construction activities of rail to move stone downwards from the stone workshop to restoration sections



Figure 7: View of rail after construction was completed

c. Constructing temporary bypass for visitors

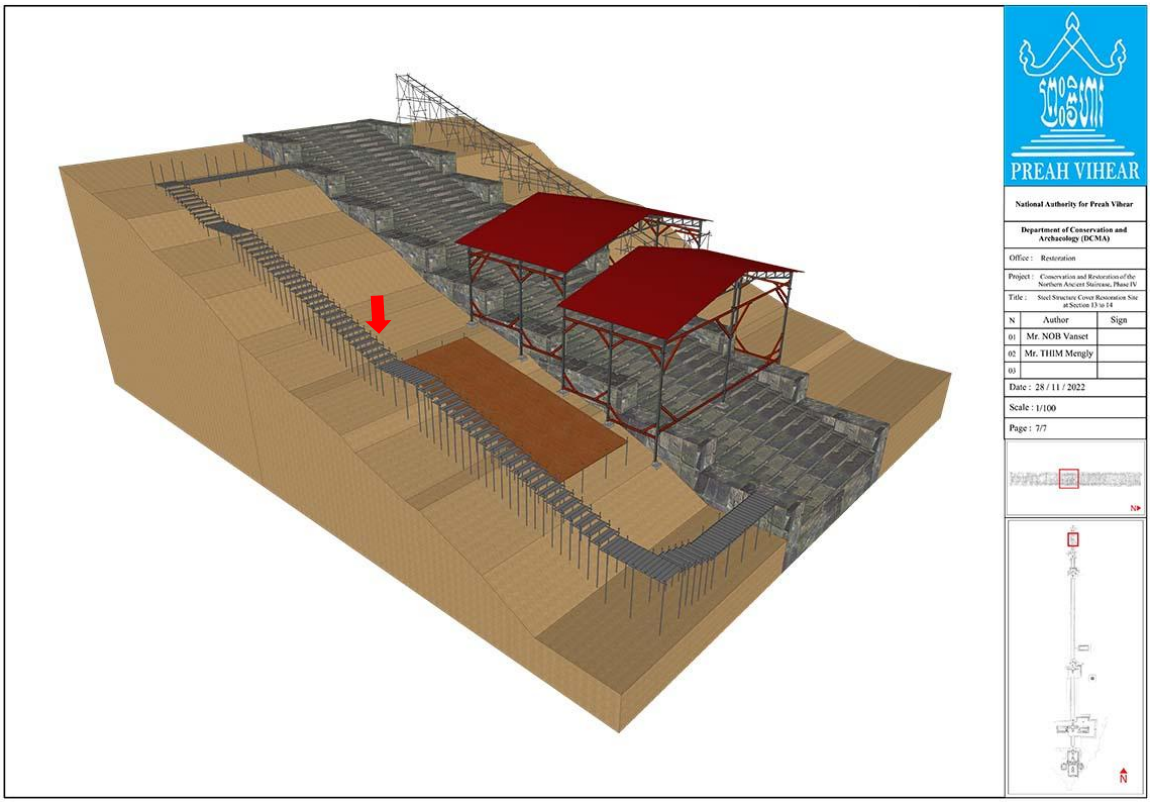


Figure 8: Long line with red arrow color is the design of bypass for tourists to move around



Figure 9: Installation activities of bypass for tourists



Figure 10: General view of bypass after installation was completed

d. Shelter at the restoration sections for safeguard of project staff

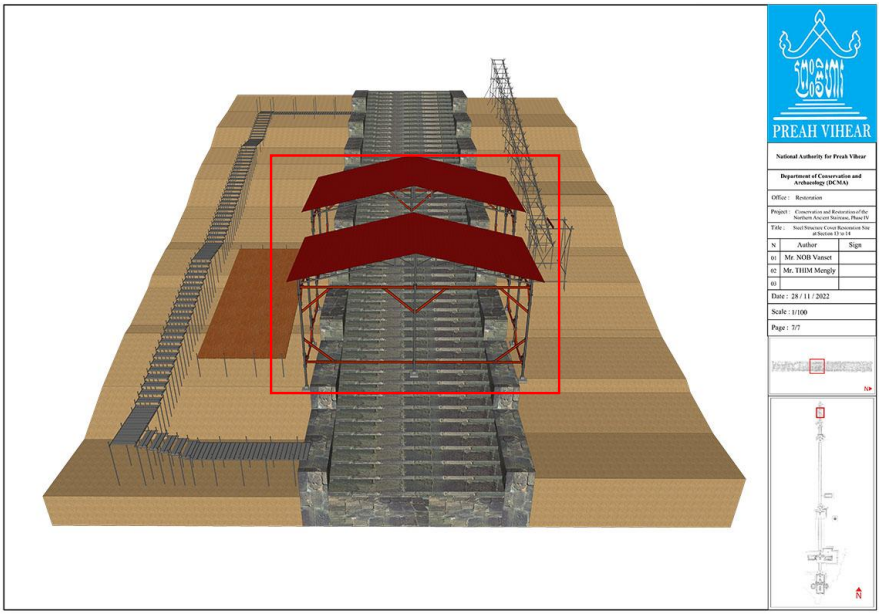


Figure 11: Within red box is the design of shelter at section 13 and 14



Figure 12: Installing structure of metal pole for shelter



Figure 13: Activities of project staff to carry metal bars to restoration section



Figure 14: Storage room under the warehouse to keep restoration materials



Figure 15: Wooden stair over a rail on the western causeway for tourists to pass

Annex 3: Drainage system restoration and rehabilitation

Drainage management system

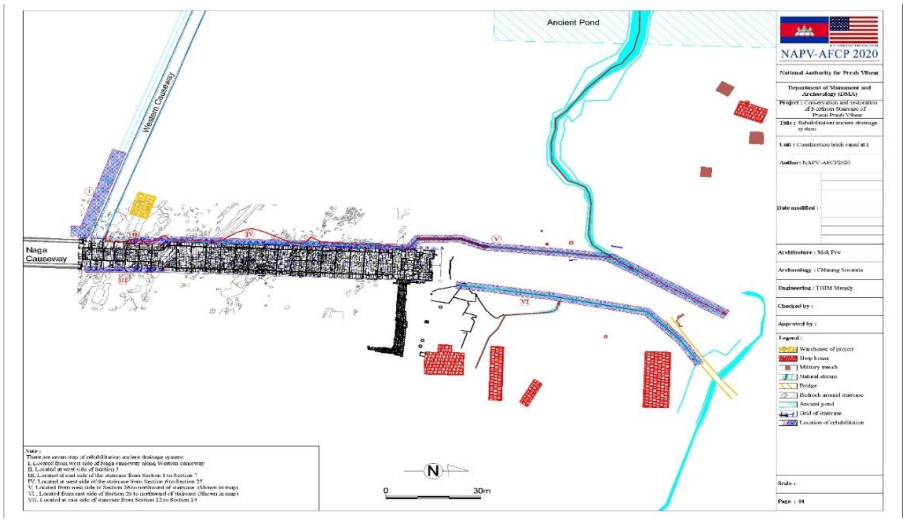


Figure 16: Plan showing the location of rehabilitation of water management





Figure 17: Rehabilitation of drainage system located at northern part of the staircase



Figure 18: Preparing sand bags to prevent rain water destroys foundation

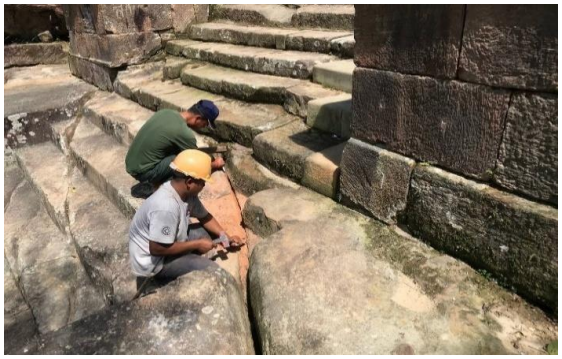


Figure 19: Added new mortar to replace old weak mortar

Annex 4: Archaeological survey

The result of archaeological excavation and trenches 1-5

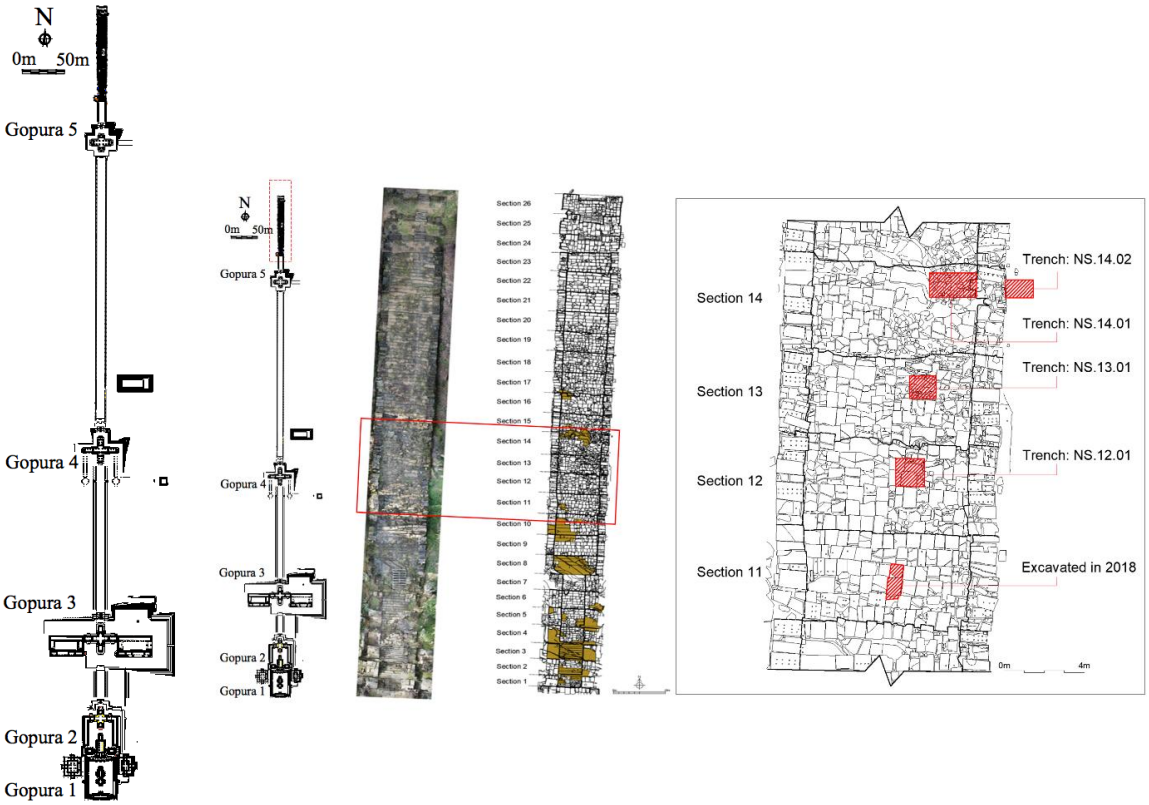


Figure 20: Locations of excavation trenches at sections 14-11

Excavation trench NS.13.01



Figure 21: Plan and photo of excavation trench no. NS.13.01



Figure 22: Excavation trench after stones were removed and excavating activities



Figure 23: Left hand side photo shows mixture of clay, sand and small stone fragment used for compacting first layer of foundation and right-hand side photo is stone fragments being taken from the excavation trench

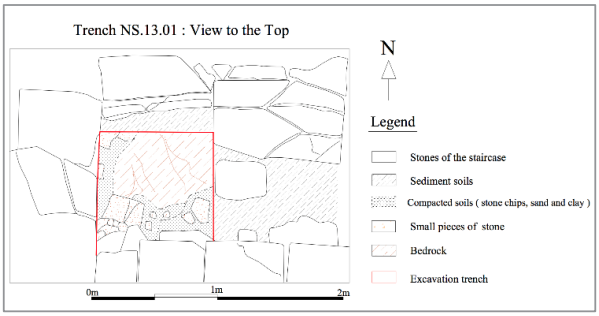




Figure 24: Plan and excavation trench (view from top)

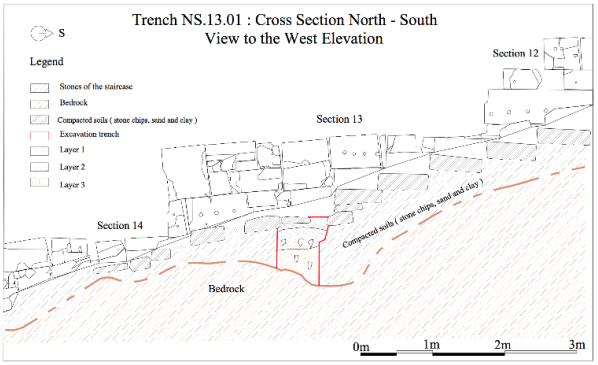




Figure 25: Cross section plan and excavation trench on north-south direction (View from the west)

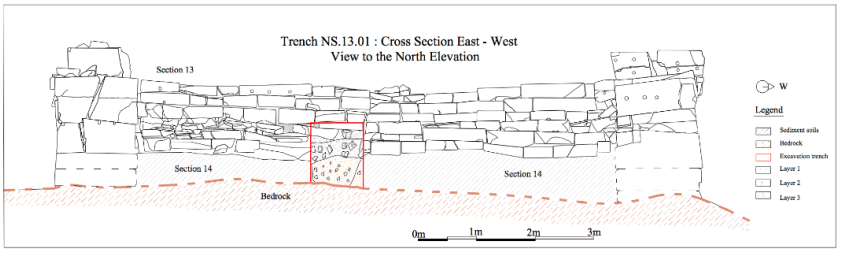




Figure 26: Cross section plan and excavation trench from east to west (View from north)

Excavation trench 2 (NS.14.10)



Figure 27: Location of excavation trench NS.14.01



Figure 28: Photo in the left hand side shows clay, sand and small stone chips used for compacting foundation and photo in the right hand side shows small-large stone fragments being removed from the foundation during the excavation

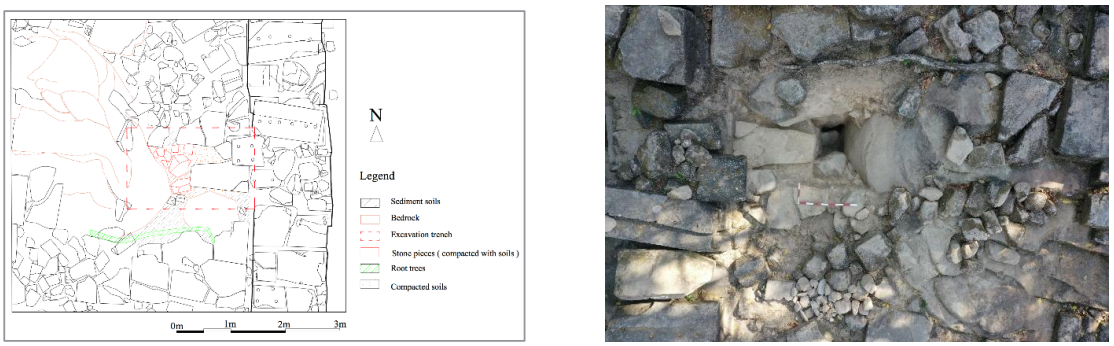


Figure 29: Plan and photo of excavation trench NS.14.01 (View from top)

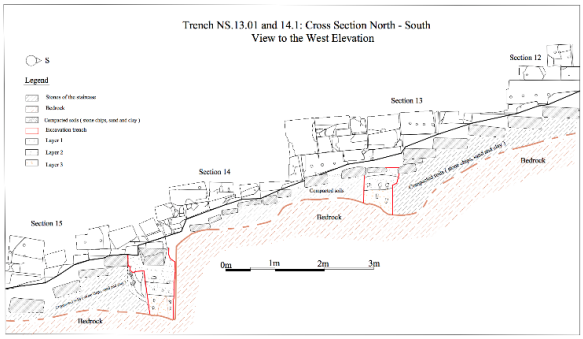




Figure 30: Cross section plan and excavation trench from north to south (View from the west)

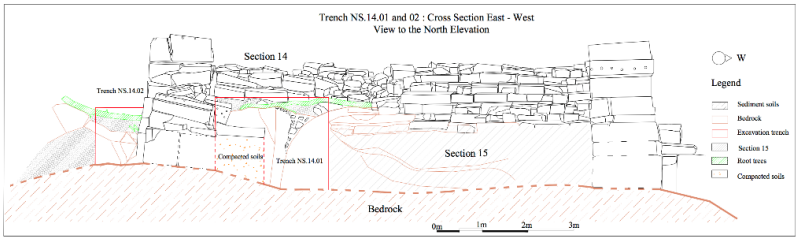




Figure 31: Cross section plan and excavation trench from east to west (View from north)

Excavation trench 3 (NS.14.02)

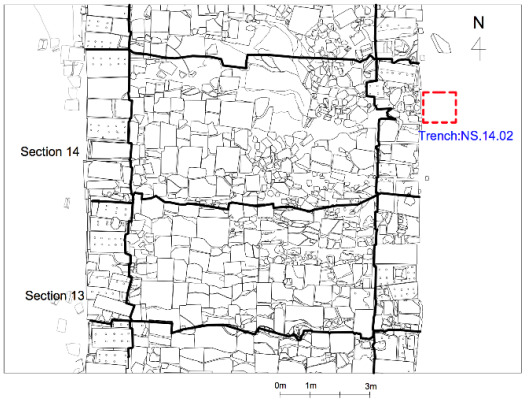




Figure 32: Location of excavation trench NS.14.02



Figure 33: Tree roots penetrated into the foundation structure of the staircase (View from east)

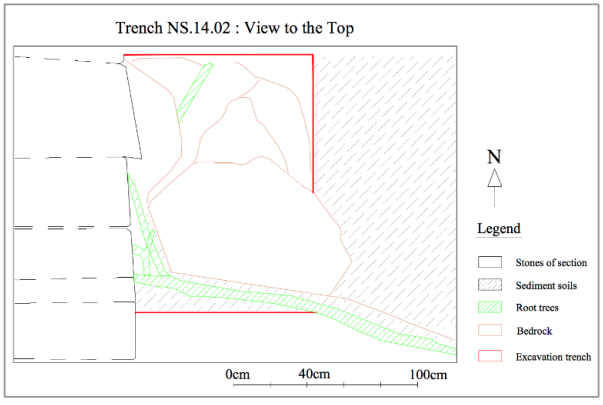




Figure 34: Plan and excavation trench (View from top)

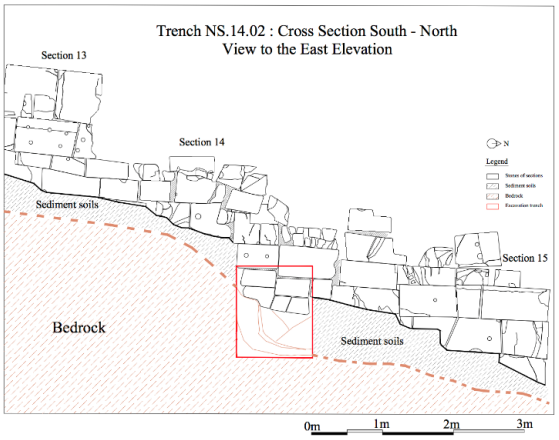




Figure 35 Cross section and excavation trench from south to north (View from east)

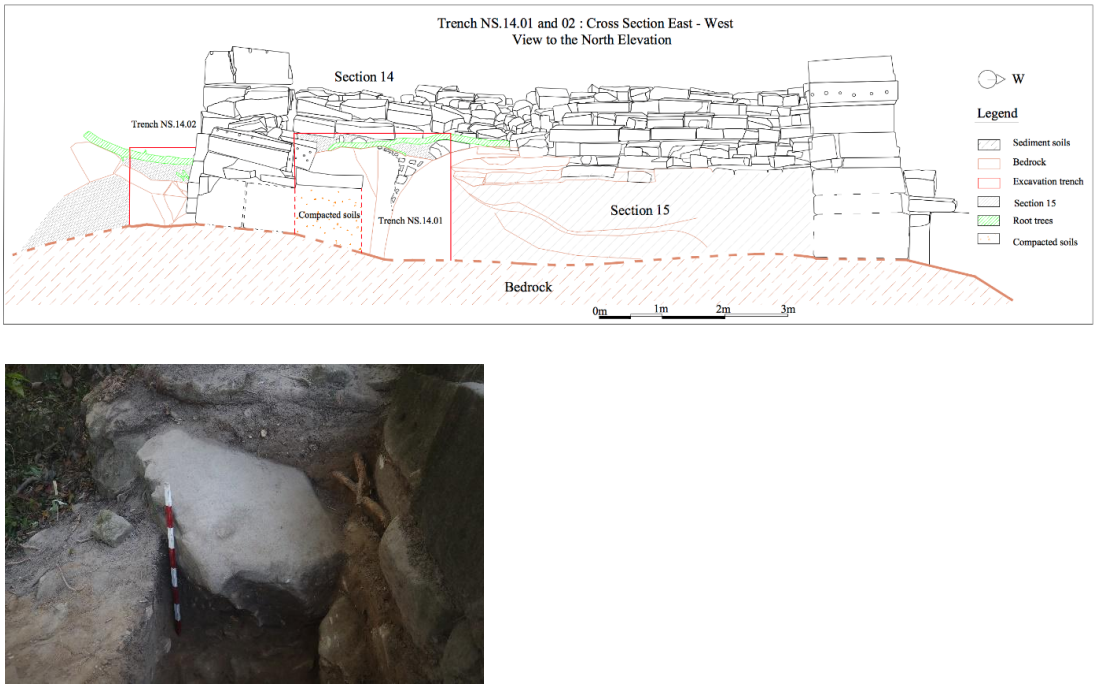


Figure 36: Cross section and excavation trench from east to west (View from north)

Excavation trench 4 (NS12.01.3.8)

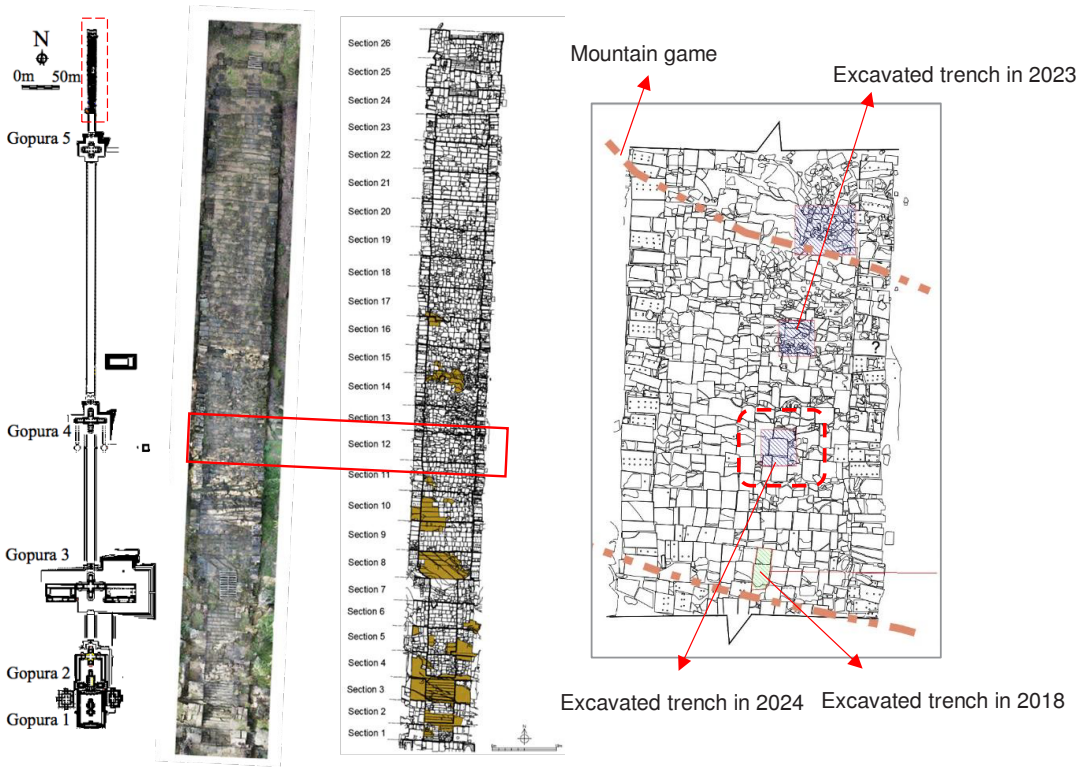


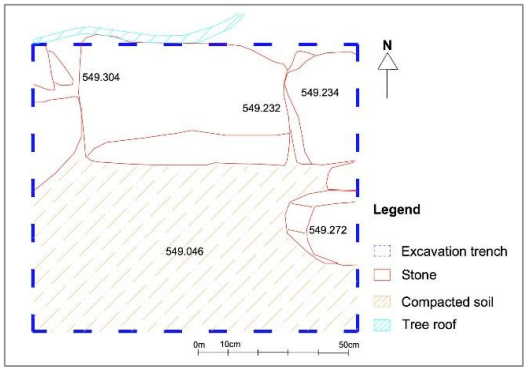
Figure 37: Plan of excavated trench at section 12 in 2024



Figure 38: Excavated trench viewing from the north



Figure 39: Excavated trench viewing from the top



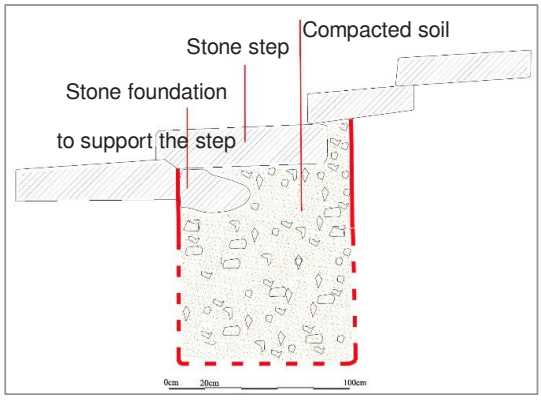


Figure 39: top view plan and profile plan showing the technique of foundation compaction of the east wall

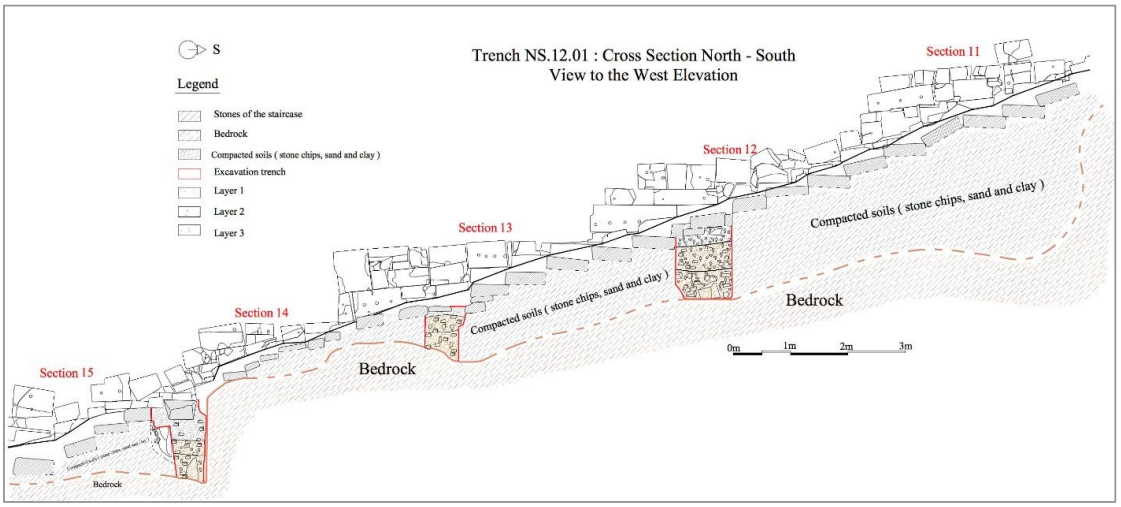


Figure 40: Profile plan showing the excavated trenches from sections 14 to 11



Figure 41: Images of the east and south walls of trench on section 12

Annex 5: Conservation and restoration of lion sculpture

Conservation and restoration of lion sculpture

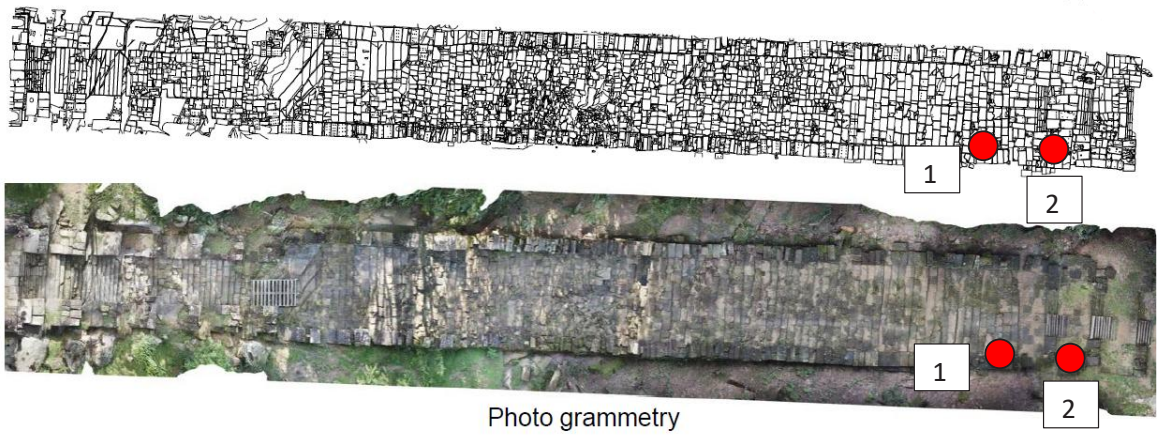


Figure 42: Red marks showing the location of lion sculptures

No.	Code No.	sculpture	Description	others
1	PV2007	Base	Remained only base, lost body	
2	PVH2016-063	Lion	Lion sculpture, damaged, lost legs, and base	

Base of lion sculpture



Figure 43: Base of lion sculpture (PVH2016-063) located on the east wall of section 24 of the staircase, inventory no. PV2007

រដ្ឋាភិបាលអាមេរិក

ព្រះរាជាណាចក្រកម្ពុជា

អាជ្ញាធរជាតិព្រះវិហារ

កិច្ចសហប្រតិបត្តិការណ៍រវាងរាជរដ្ឋាភិបាលកម្ពុជា ជាមួយរដ្ឋាភិបាលអាមេរិក
គម្រោងអភិរក្ស និងជួសជុលជណ្តើរខាងជើង ប្រាសាទព្រះវិហារ

វត្ថុសិល្បៈ	ចម្លាក់រូបគោ			**ពិពណ៌នា**
ទីតាំង	GPS/P0465545/1591753			រូបនេះមានតែជើងទម្រ មួយបំណែក, ជើងពីរមុខក្រោយខាងឆ្វេងនៅម្រាមទាំងអស់ ឯពីរផ្សេងទៀតសឹករីករិល, និងមានស្លែដុះលើផ្ទៃ។
ប្រភេទ	ថ្មភក់			
រចនាបថ/អាយុកាល	ស.វទី៩-ស.វទី១១			
ប្រភព	ប្រាសាទព្រះវិហារ			
លេខសំគាល់	PVH2016-063			**ស្ថានភាពខូចខាត** / **អន្តរាគមន៍**
ទំហំ(cm)	កំពស់	27cm		នៅសល់តែជើងទម្រ, ម្រាមមុខក្រោយ ខាងស្តាំខូចខាត, និងមានស្លែដុះលើផ្ទៃ។ / ស្វែងរកបំណែកដែលបាត់ធ្វើការជួសជុលឡើងវិញ និងធ្វើការសម្អាត់។
	បណ្តោយ	66cm		
	ទទឹង	53cm		
	កម្រាស់	18cm		
ហានិភ័យ				
ខ្ពស់ √	មធ្យម		ទាប	
ការបែងចែកប្រភេទ				
ក្បាច់ចម្លាក់ √	គ្រឿងសំណង់		សិលាចរិក	
ទីតាំងបច្ចុប្បន្ន	ថ្នាក់ទី៤(ពីក្រោមទៅលើ) ជណ្តើរខាងជើង ផ្នែកខាងកើត			
ការងារជួសជុលពីមុន				
រូបថត				



កំណត់ចំណាំ:	
ឈ្មោះអ្នកធ្វើបញ្ជី ថាច់ ថានិត	ថ្ងៃ/ខែ/ឆ្នាំ 08/02/2019

Figure 44: Data of the base of lion sculpture no. PV2007

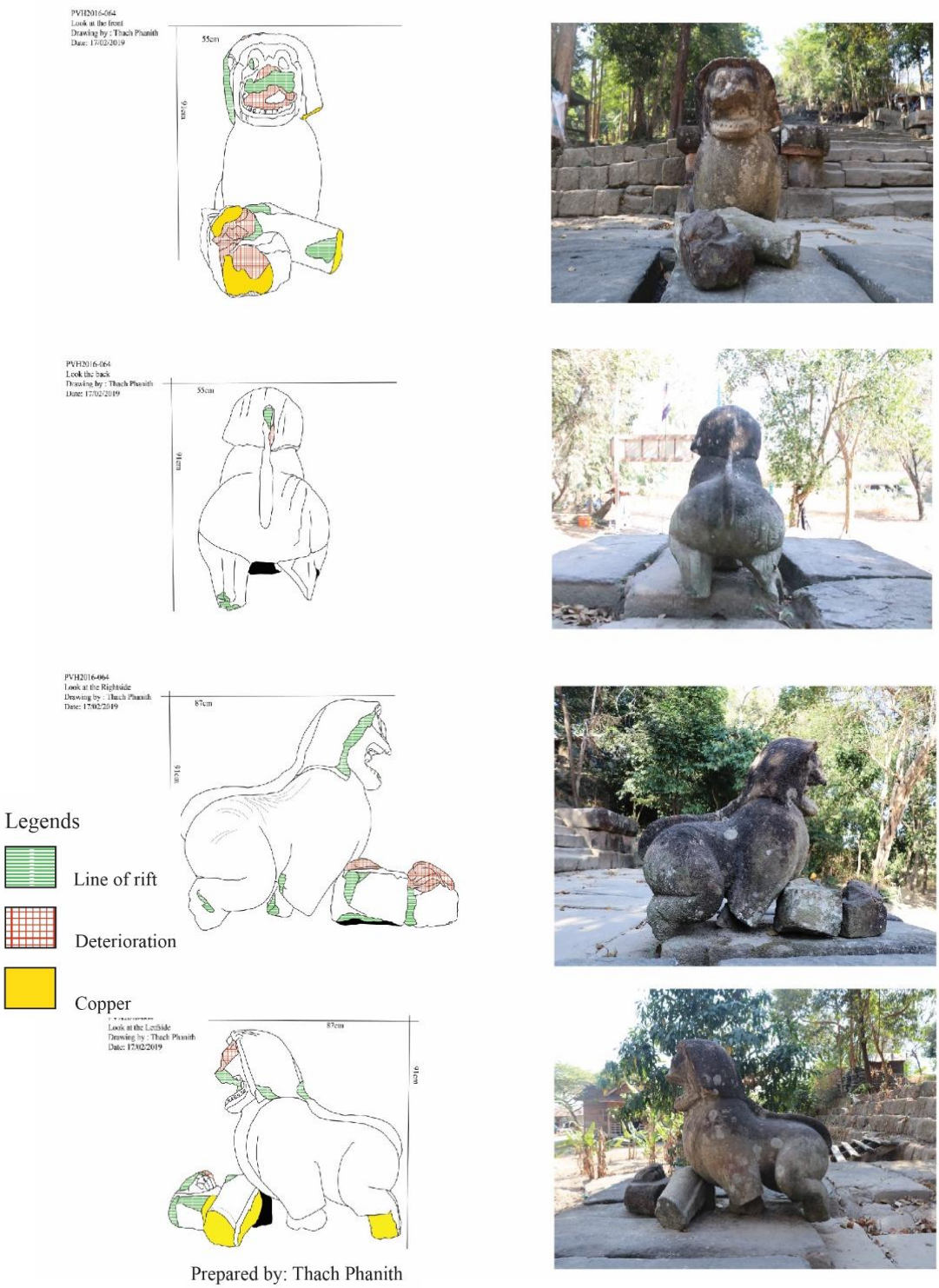


Figure 45: Current condition of lion sculpture (code PVH2016-064) on the east wall, section 25

ឡោតច្បាលអាមេរិក ព្រះរាជាណាចក្រកម្ពុជា

អាជ្ញាធរជាតិព្រះវិហារ

កិច្ចសហប្រត្តិបត្តការណ៍រវាងរាជរដ្ឋាភិបាលកម្ពុជា ជាមួយរដ្ឋាភិបាលអាមេរិក

គម្រោងអភិរក្ស និងជួសជុលជណ្តើរខាងជើង ប្រាសាទព្រះវិហារ

វត្ថុសិល្បៈ:	ចង្កាក់តោ		**ពិពណ៌នា**	
ទីតាំង	GPS/ P0465545/1591756		រូបនេះ មានបួនបំណែក បាក់ត្រឹមមាត់ដល់ទ្រូង, ដើមដៃដល់កដៃ,ពីកែងជើងដល់កជើង, កជើងដល់ជើងទម្រ, ស្លៀដុះលើផ្ទៃ។	
ប្រភេទ	ថ្មកក់			
រចនាបថ/អាយុកាល	ស.វទី៩-ស.វទី១១			
ប្រភព	ប្រាសាទព្រះវិហារ			
លេខសំគាល់	PVH2016-064		**ស្ថានភាពខូចខាត**	**អន្តរាគមន៍**
ទំហំ(cm)	កំពស់	87cm	បាក់៥បំណែក បាត់ត្រចៀកឆ្វេងនិងផ្នែកសក់ខាងក្រោម, ទ្រូងប្រេះនិងរបក់ជាស្រទាប់, ជើងទម្រមុខខាងស្តាំបាត់,ពីក្រមុះចុះក្រោមបាក់, ម្រាមជើងស្តាំបាត់បី, ជុំវិញជើងទម្រមានស្នាមបន្លៀក,មានស្លៀដុះលើផ្ទៃ។	ស្វែងរកបំណែកដែលបាត់ធ្វើការជួសជុលឡើងវិញ និងធ្វើការសម្អាត់។
	បណ្តោយ	91cm		
	ទទឹង	55cm		
	កម្រាស់	45cm		
ហានិភ័យ				
ខ្ពស់		មធ្យម	ទាប	
ការបែងចែកប្រភេទ				
ក្បាច់ចង្កាក់	√	គ្រឿងសំណង់		សិលាចរិក
ទីតាំងបច្ចុប្បន្ន	ថ្នាក់ទី២(ពីក្រោមទៅលើ) ជណ្តើរខាងជើង ផ្នែកខាងកើត			
ការងារជួសជុលពីមុន				

រូបថត



មើលពីឆ្វេង



មើលពីស្តាំ



មើលពីក្រោយ



មើលពីមុខ

កំណត់ចំណាំ:

ឈ្មោះអ្នកធ្វើបញ្ជី	ថាច់ ដានិត	ថ្ងៃ/ខែ/ឆ្នាំ	08/02/2019

Figure 46: Inventory of lion sculpture, no. PVH2016-064



Figure 47: Reassembling activity of lion sculpture



Figure 48: Making clay mold of lion legs





Figure 49-50: Carving new legs of lion sculpture to replace the mission ones

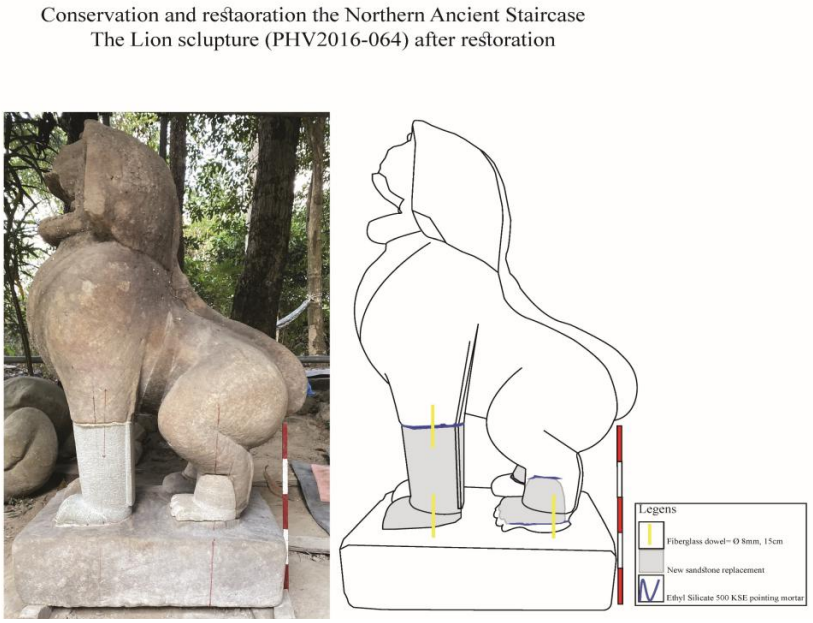


Figure 51: General view of lion sculpture after restoration and drawing of lion sculpture

Lion sculpture (PVH2016-068)



Figure 52: Body of lion sculpture with lack of four legs

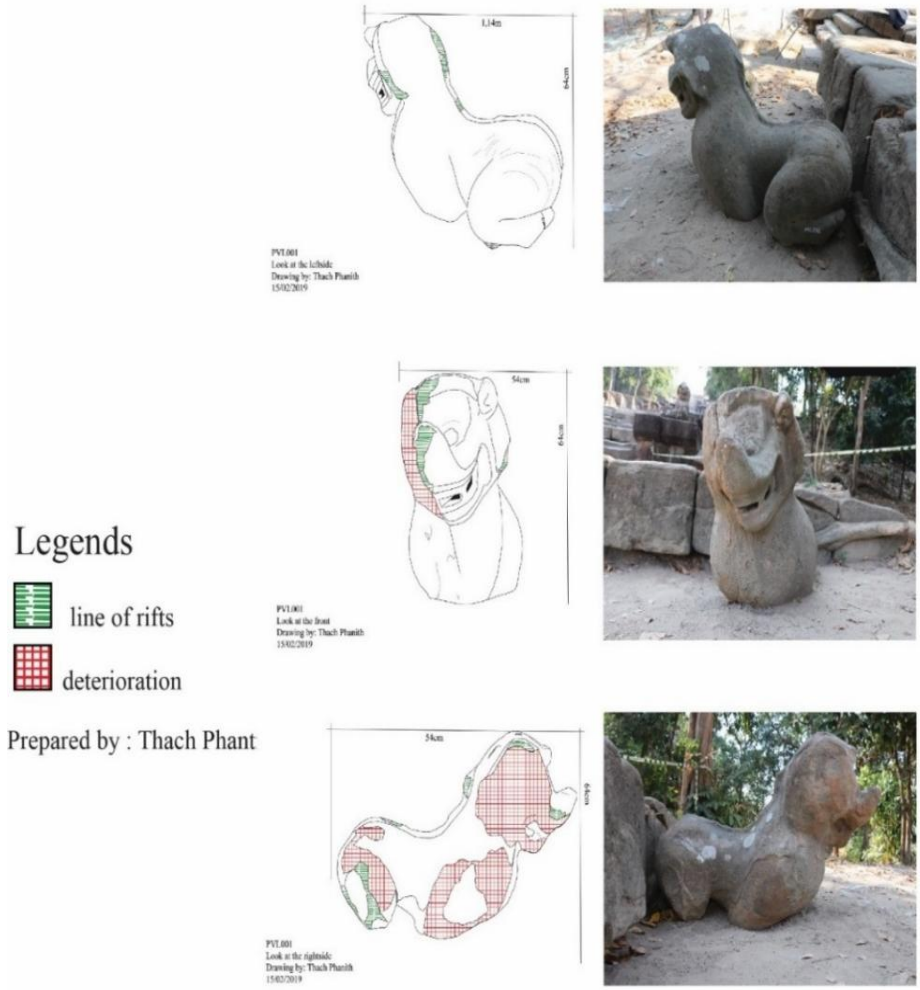


Figure 53: Risk analysis of a lion before restoration



Figure 54: Inventory of a lion sculpture



Fig. 55: Surveying of lion sculpture

United States of America

Kingdom of Cambodia

National Authority for Preah Vihear

Ambassador Fund for Cultural Preservation

Project for Conservation and Restoration of Northern Ancient Staircase, Preah Vihear Temple

Art Object	Gaja Shimha Statue		**Description**	
Location	GPS/P0465536/1591759		This statue was fallen from the upper stair wall, only one piece from leg to body and covers with lichen.	
Type	Sandstone			
Style/Dating	9th -11th centuries			
Origin	Preah Vihear Temple			
Inventory Number	PVH2016-068			**Intervention**
Size (cm)	Height	64cm	Lost from half leg to lower part, hair and right ear and tail. Right thigh was broken and crack on head, body and right thigh and cover with lichen.	Finding the lost fragments, restore and move to origin location
	Length	114cm		
	Width	54cm		
	Thickness	46cm		
Risk				
High √	Medium	Low		
Classification				
Statue/Art ob √	Construction mate	Inscription		
Current location	Section 1 (from bottom to the top), western wall			
Previous intervention				
Photos				
Note				
Recorder	Thach Phanith		Day/month/year	08/02/2019

Figure 56: Inventory of lion sculpture

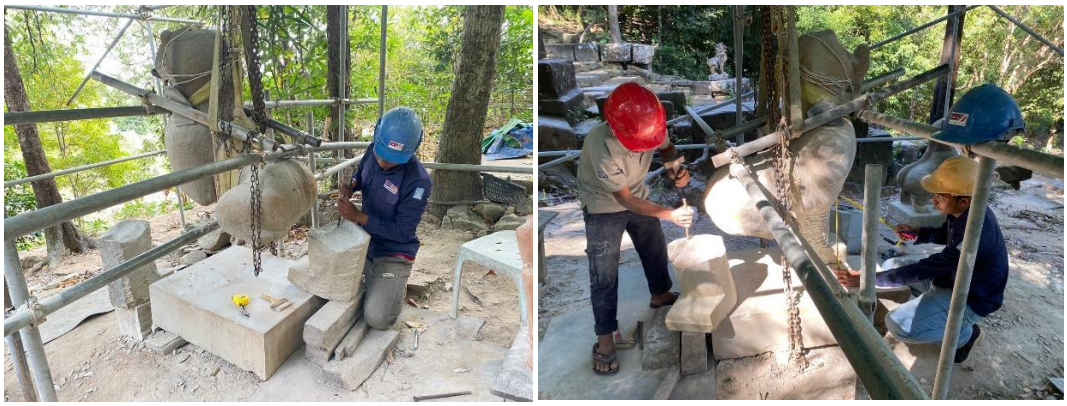


Figure 57: Conservation and restoration of a lion sculpture



Figure. 58: General view of the lion sculpture after restoration were completed

Annex 6: Conservation and restoration of section 14



Figure 59: Location and general condition of stair step at section 14 (View from north)

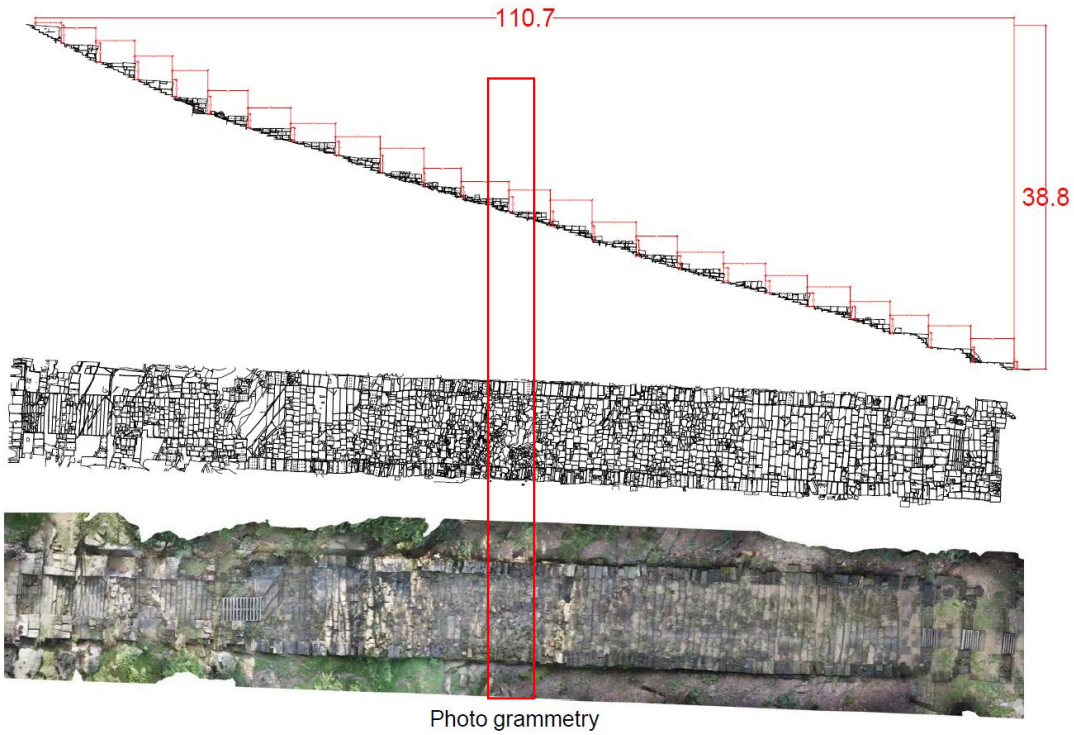
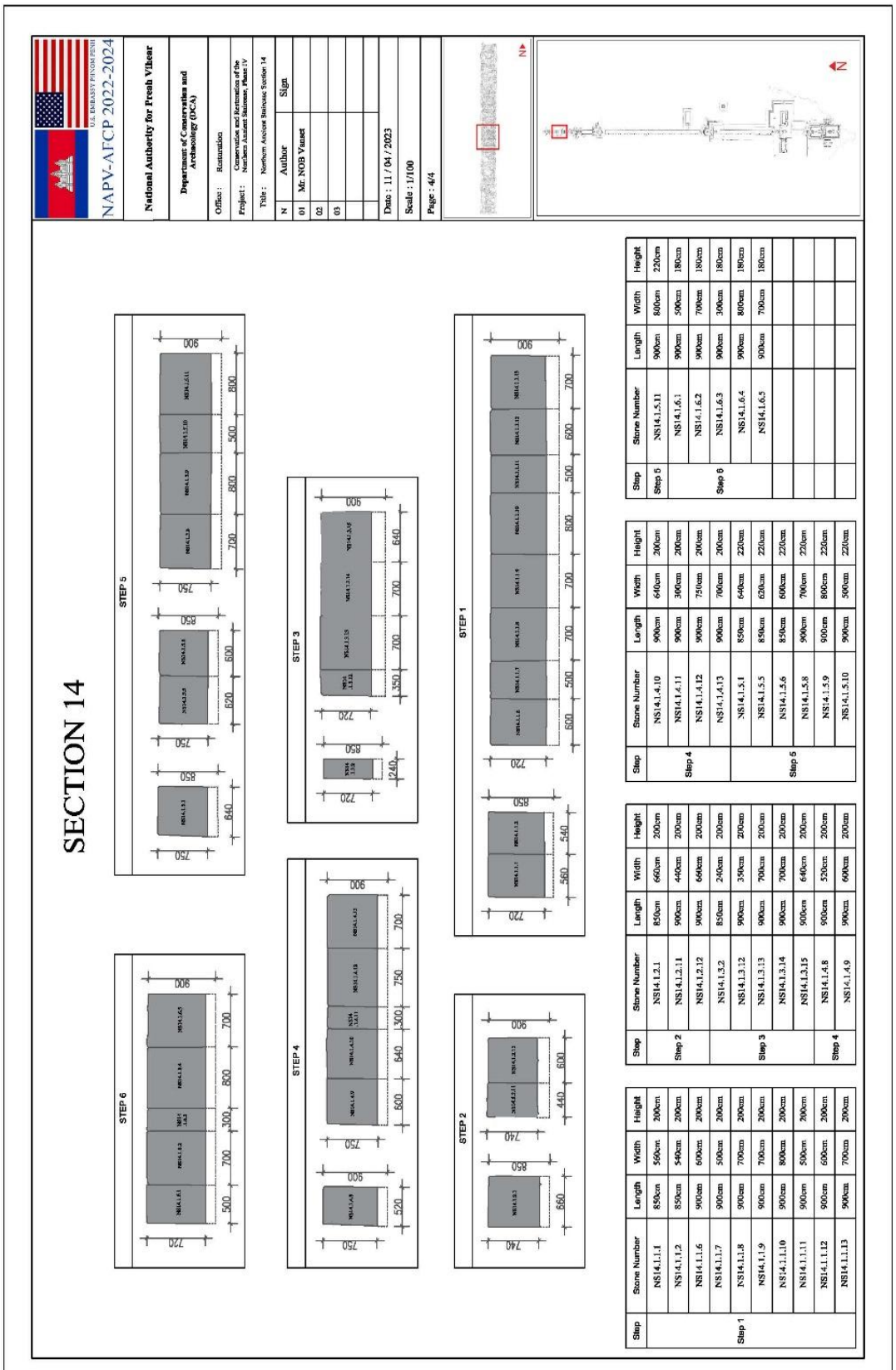


Figure 60: Plan showing section 14 (View from top)



Step	Stone Number	Langth	Width	Height
Step 1	NS14.1.1.1	850cm	560cm	200cm
	NS14.1.1.2	850cm	540cm	200cm
	NS14.1.1.6	900cm	600cm	200cm
	NS14.1.1.7	900cm	500cm	200cm
	NS14.1.1.8	900cm	700cm	200cm
	NS14.1.1.9	900cm	700cm	200cm
	NS14.1.1.10	900cm	800cm	200cm
	NS14.1.1.11	900cm	500cm	200cm
	NS14.1.1.12	900cm	600cm	200cm
	NS14.1.1.13	900cm	700cm	200cm
Step 2	NS14.1.2.1	850cm	660cm	200cm
	NS14.1.2.11	900cm	440cm	200cm
	NS14.1.2.12	900cm	660cm	200cm
Step 3	NS14.1.3.2	850cm	240cm	200cm
	NS14.1.3.12	900cm	350cm	200cm
	NS14.1.3.13	900cm	700cm	200cm
	NS14.1.3.14	900cm	700cm	200cm
	NS14.1.3.15	900cm	640cm	200cm
Step 4	NS14.1.4.8	900cm	520cm	200cm
	NS14.1.4.9	900cm	600cm	200cm
Step 4	NS14.1.4.10	900cm	640cm	200cm
	NS14.1.4.11	900cm	300cm	200cm
	NS14.1.4.12	900cm	750cm	200cm
	NS14.1.4.13	900cm	700cm	200cm
Step 5	NS14.1.5.1	850cm	640cm	220cm
	NS14.1.5.5	850cm	620cm	220cm
	NS14.1.5.6	850cm	600cm	220cm
	NS14.1.5.8	900cm	700cm	220cm
	NS14.1.5.9	900cm	800cm	220cm
	NS14.1.5.10	900cm	500cm	220cm
Step 5	NS14.1.5.11	900cm	800cm	220cm
	NS14.1.6.1	900cm	500cm	180cm
Step 6	NS14.1.6.2	900cm	700cm	180cm
	NS14.1.6.3	900cm	300cm	180cm
	NS14.1.6.4	900cm	800cm	180cm
	NS14.1.6.5	900cm	700cm	180cm

Figure 61: Data showing quantity of new stone required to replace ancient broken stones of stair steps at section 14

Conservation and restoration of the west stair wall of section 14



Figure 62: Eastern side of the foundation of the west stair wall settled and stone broke



Figure 63: Dismantling stone blocks at 2nd layer of the west stair wall from their original positions



Figure 64: Stone blocks at 3rd layer were broken and moved from their original positions



Figure 65: Weak foundation condition of the stair wall (View from top)



Figure 66: Removing deposited soil and debris from the gaps between stone blocks



Figure 67: Foundation condition at the 3rd layer of the west stair wall after

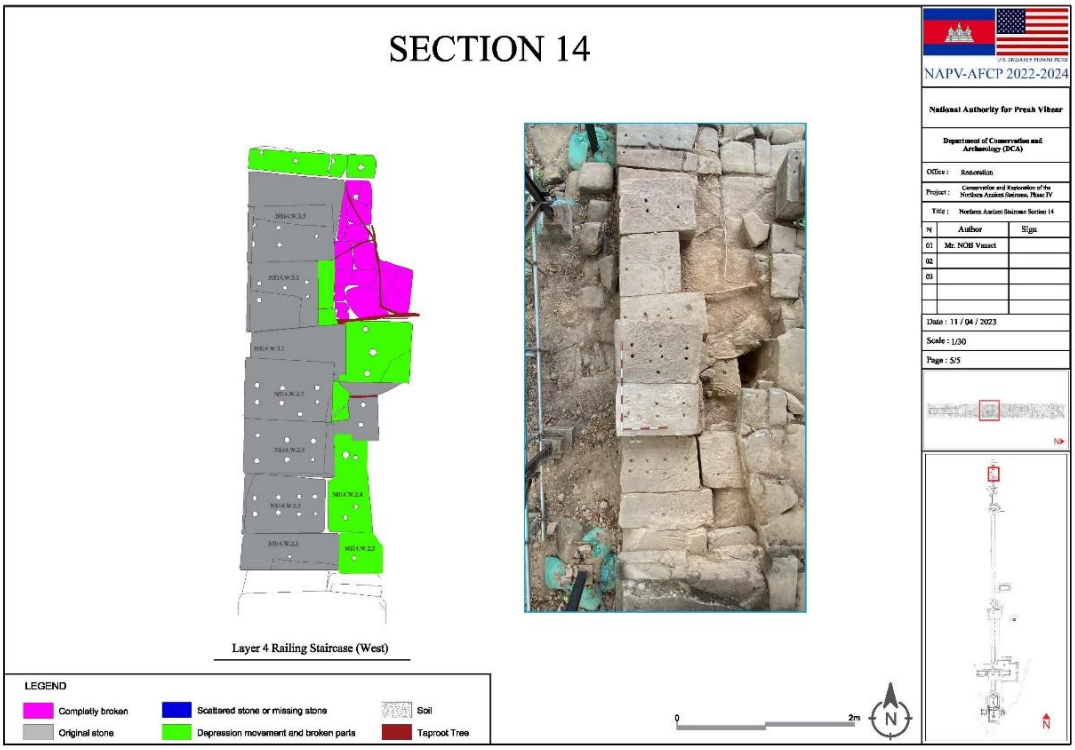


Figure 68: Floor plan of the west stair wall (View from top)





Figure 69: Activity of conservation and restoration of the west stair wall

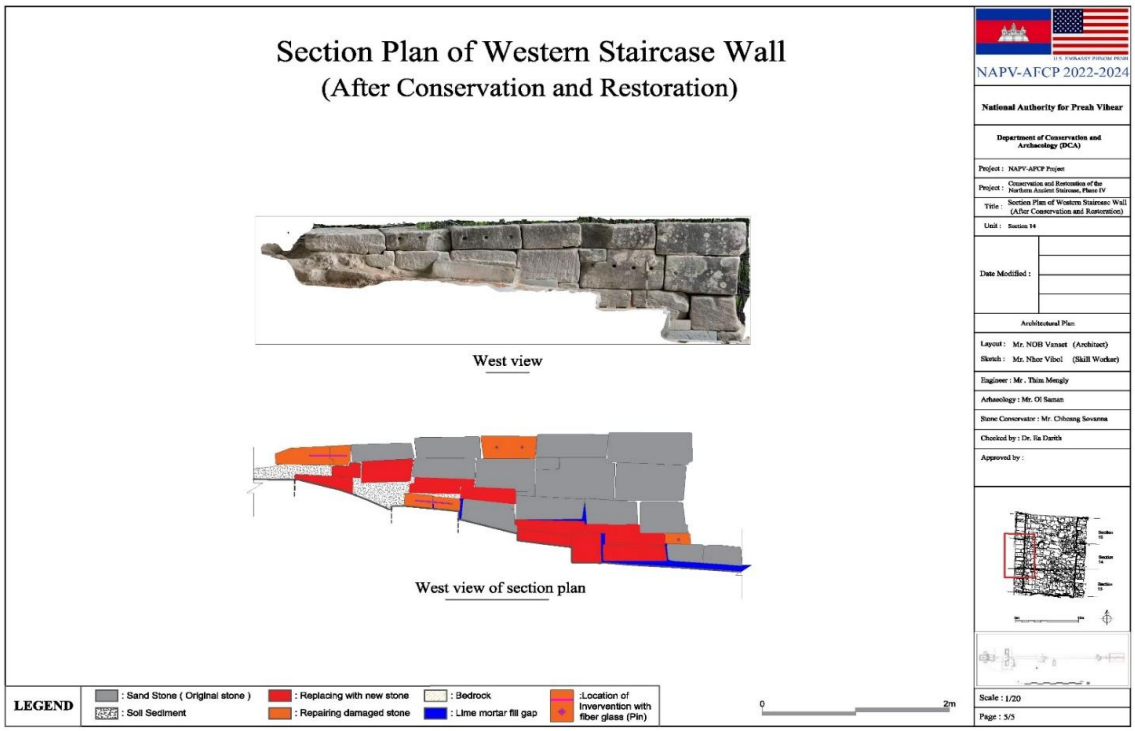


Figure 70: Image and plan of the west stair wall after restoration (viewing from the east)

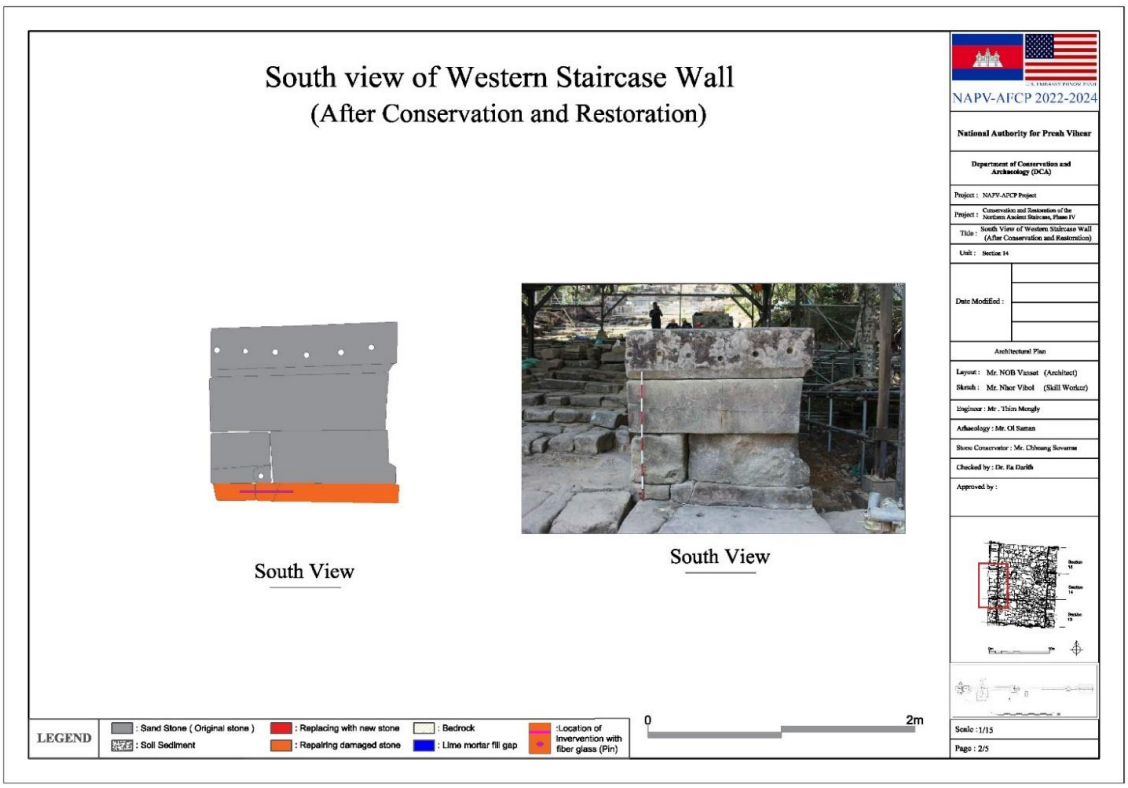


Figure 71: Image and plan of west stair wall after restoration (viewing from the north)

Conservation and restoration of the eastern stair wall



Figure 72: Poor condition of the east stair wall and fallen stone blocks scatter on the ground



Figure 73: Stone blocks of the east stair wall fallen down, decayed and broken



Figure 74: Dismantling stone blocks from their original positions



Figure 75: Scope of damage at the 2nd layer of the eastern stair wall

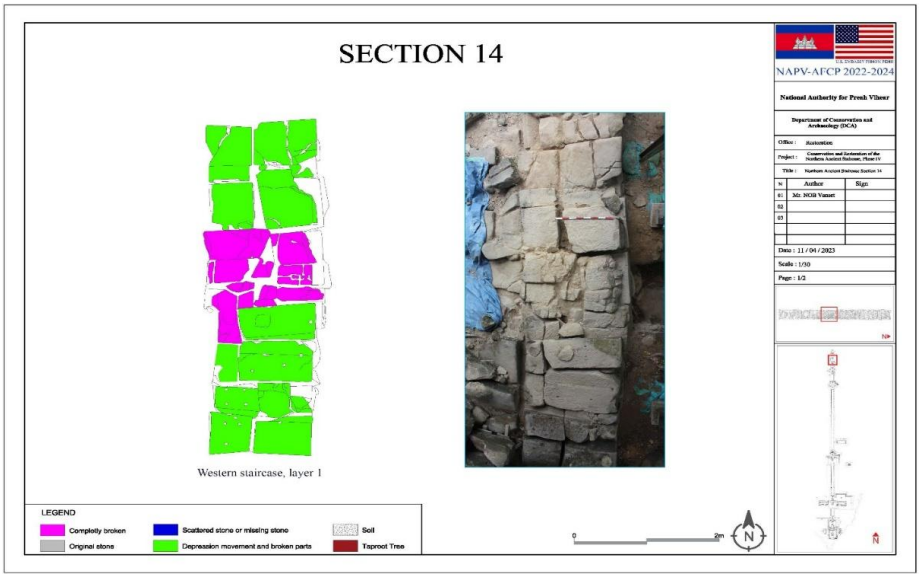


Figure 76: Plan at the 2nd layer illustrating scope of damage of the east stair wall

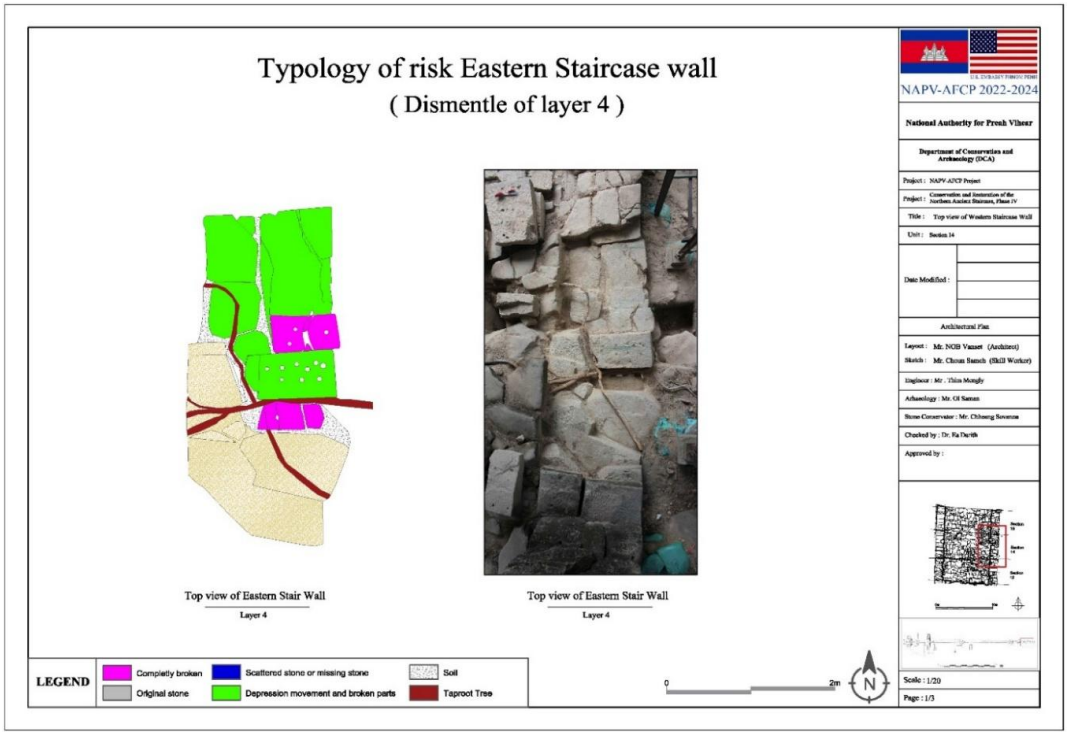


Figure 77: Image and plan showing condition of the east stair wall before restoration, layer 4, (top view)



Figure 78: Deposited debris and soil and termite nest within the gaps of stone blocks



Figure 79: Removing debris and deposited soil in the gaps between stone blocks



Figure 80: Restoration activities of the east stair wall

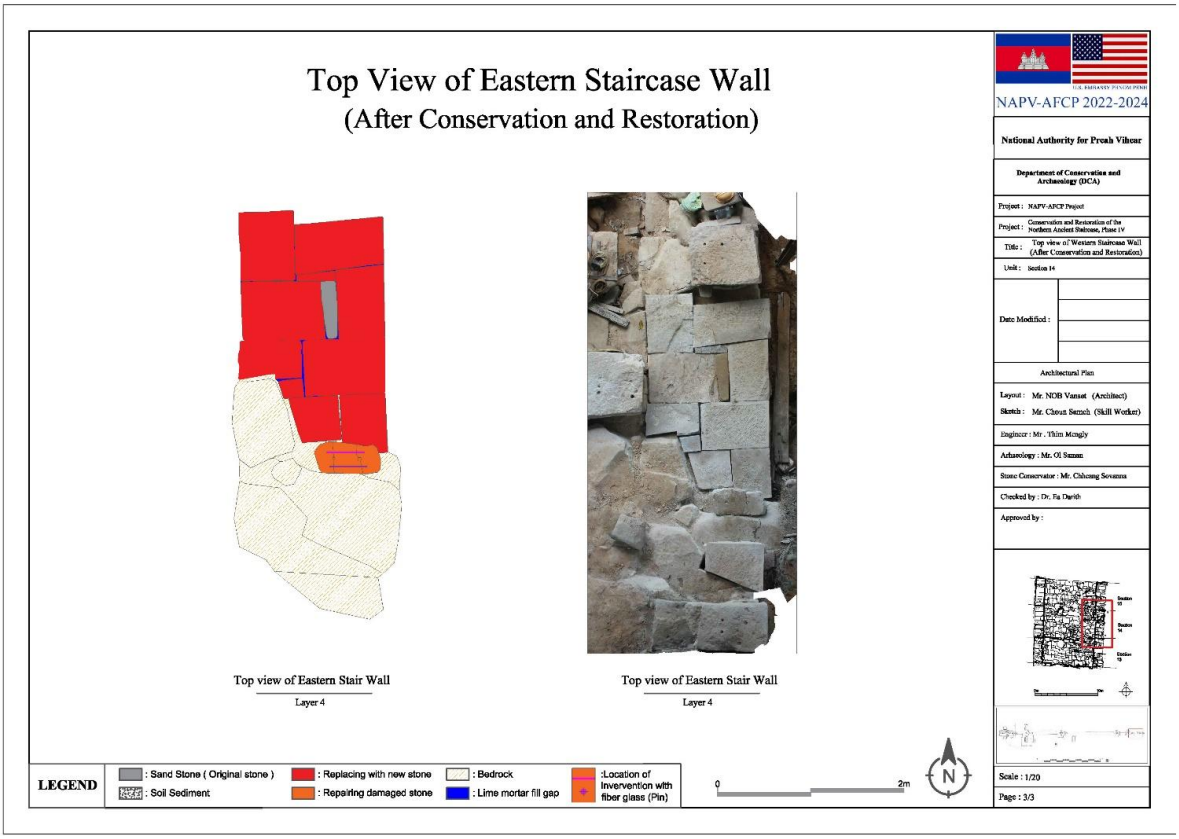


Figure 81: Plan and image of east stair wall after restoration, layer 4, top view

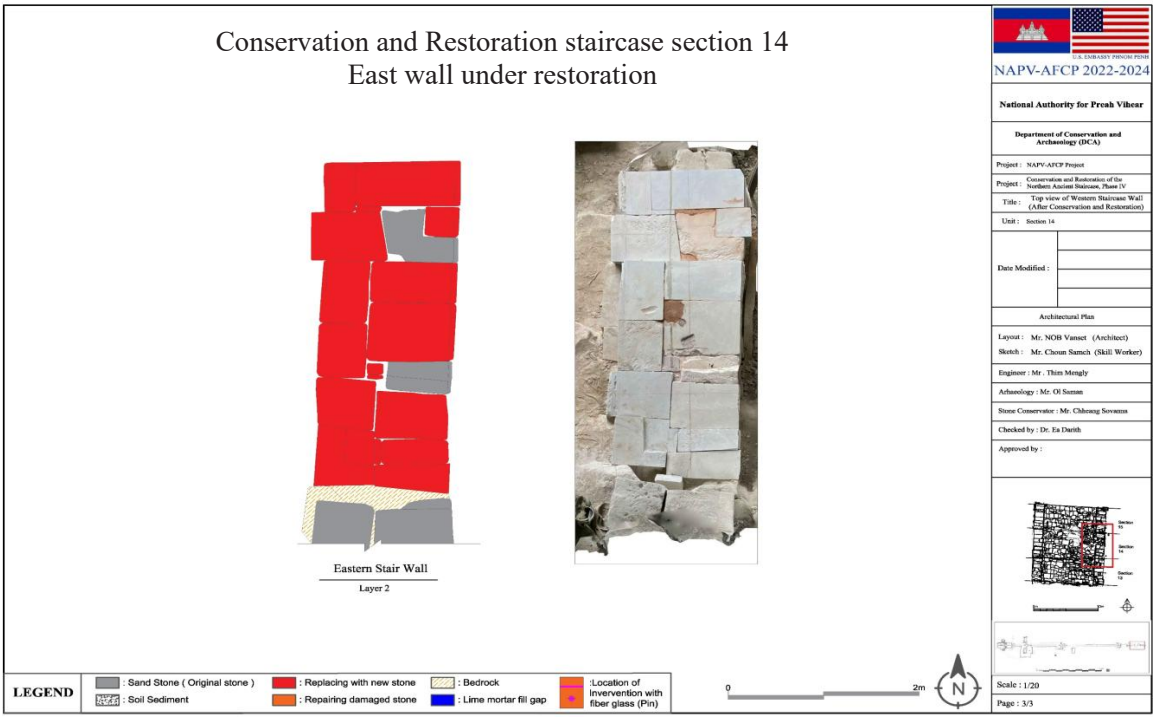


Figure 82: Layer 2 of the east stair wall, viewing from the top



Figure 83: Condition of the east stair wall before and after restoration

Conservation and restoration of stair step, section 14

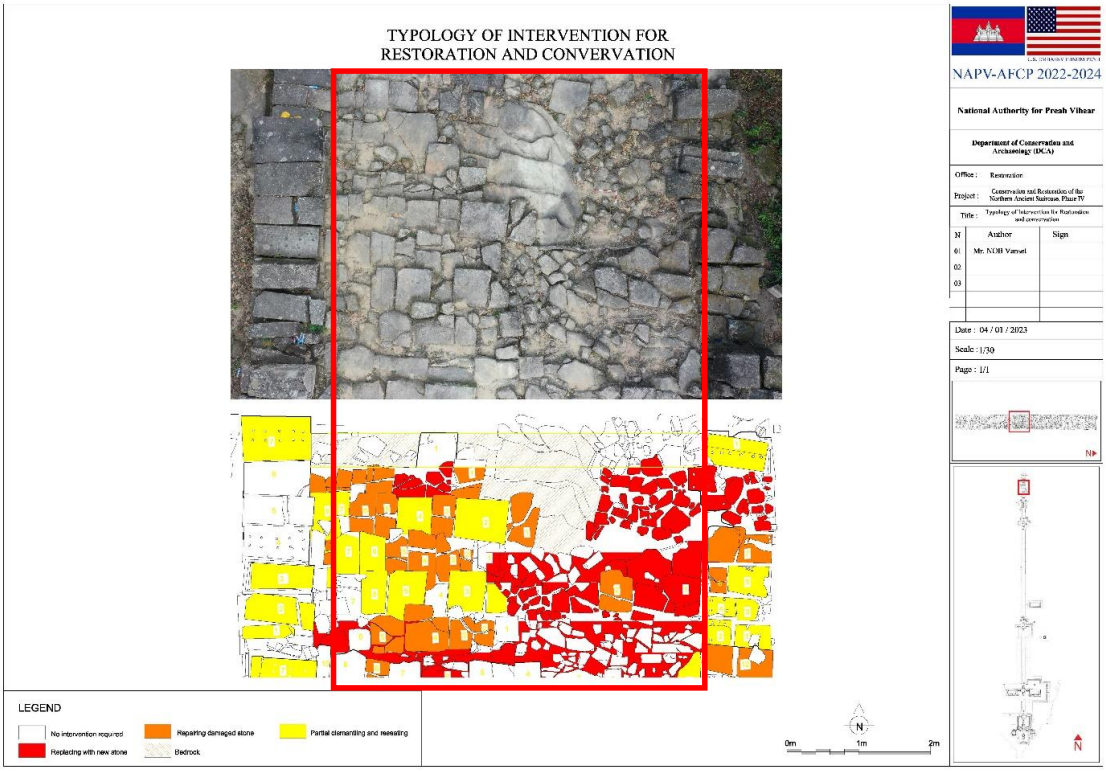


Figure 84: Stair steps before restoration





Figure 85: Dismantling activities of stone slabs from stair step and removed weak soil from foundation

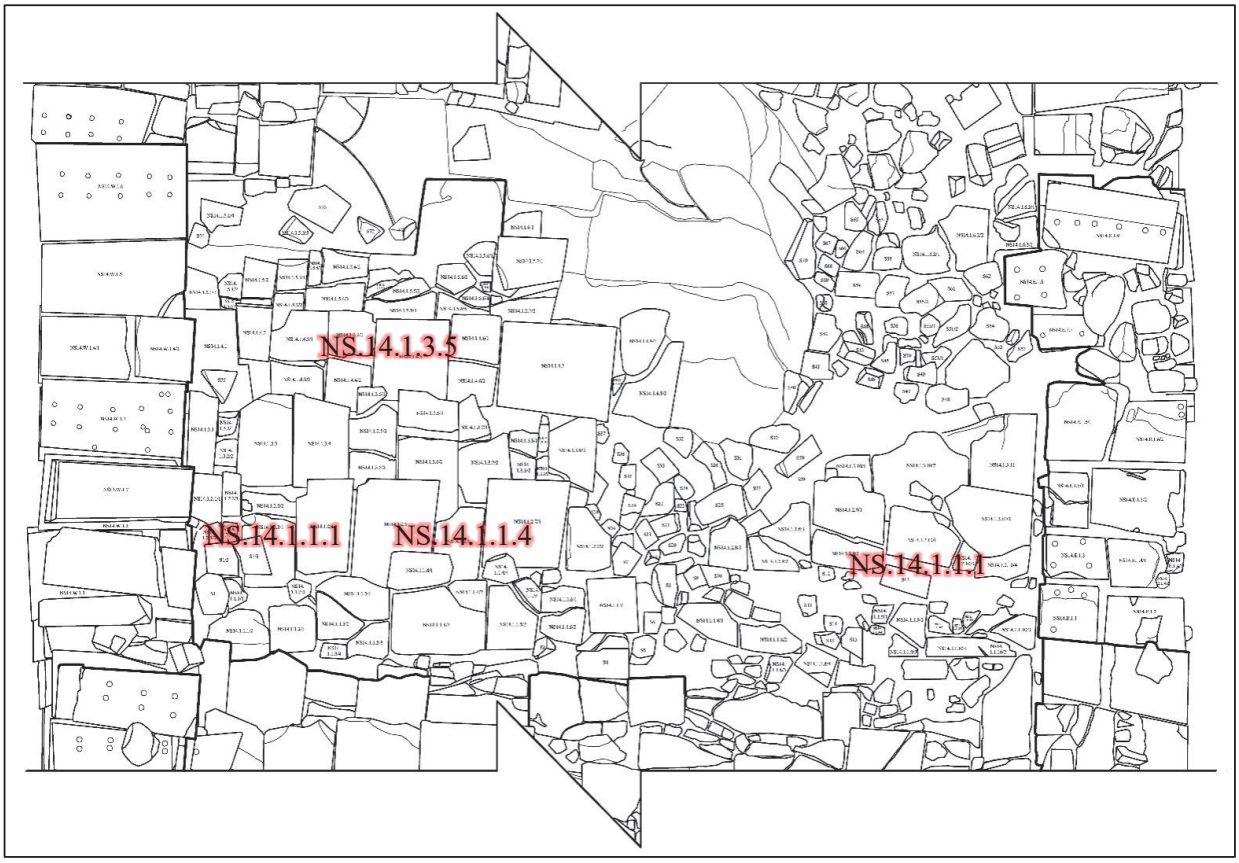


Figure 86: Locations of Dynamic Cone Penetration Test on staircase, section 14





Figure 87: Activities of Dynamic Cone Penetration Test

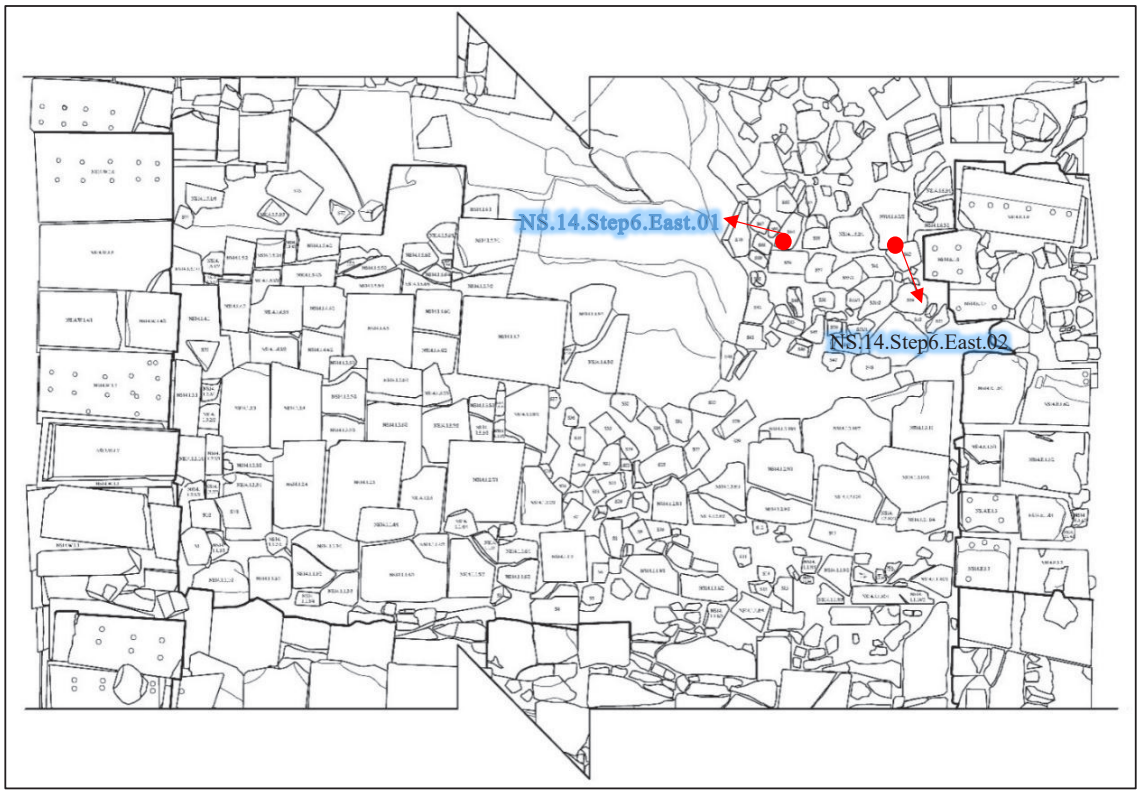


Figure 88: Location of Dynamic Cone Penetration Test at the half eastern part of the central axis



Figure 89: Foundation of stair step, eastern side of central axis. The yellow line shows the boundary of foundation added with fragment of stones in red lines to compact as final foundation



Figure 90: Condition of foundation of staircase building by cutting bedrock to make steps (yellow line), adding some stones (red line) and added mixture of soil and stone chip

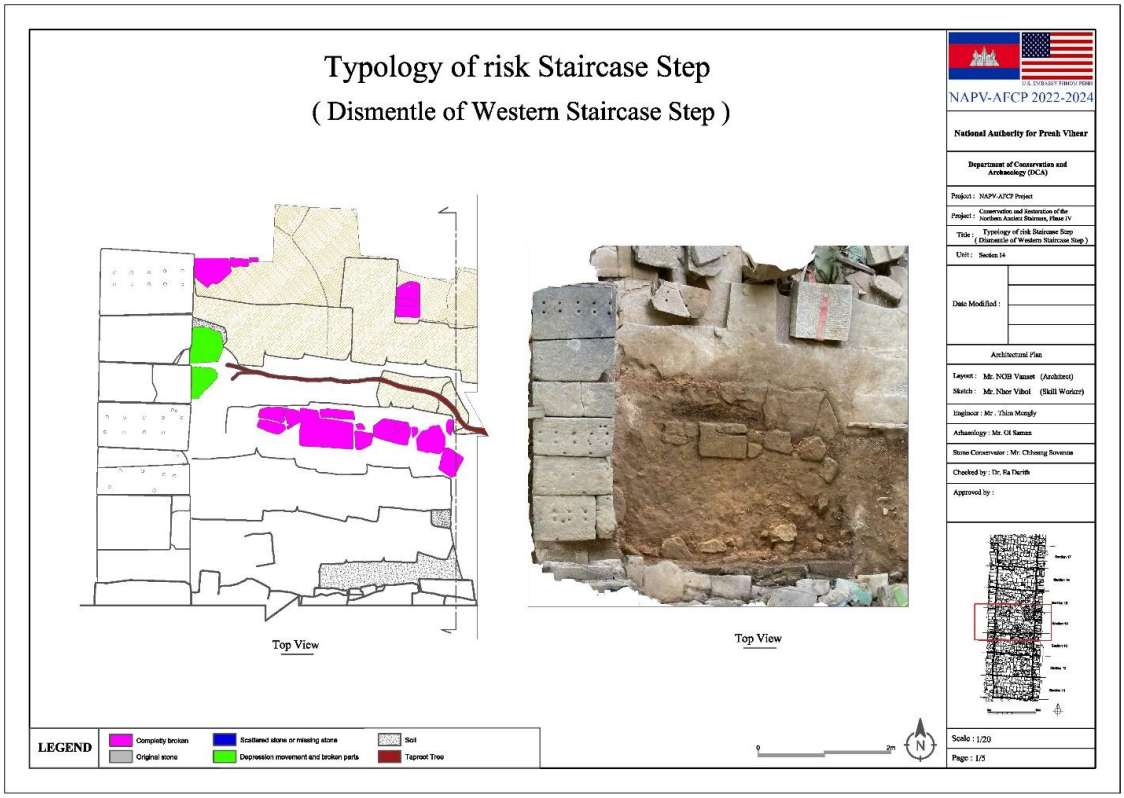


Figure 91: Current condition of foundation of staircase after dismantling

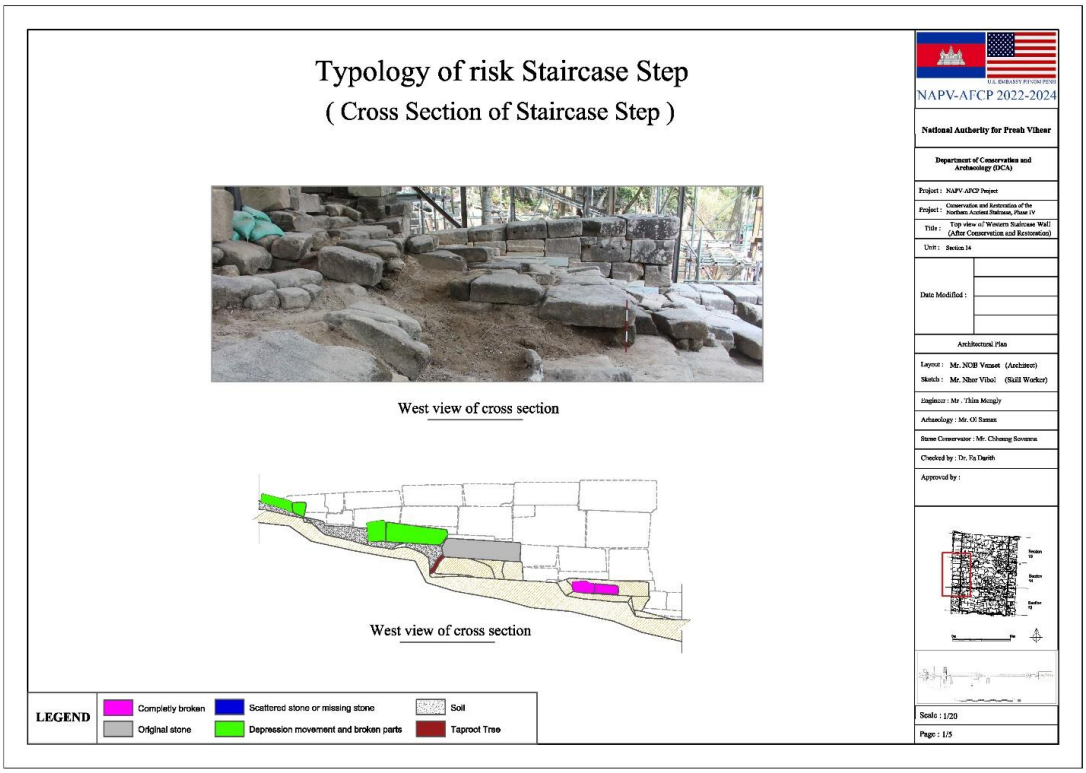


Figure 92: Image and plan showing step 4 of the staircase, section 14

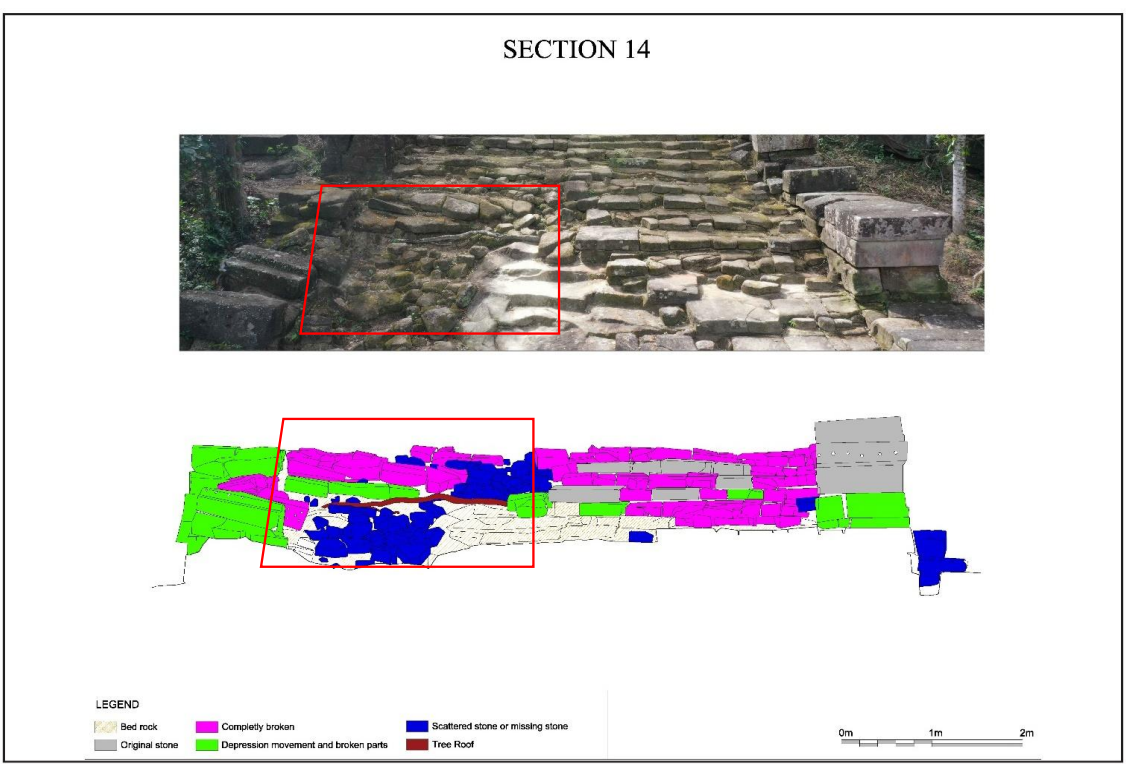


Figure 93: Photo and plan showing the condition of staircase before restoration

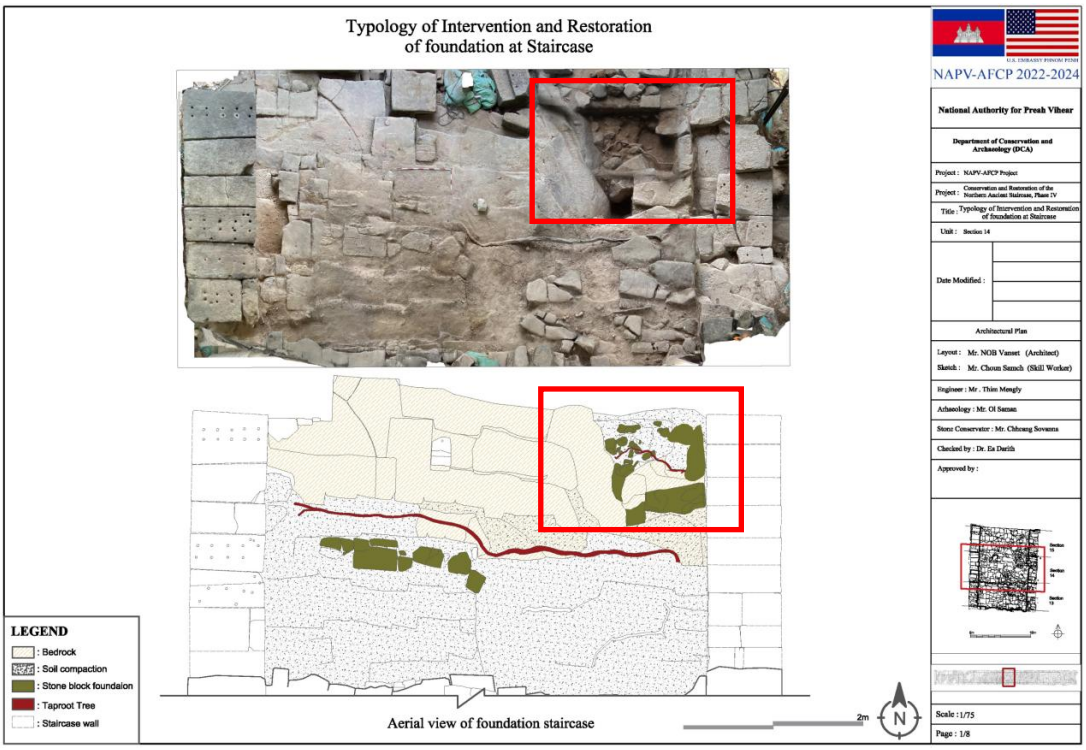


Figure 94: Photo and plan showing bed rock and slope at staircase, eastern side of central Axis, section 14, viewing from the top

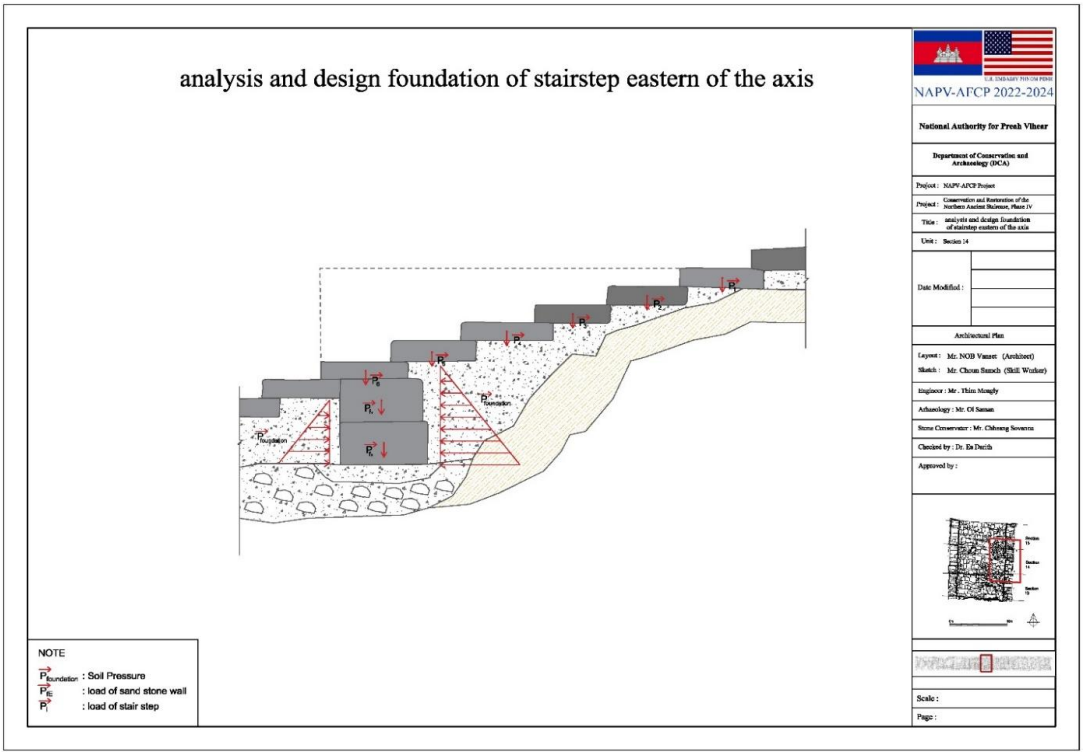


Figure 95: Cross section of foundation and stair step before restoration, eastern side of central axis, section 14, viewing from west

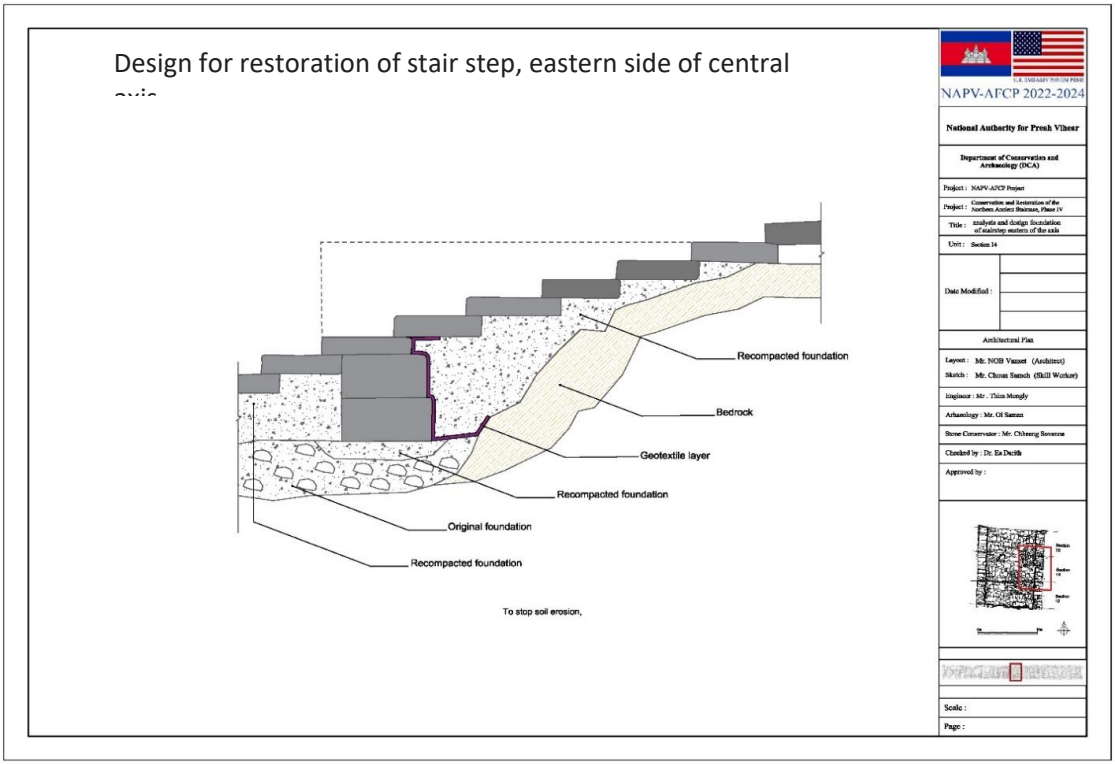


Figure 96: Cross section showing the design for restoration of stair step, eastern side of central axis, viewing from west

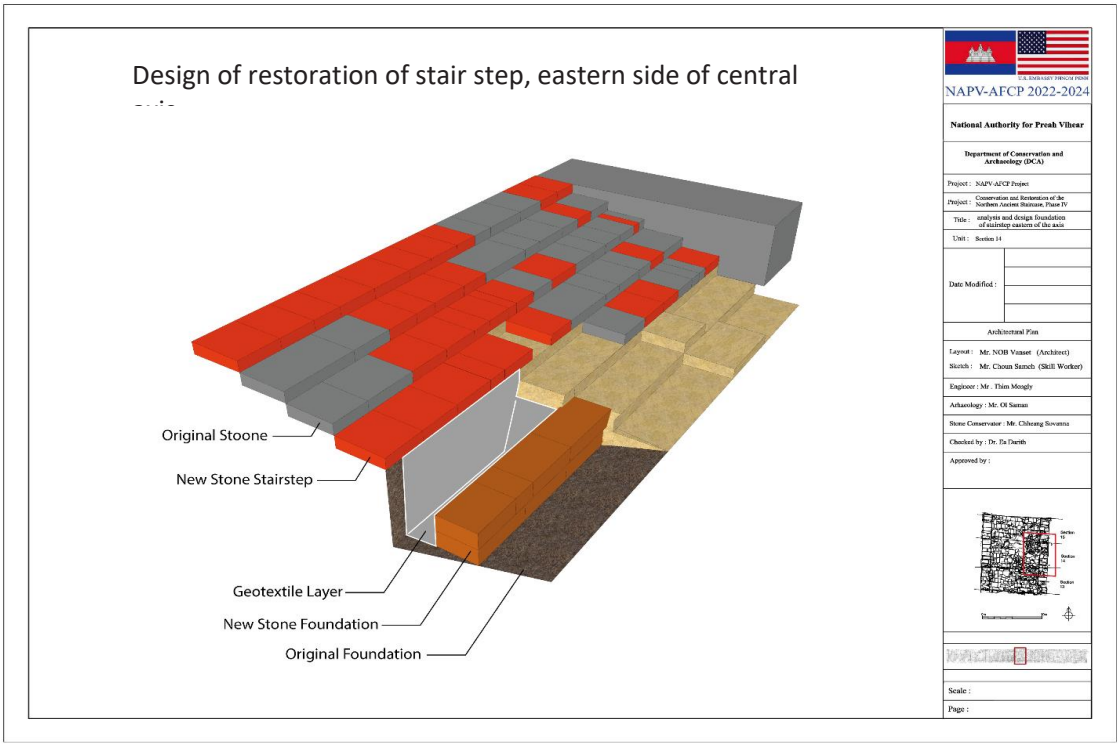


Figure 97: 3D design of restoration of stair step, eastern side of central axis



Figure 98: Preparation of geotextile to Prevent the soil flowing out



Figure 99: Compacting foundation of stair step, eastern side of central axis

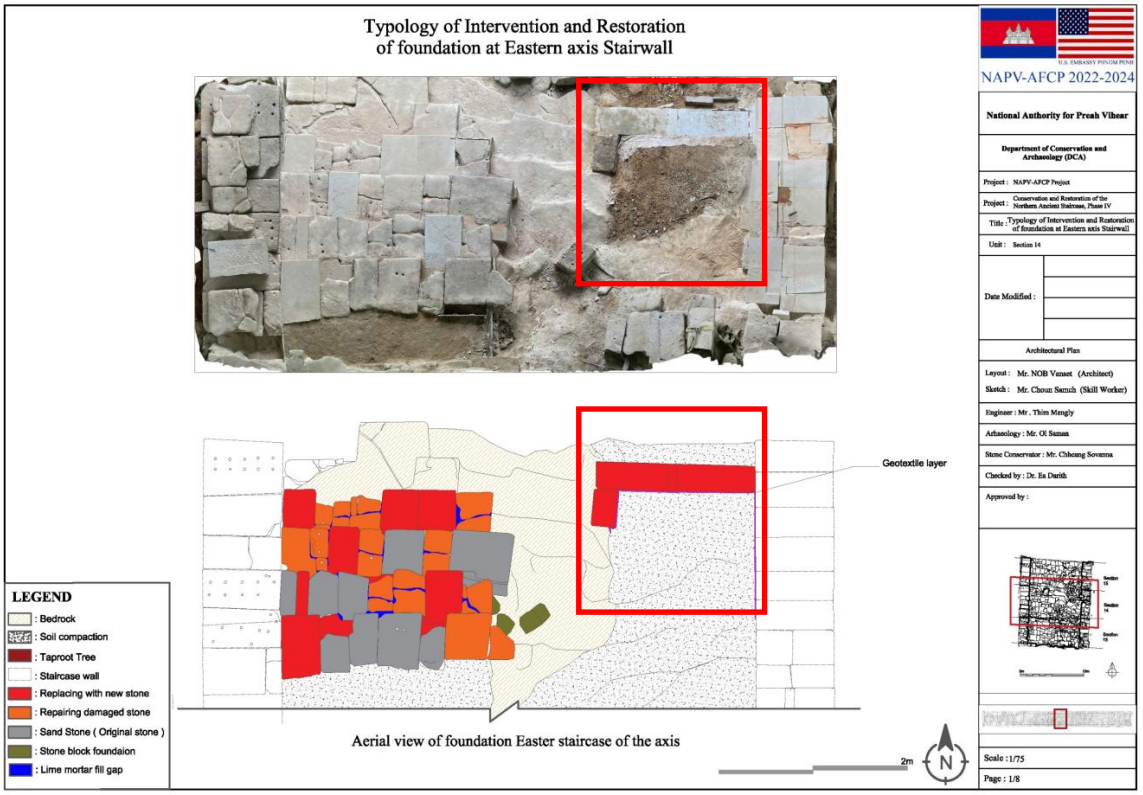


Figure 100: Photo and plan showing the foundation of eastern side staircase after compacted



Figure 101: The activities of soil compaction in the foundation and reassembling stone slabs

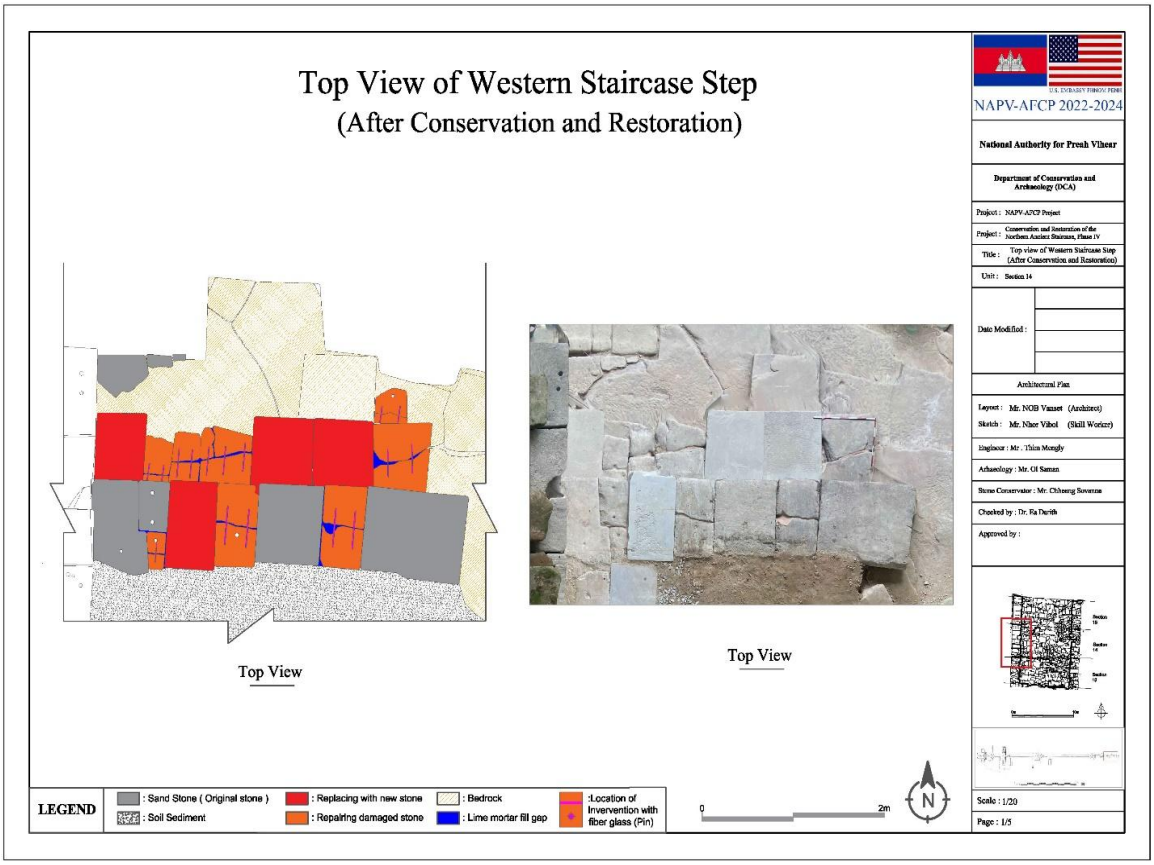


Figure 102: 03 steps of staircase were restored (top view)



Figure 103: The activities of reassembling stair steps at the half eastern part

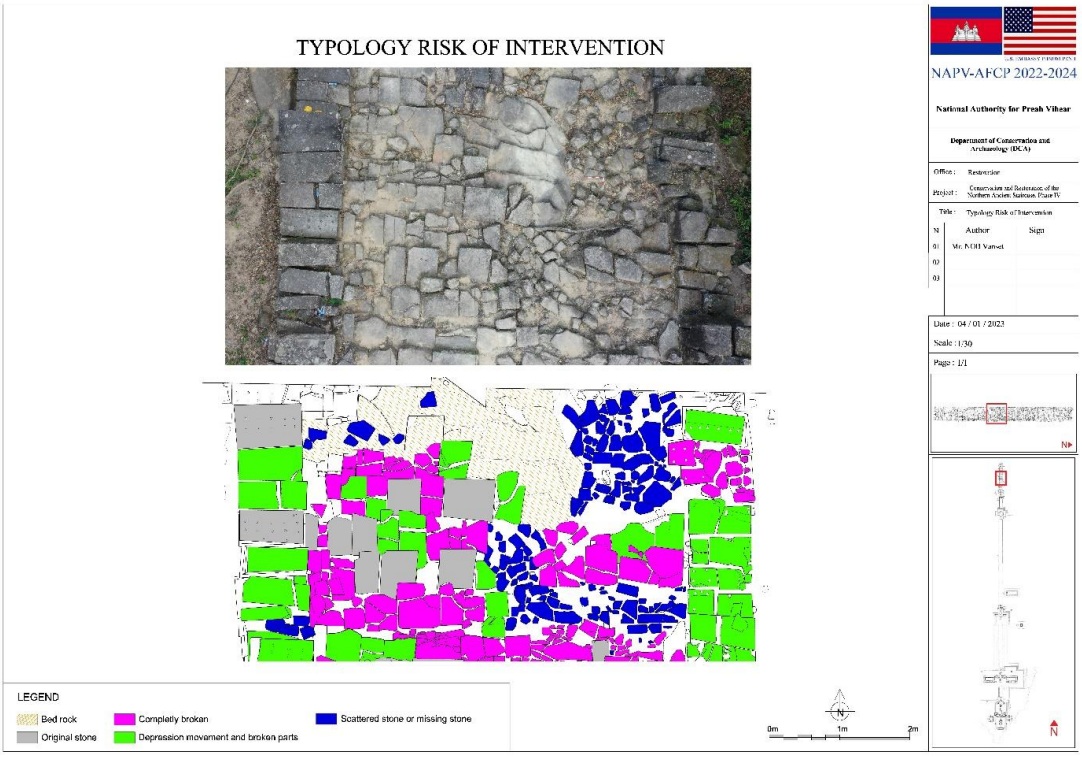


Figure 104: Image and plan of staircase at section 14 before restoration (top view)

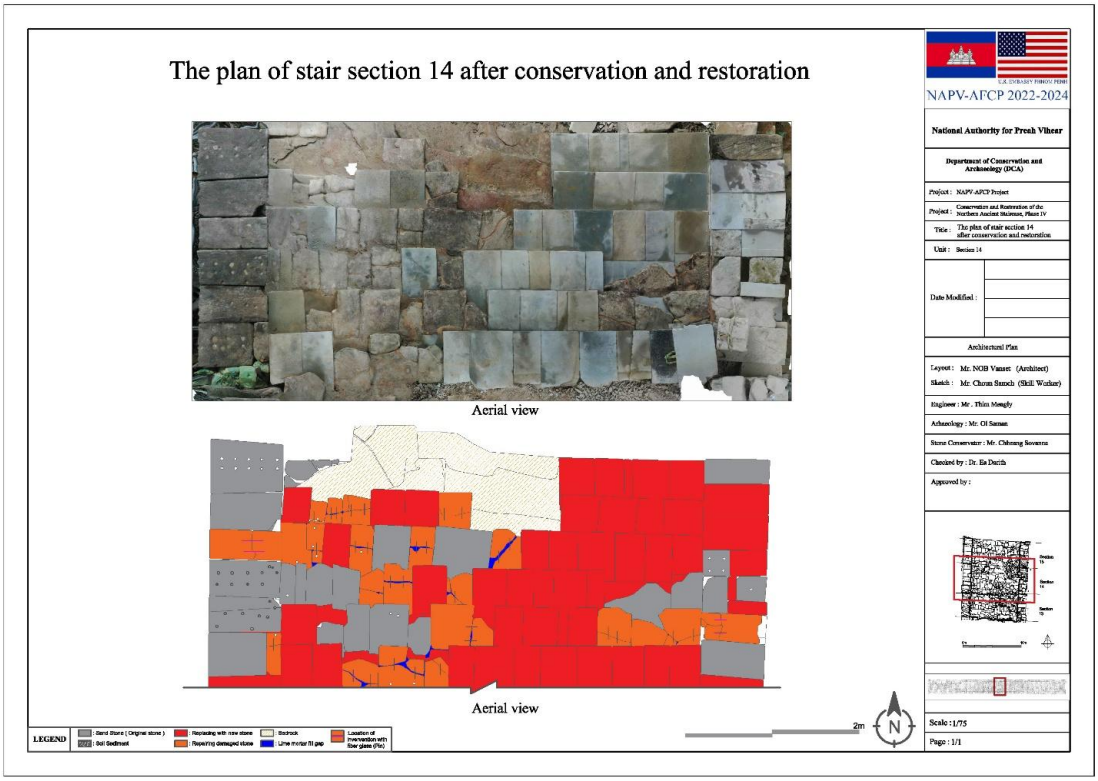


Figure 105: Image and plan of the staircase at section 14 after restoration (top view)

Table 1: Data of stone blocks/slabs of section 14 before and after restoration

Number of stone blocks dismantled at the west stair wall					
Layer	**Total stone blocks on western wall**	**Total stone blocks dismantled**	**Good ancient stone blocks**	**minor broken stone blocks-restorable**	**Severely broken stone blocks**
1	8	8	5	2	1
2	13	7	6	1	
3	13	5	5		
4	9	5	1	1	3
Total	**43**	**25**	**17**	**4**	**4**
Number of stone blocks reassembled at the west stair wall					
Layer	**Total stone blocks reassembled**	**Good ancient stone blocks**	**restored broken stone blocks**	**New stone blocks**	**Stone piece for foundation restoration**
1	9	5	2	2	
2	9	6	1	2	
3	7	5		2	
4	4	1	1	2	
Total	**29**	**17**	**4**	**8**	**0**
Number of stone blocks dismantled at the east stair wall					

Layer	Total stone blocks on eastern wall	Total stone blocks dismantled	Good ancient stone blocks	minor broken stone blocks-restorable	Severely broken stone blocks
1	13	13	7	2	4
2	15	15	8	2	5
3	10	10	4		6
4	7	5	3	1	1
Total	**45**	**43**	**22**	**5**	**16**
Number of stone blocks reassembled at the east stair wall					
Layer	**Total stone blocks reassembled**	**Good ancient stone blocks**	**restored broken stone blocks**	**New stone blocks**	**Stone piece for foundation restoration**
1	12	5		7	
2	49	8	2	39	
3	10	4		6	
4	30	3	1	11	15
Total	**101**	**20**	**3**	**63**	**15**
Number of stone slabs dismantled					
Step	**Total stone slabs on stair steps**	**Total stone slabs dismantled on stair steps**	**Good ancient stone slabs**	**minor broken stone slabs-restorable**	**Severely broken stone slabs**
1	10	10	0	3	7
2	10	10	6	3	1
3	11	11	3	5	3
4	8	8	2	5	1
5	8	8	1	4	3
6	3	3	0	1	2
Total	**50**	**50**	**12**	**21**	**17**
Number of stone slabs reassembled					
Step	**Total stone slabs**	**Good ancient stone slabs**	**Restored ancient stone slabs**	**New stone slabs**	**Stone for foundation**
1	16	0	3	11	2
2	18	6	3	4	5
3	22	3	5	7	7
4	24	2	5	7	10
5	12	1	3	7	1
6	13	0	1	5	7
Total	**105**	**12**	**20**	**41**	**32**

Table 2: Data of bearing capacity test of the foundation at the eastern half of stair steps before restoration

Location 1: NS.14.Step6.East.01

Depth of zero point below Surface: 0.000m (On the Ground)

Testing Date: 24/08/2023(Before Restore)

Material: Original Foundation

No.	Cumulative Num. of Blow	Cumulative Penetration (mm)	Penetration Between Readings(mm)	Penetration per Blow (mm)	Hammer Factor	DCP Index(mm/blow)	CBR(%)
1	0	0	0	0	0	0	0
2	5	97	97	19.40	1	19.40	10.54
3	10	160	63	6.30	1	6.30	37.16
4	15	245	85	5.67	1	5.67	41.85
5	20	375	130	6.50	1	6.50	35.89
6	25	448	73	2.92	1	2.92	87.93
7	30	502	54	1.80	1	1.80	100
8	35	560	58	1.66	1	1.66	100
9	40	607	47	1.18	1	1.18	100
10	45	630	23	0.51	1	0.51	100
11	50	659	29	0.58	1	0.58	100
12	55	689	30	0.55	1	0.55	100
13	60	720	31	0.52	1	0.52	100
14	65	748	28	0.43	1	0.43	100
15	70	777	29	0.41	1	0.41	100
16	75	805	28	0.37	1	0.37	100
17	80	831	26	0.33	1	0.33	100
18	85	841	10	0.12	1	0.12	100

Location 2: NS.14.Step6.East.01

Depth of zero point below Surface: 0.000m (On the ground)

Testing Date: 30/08/2023(After Restored)

Material: Recompacted Foundation

No.	Cumulative Num. of Blow	Cumulative Penetration (mm)	Penetration Between Readings (mm)	Penetration per Blow (mm)	Hammer Factor	DCP Index(mm/blow)	CBR(%)
1	0	0	0	0	0	0	0.00
2	5	107	107	21.40	1	21.40	9.45
3	10	197	90	9.00	1	9.00	24.92
4	15	268	71	4.73	1	4.73	51.19
5	20	324	56	2.80	1	2.80	92.16
6	25	370	46	1.84	1	1.84	100
7	30	423	53	1.77	1	1.77	100
8	35	498	75	2.14	1	2.14	100

9	40	559	61	1.53	1	1.53	100
10	45	606	47	1.04	1	1.04	100
11	50	657	51	1.02	1	1.02	100
12	55	718	61	1.11	1	1.11	100
13	60	763	45	0.75	1	0.75	100
14	65	778	15	0.23	1	0.23	100
15	70	789	11	0.16	1	0.16	100
16	75	797	8	0.11	1	0.11	100
17	80	808	11	0.14	1	0.14	100

Table 3: Data of bearing capacity test of the foundation after restoration

Location 1: NS.14.Step6.East.01

Depth of zero point below Surface: 0.000m (On the ground)

Testing Date: 30/08/2023(After Restored)

Material: Recompacted Foundation

No.	Cumulative Num. of Blow	Cumulative Penetration (mm)	Penetration Between Readings(mm)	Penetration per Blow (mm)	Hammer Factor	DCP Index(mm/blow)	CBR(%)
1	0	0	0	0	0	0	0.00
2	5	107	107	21.40	1	21.40	9.45
3	10	197	90	9.00	1	9.00	24.92
4	15	268	71	4.73	1	4.73	51.19
5	20	324	56	2.80	1	2.80	92.16
6	25	370	46	1.84	1	1.84	100
7	30	423	53	1.77	1	1.77	100
8	35	498	75	2.14	1	2.14	100
9	40	559	61	1.53	1	1.53	100
10	45	606	47	1.04	1	1.04	100
11	50	657	51	1.02	1	1.02	100
12	55	718	61	1.11	1	1.11	100
13	60	763	45	0.75	1	0.75	100
14	65	778	15	0.23	1	0.23	100
15	70	789	11	0.16	1	0.16	100
16	75	797	8	0.11	1	0.11	100
17	80	808	11	0.14	1	0.14	100

Location 2: NS.14.Step6.East.02

Depth of zero point below Surface: 0.000m (On the ground)

Date of testing: 30/08/2023(After Restored)

Material: Recompacted Foundation

No.	Cumulative Num. of Blow	Cumulative Penetration (mm)	Penetration Between Readings(mm)	Penetration per Blow (mm)	Hammer Factor	DCP Index(mm/blow)	CBR(%)

1	0	0	0	0	0	0	0.00
2	5	77	77	15.40	1	15.40	13.66
3	10	156	79	7.90	1	7.90	28.84
4	15	193	37	2.47	1	2.47	100
5	20	218	25	1.25	1	1.25	100
6	25	244	26	1.04	1	1.04	100
7	30	282	38	1.27	1	1.27	100
8	35	323	41	1.17	1	1.17	100
9	40	346	23	0.58	1	0.58	100
10	45	368	22	0.49	1	0.49	100
11	50	384	16	0.32	1	0.32	100
12	55	402	18	0.33	1	0.33	100
13	60	423	21	0.35	1	0.35	100
14	65	439	16	0.25	1	0.25	100
15	70	480	41	0.59	1	0.59	100
16	75	539	59	0.79	1	0.79	100
17	80	638	99	1.24	1	1.24	100
18	85	722	84	0.99	2	1.98	100
19	90	744	22	0.24	3	0.73	100
20	95	756	12	0.13	4	0.51	100
21	100	767	11	0.11	5	0.55	100
22	105	778	11	0.10	6	0.63	100
23	110	790	12	0.11	7	0.76	100
24	115	805	15	0.13	8	1.04	100
25	120	818	13	0.11	9	0.98	100
26	125	837	19	0.15	10	1.52	100
27	130	852	15	0.12	11	1.27	100
28	135	873	21	0.16	12	1.87	100
29	140	896	23	0.16	13	2.14	100
30	145	923	27	0.19	14	2.61	99.84
31	150	949	26	0.17	15	2.60	100

Annex 7: Conservation and restoration of section 13

Architecture of section 13



Figure 106: Red lines showing the location of staircase, section 13



Figure 107: surveyed architectural plan and leveling stones before restoration

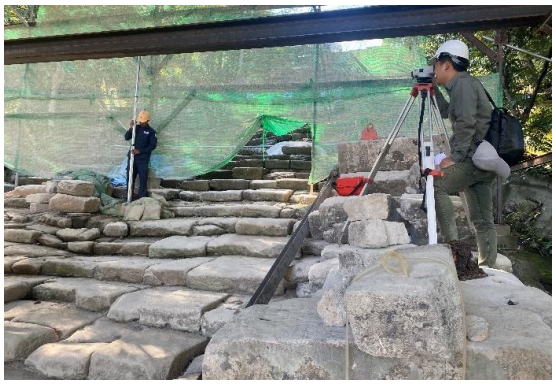
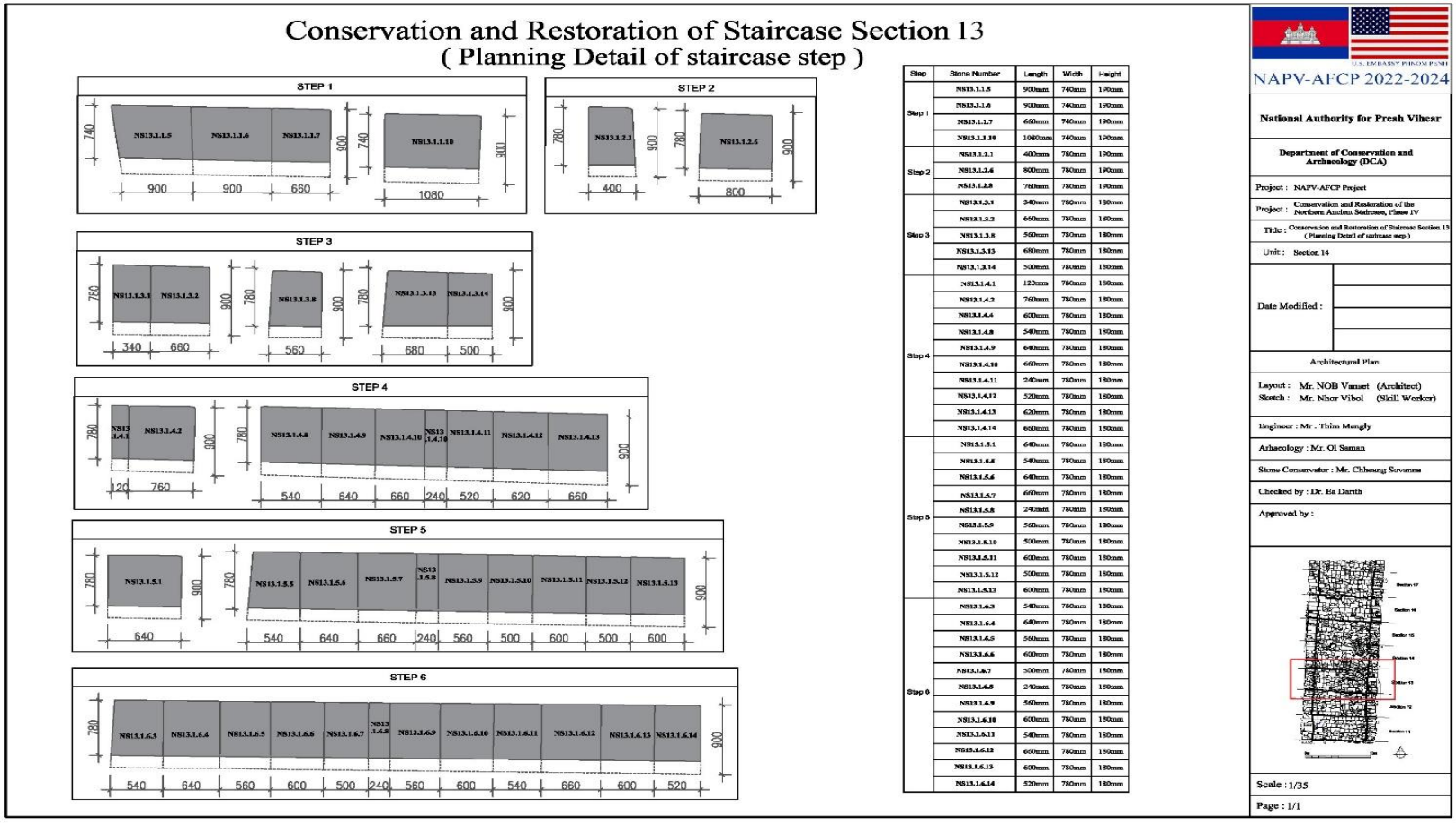


Figure 108: topography survey



Step	Stone Number	Length	Width	Height
Step 1	NS13.1.1.5	900mm	740mm	190mm
	NS13.1.1.6	900mm	740mm	190mm
	NS13.1.1.7	660mm	740mm	190mm
	NS13.1.1.10	1080mm	740mm	190mm
Step 2	NS13.1.2.1	400mm	780mm	190mm
	NS13.1.2.6	800mm	780mm	190mm
	NS13.1.2.8	760mm	780mm	190mm
Step 3	NS13.1.3.1	340mm	780mm	180mm
	NS13.1.3.2	660mm	780mm	180mm
	NS13.1.3.8	560mm	780mm	180mm
	NS13.1.3.13	680mm	780mm	180mm
	NS13.1.3.14	500mm	780mm	180mm
Step 4	NS13.1.4.1	120mm	780mm	180mm
	NS13.1.4.2	760mm	780mm	180mm
	NS13.1.4.4	600mm	780mm	180mm
	NS13.1.4.8	540mm	780mm	180mm
	NS13.1.4.9	640mm	780mm	180mm
	NS13.1.4.10	660mm	780mm	180mm
	NS13.1.4.11	240mm	780mm	180mm
	NS13.1.4.12	520mm	780mm	180mm
	NS13.1.4.13	620mm	780mm	180mm
	NS13.1.4.14	660mm	780mm	180mm
Step 5	NS13.1.5.1	640mm	780mm	180mm
	NS13.1.5.5	540mm	780mm	180mm
	NS13.1.5.6	640mm	780mm	180mm
	NS13.1.5.7	660mm	780mm	180mm
	NS13.1.5.8	240mm	780mm	180mm
	NS13.1.5.9	560mm	780mm	180mm
	NS13.1.5.10	500mm	780mm	180mm
	NS13.1.5.11	600mm	780mm	180mm
	NS13.1.5.12	500mm	780mm	180mm
	NS13.1.5.13	600mm	780mm	180mm
Step 6	NS13.1.6.3	540mm	780mm	180mm
	NS13.1.6.4	640mm	780mm	180mm
	NS13.1.6.5	560mm	780mm	180mm
	NS13.1.6.6	600mm	780mm	180mm
	NS13.1.6.7	500mm	780mm	180mm
	NS13.1.6.8	240mm	780mm	180mm
	NS13.1.6.9	560mm	780mm	180mm
	NS13.1.6.10	600mm	780mm	180mm
	NS13.1.6.11	540mm	780mm	180mm
	NS13.1.6.12	660mm	780mm	180mm
	NS13.1.6.13	600mm	780mm	180mm
	NS13.1.6.14	520mm	780mm	180mm

Figure 109: database of new stones for restoration of section 13

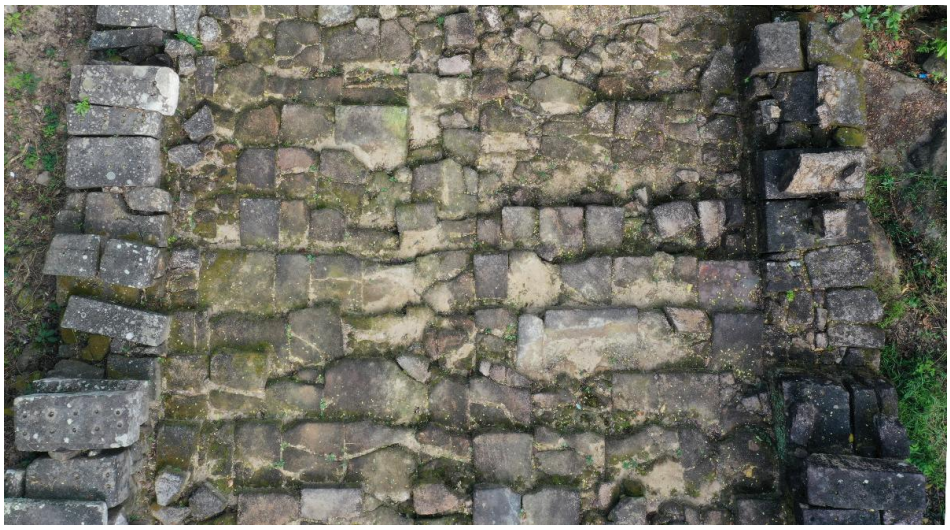


Figure 110: image of staircase, section 13 viewing from the top

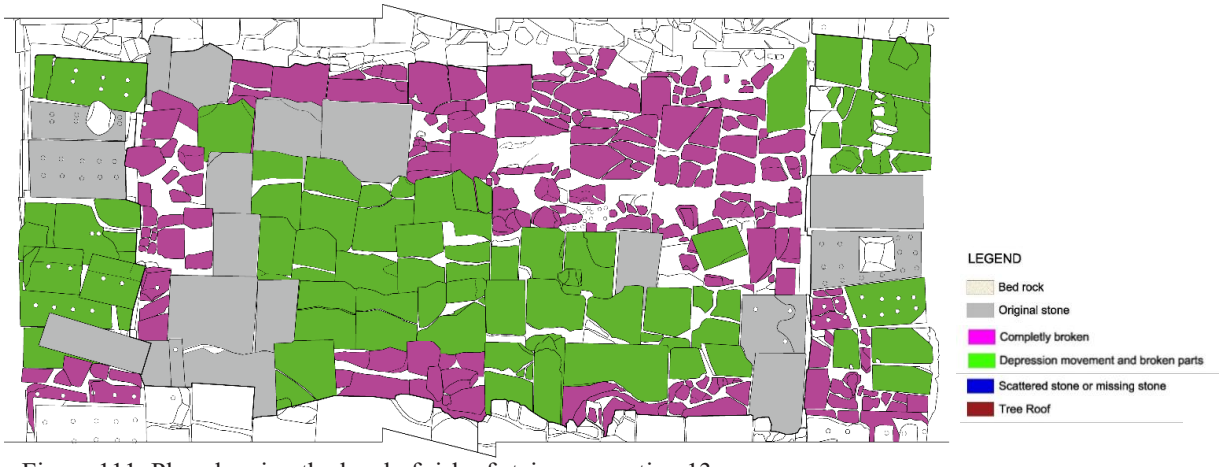


Figure 111: Plan showing the level of risk of staircase, section 13

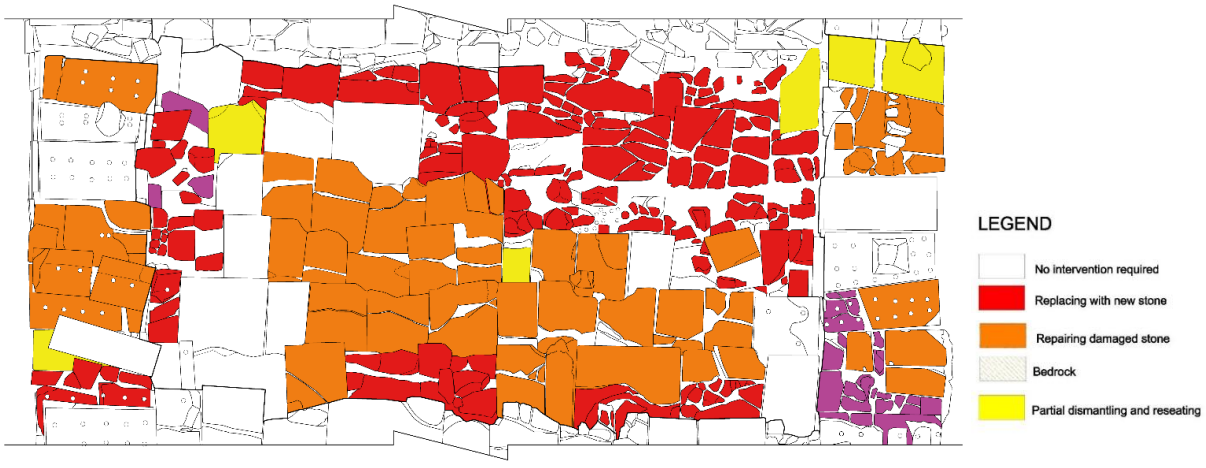


Figure 112: Intervention plan of staircase, section 13

West stair wall



Figure 113: Location at western wall of section 13 (top view)

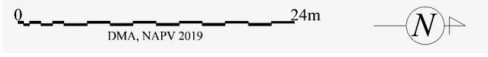




Figure 114: Condition of western wall, section 13, viewing from the west



Figure 115: Plan analyzing damage level of the western wall, section 13, viewing from the west

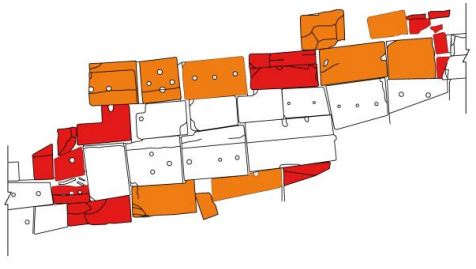


Figure 116: Intervention plan of the eastern wall, viewing from the west

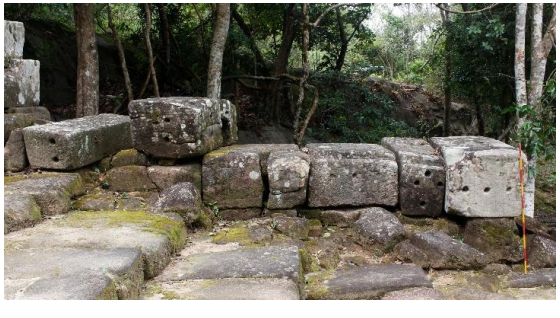


Figure 117: Condition of the western wall, section 13, viewing from the east



Figure 118: Plan analyzing damage level of the western wall, viewing from the east



Figure 119: Intervention plan at the eastern wall, viewing from the east



Figure 120: Dismantled stones



Figure 121: Cleaned deposited soil and tree roots

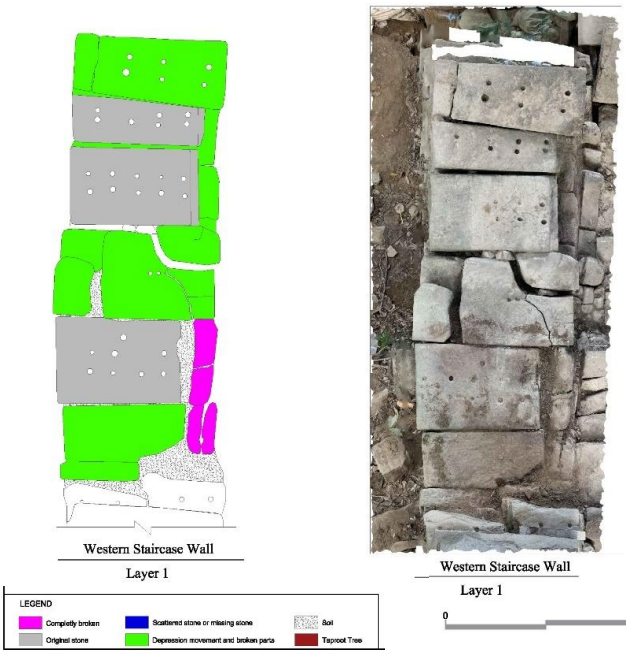


Figure 122: Plan analyzing risk of stones and damage of the western wall, layer 1, top view

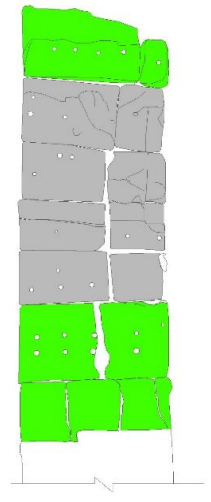




Figure 48: Plan analyzing risk of stones and damage of the western wall, layer 2, top view





Figure 123: Reassembled stones at the western wall



Figure 124: Condition of the western wall before restoration, north view



Figure 125: Condition of the west wall after restoration, north view



Figure 126: Condition of the western wall before restoration (east view)



Figure 127: Condition of the western wall after restoration (east view)

East stair wall



Figure 128: Location at eastern wall of section 13 (top view)

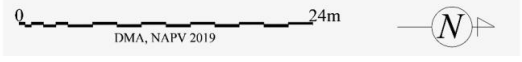




Figure 129: Eastern wall, outer view



Figure 130: Plan analyzing the damage level of the eastern wall, outer view



Figure 131: Intervention plan of the eastern wall, outer view



Figure 132: Eastern wall, inner view

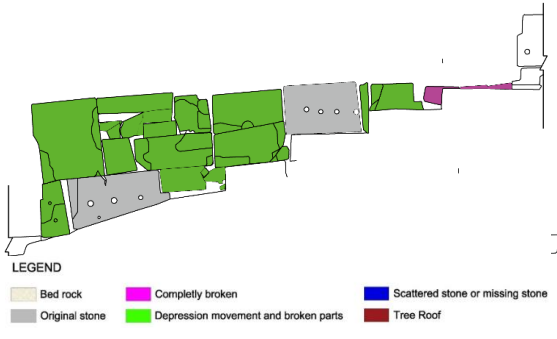


Figure 133: Plan analyzing damage level of the eastern wall, inner view

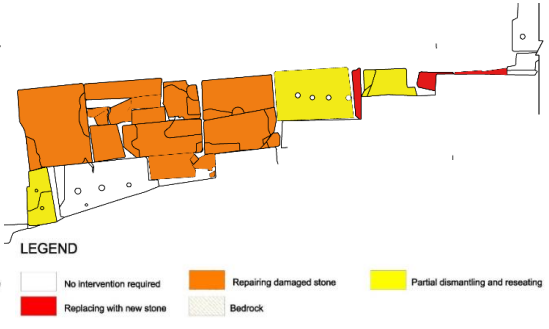


Figure 134: Intervention plan of the eastern wall, inner view



Figure 135: Dismantled eastern wall stones



Figure 136: Removed tree root from the eastern wall

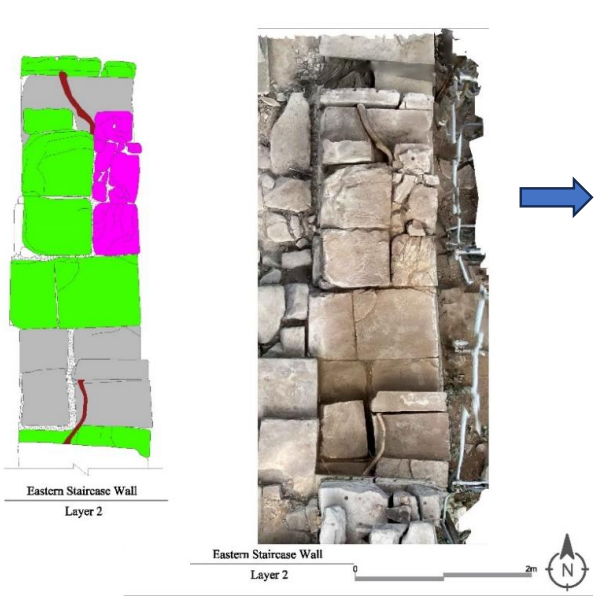


Figure 137: Plan analyzing the level of risk and condition of the eastern wall, layer 2

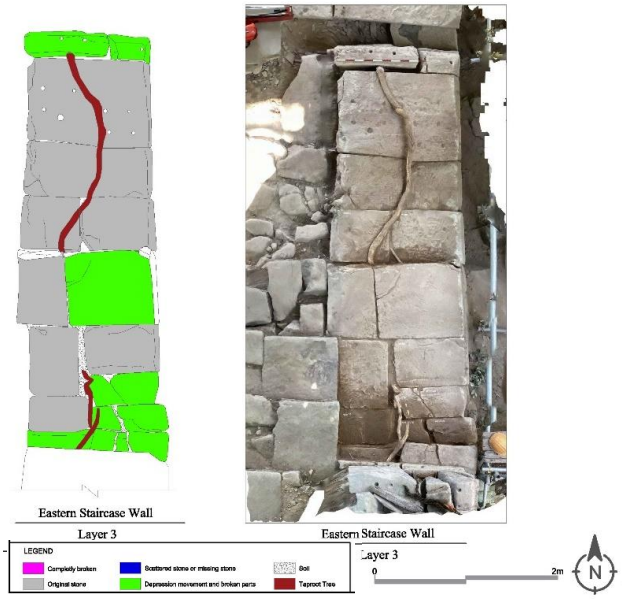


Figure 138: Plan analyzing the level of risk and condition of the eastern wall, layer 3



Figure 139: Reassembled stones to eastern wall



Figure 140: Filled mortar in gaps to prevent water infiltration



Figure 141: Eastern wall, section 13 before restoration, viewing from the west



Figure 142: Eastern wall, section 13 after restoration, viewing from the west



Figure 143: Eastern wall, section 13 before restoration, viewing from the north



Figure 144: Eastern wall, section 13 before restoration, viewing from the north



Figure 145: The plan showing location of section 13

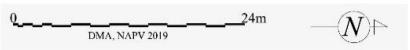




Figure 146: The condition of stair steps before restoration



Figure 147: Typology risk of stair steps

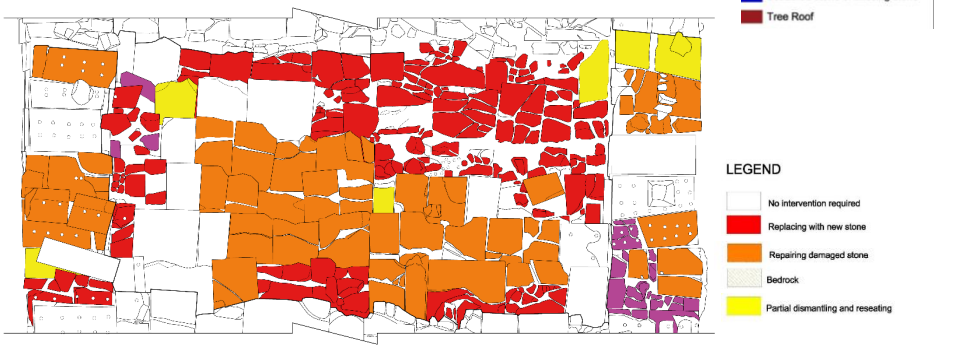


Figure 148: Typology of intervention of stair steps



Figure 149: Dismantling activities of stone slab



Figure. 150: Short overlapping area between step 5 and step 6 may cause to collapse or breaking stone slabs of step 5, so adding more stone slabs under the step 5 is necessary.

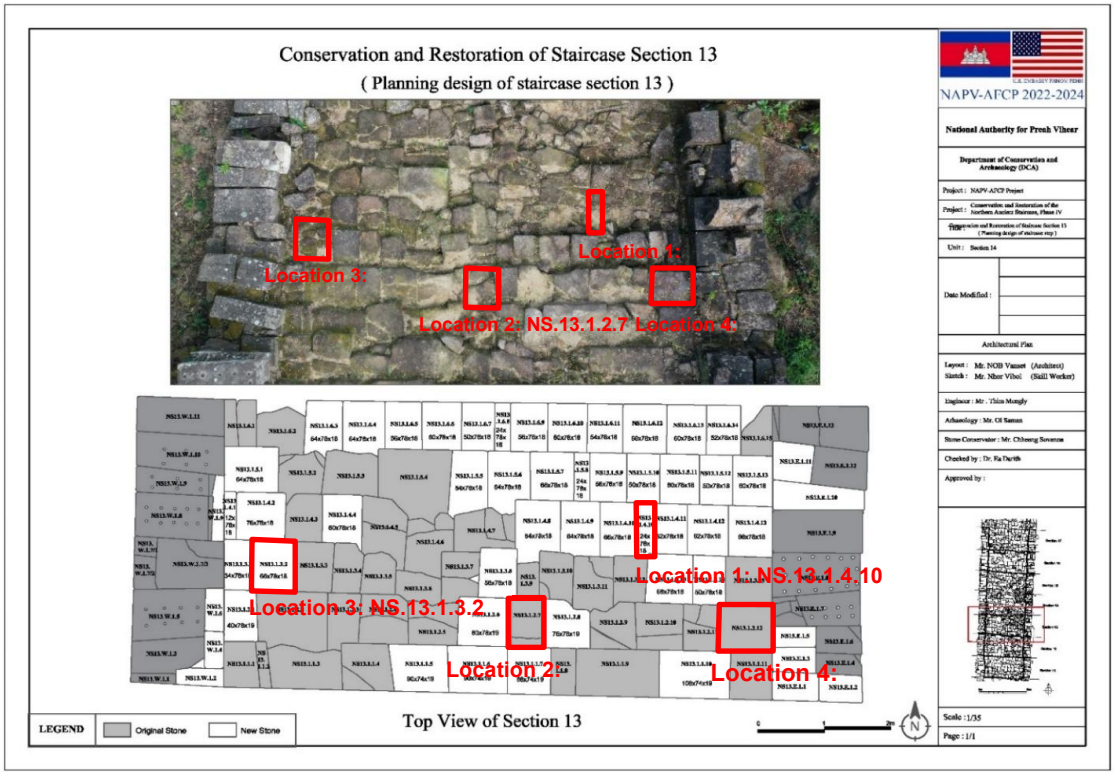


Figure. 151: Plan showing locations of DCPT conducted at section 13



Figure 152: Dynamic Cone Penetrometer Test (DCPT) at section 13 before restoration



Figure. 153: DCPT test of foundation after restoration

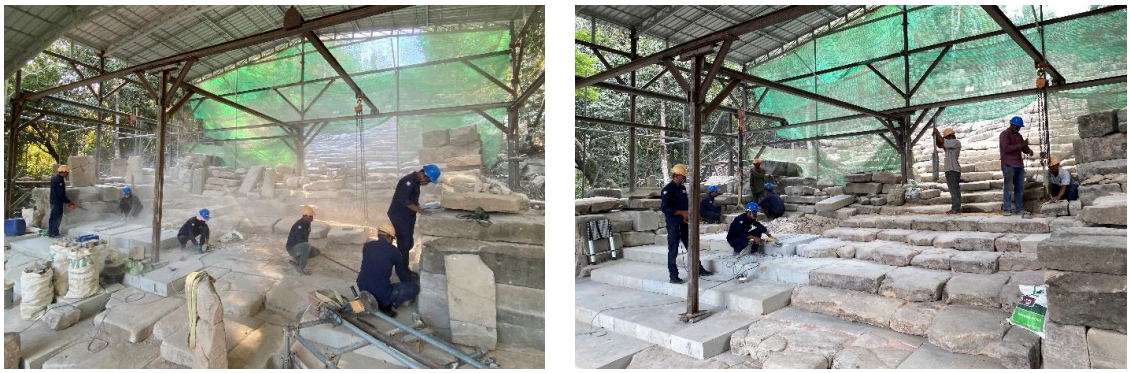


Figure 154: Conservation and restoration of stair steps at section 13

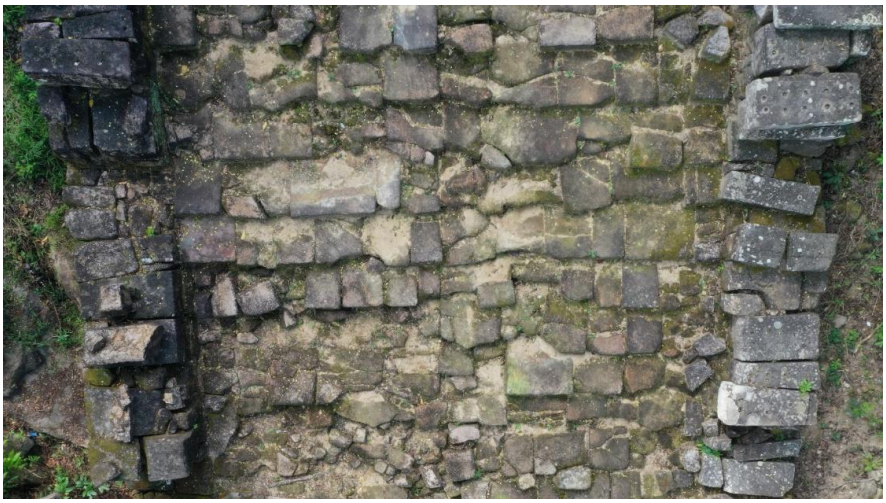


Figure 155: The general condition of section 13 before restoration (top view)



Figure 155: The general condition of section 13 after restoration (top view)



Figure 156: The general condition of section 13 before restoration (north view)



Figure 157: The general condition of section 13 after restoration (north view)

Table 4: database of stone blocks/ slabs of section 13

Number of stone blocks dismantled at the west stair wall					
Layer	**Total stone blocks on western wall**	**Total stone blocks dismantled**	**Good ancient stone blocks**	**minor broken stone blocks-restorable**	**Severely broken stone blocks**
1	11	10	4	5	1
2	13	11	9	2	
3	6	4	3	1	
Total	**30**	**25**	**16**	**8**	**1**
Number of stone blocks reassembled at the west stair wall					
Layer	**Total stone blocks reassembled**	**Good ancient stone blocks**	**restored broken stone blocks**	**New stone blocks**	**Stone piece for foundation restoration**
1	14	4	5	5	
2	16	9	2	3	2
3	5	3	1		1
Total	**35**	**16**	**8**	**8**	**3**
Number of stone blocks dismantled at the east stair wall					
Layer	**Total stone blocks on eastern wall**	**Total stone blocks dismantled**	**Good ancient stone blocks**	**minor broken stone blocks-restorable**	**Severely broken stone blocks**
1	12	12	6	5	1

2	15	10	4	3	3
3	10				1
4	2				
Total	**39**	**22**	**10**	**8**	**5**
Number of stone blocks reassembled at the east stair wall					
Layer	**Total stone blocks reassembled**	**Good ancient stone blocks**	**restored broken stone blocks**	**New stone blocks**	**Stone piece for foundation restoration**
1	12	6	5	1	
2	13	4	3	6	
3	1				1
4					
Total	**26**	**10**	**8**	**7**	**1**
Number of stone slabs dismantled					
Step	**Total stone slabs on stair steps**	**Total stone slabs dismantled on stair steps**	**Good ancient stone slabs**	**minor broken stone slabs-restorable**	**Severely broken stone slabs**
1	12	12	5	4	2
2	12	12	2	9	1
3	14	14	3	10	1
4	13	13	1	6	6
5	11	11	3	2	6
6	10	10	3	3	4
Total	**72**	**72**	**17**	**34**	**20**
Number of stone slabs reassembled					
Step	**Total stone slabs**	**Good ancient stone slabs**	**Restored ancient stone slabs**	**New stone slabs**	**Stone for foundation**
1	17	6	4	2	5
2	12	2	9	1	0
3	17	5	10	2	0
4	17	1	6	7	3
5	15	3	2	8	2
6	25	3	3	8	11
Total	**103**	**20**	**34**	**28**	**21**

Table 5: Data of DCP test of the original foundation of stair steps

Project: Conservation and Restoration of Northern Ancient Staircase of Preah Vihear Temple

Location of Testing: NS.13.1.4.10

Depth of zero point below the surface: 0.000m (The ground under the stair step)

Date of Testing:10/01/2024(Before re-compacted)

Material: Original Foundation

No.	Cumulative Num. of Blow	Cumulative Penetration (mm)	Penetration Between Readings(mm)	Penetration per Blow (mm)	Hammer Factor	DCP (mm/blow) DCP Index (mm/blow)	CBR (%)
1	0	0	0	0	0	0	0
2	5	71	71	14.20	1	14.20	14.96
3	10	111	40	4.00	1	4.00	61.81
4	15	169	58	3.87	1	3.87	64.20
5	20	225	56	2.80	1	2.80	92.16
6	25	306	81	3.24	1	3.24	78.27
7	30	381	75	2.50	1	2.50	100
8	35	427	46	1.31	1	1.31	100
9	40	441	14	0.35	1	0.35	100
10	45	448	7	0.16	1	0.16	100

Project: Conservation and Restoration of Northern Ancient Staircase of Preah Vihear Temple

Location of Testing: NS.1.1.2.7

Depth of zero point below the surface: 0.000m (The ground under the stair step)

Date of Testing:10/01/2024(Before re-compacted)

Material: Original Foundation

No.	Cumulative Num. of Blow	Cumulative Penetration (mm)	Penetration Between Readings(mm)	Penetration per Blow (mm)	Hammer Factor	DCP (mm/blow) DCP Index(mm/blow)	CBR (%)
1	0	0	0	0	0	0	0
2	5	145	145	29.00	1	29.00	6.72
3	10	263	118	11.80	1	11.80	18.40
4	15	378	115	7.67	1	7.67	29.83
5	20	486	108	5.40	1	5.40	44.17
6	25	544	58	2.32	1	2.32	100
7	30	612	68	2.27	1	2.27	100
8	35	660	48	1.37	1	1.37	100
9	40	703	43	1.08	1	1.08	100
10	45	763	60	1.33	1	1.33	100
11	50	809	46	0.92	1	0.92	100
12	55	865	56	1.02	1	1.02	100
13	60	896	31	0.52	1	0.52	100
14	63	921	25	0.40	1	0.40	100

Project: Conservation and Restoration of Northern Ancient Staircase of Preah Vihear Temple

Location of Testing: NS.13.1.3.2

Depth of zero point below the surface: 0.000m (The ground under the stair step)

Date of Testing:10/01/2024(Before re-compacted)

Material: Original Foundation

No.	Cumulative Num. of Blow	Cumulative Penetration (mm)	Penetration Between Readings(mm)	Penetration per Blow (mm)	Hammer Factor	DCP(mm/blow) DCP Index(mm/blow)	CBR(%)
1	0	0	0	0	0	0	0
2	5	155	155	31.00	1	31.00	6.24
3	10	294	139	13.90	1	13.90	15.32
4	15	396	102	6.80	1	6.80	34.12
5	20	487	91	4.55	1	4.55	53.51
6	25	554	67	2.68	1	2.68	96.80
7	30	604	50	1.67	1	1.67	100
8	35	662	58	1.66	1	1.66	100
9	40	712	50	1.25	1	1.25	100
10	45	770	58	1.29	1	1.29	100
11	50	827	57	1.14	1	1.14	100
12	55	866	39	0.71	1	0.71	100
13	60	907	41	0.68	1	0.68	100
14	63	932	25	0.40	1	0.40	100

Project: Conservation and Restoration of Northern Ancient Staircase of Preah Vihear Temple

Location of Testing: NS.13.1.2.12

Depth of zero point below the surface: 0.000m (The ground under the stair step)

Date of Testing:10/01/2024(Before re-compacted)

Material: Original Foundation

No.	Cumulative Num. of Blow	Cumulative Penetration (mm)	Penetration Between Readings(mm)	Penetration per Blow (mm)	Hammer Factor	DCP(mm/blow) DCP Index(mm/blow)	CBR(%)
1	0	0	0	0	0	0	0
2	5	105	105	21.00	1	21.00	9.65
3	10	198	93	9.30	1	9.30	24.03
4	15	301	103	6.87	1	6.87	33.75
5	20	438	137	6.85	1	6.85	33.84
6	25	598	160	6.40	1	6.40	36.51
7	30	714	116	3.87	1	3.87	64.20
8	35	856	142	4.06	1	4.06	60.84
9	40	946	90	2.25	1	2.25	100
10	45	1021	75	1.67	1	1.67	100
11	50	1052	31	0.62	1	0.62	100
12	55	1062	10	0.18	1	0.18	100
13	60	1067	5	0.08	1	0.08	100

Table 6: Data of DCP test after of the foundation was restored

Project: Conservation and Restoration of Northern Ancient Staircase of Preah Vihear Temple

Location of Testing: NS.13.1.2.3

Depth of zero point below the surface: 0.000m (The ground under the stair step)

Date of Testing:12/03/2024(After re-compacted)

Material: Recompacted Foundation

No.	Cumulative Num. of Blow	cumulative Penetration (mm)	Penetration Between Readings(mm)	Penetration per Blow (mm)	Hammer Factor	DCP(mm/blow) DCP Index(mm/blow)	CBR(%)
1	0	0	0	0	0	0	0
2	5	70	70	14.00	1	14.00	15.20
3	10	125	55	5.50	1	5.50	43.27
4	15	175	50	3.33	1	3.33	75.82
5	20	226	51	2.55	1	2.55	100
6	25	290	64	2.56	1	2.56	100
7	30	371	81	2.70	1	2.70	96.00
8	35	467	96	2.74	1	2.74	94.32
9	40	556	89	2.23	1	2.23	100
10	45	642	86	1.91	1	1.91	100
11	50	709	67	1.34	1	1.34	100
12	55	775	66	1.20	1	1.20	100
13	60	906	131	2.18	1	2.18	100
14	65	960	54	0.83	1	0.83	100
15	70	1006	46	0.66	1	0.66	100
16	75	1046	40	0.53	1	0.53	100
17	80	1086	40	0.50	1	0.50	100
18	85	1128	42	0.49	1	0.49	100
19	90	1164	36	0.40	1	0.40	100
20	95	1189	25	0.26	1	0.26	100
21	100	1219	30	0.30	1	0.30	100
22	105	1246	27	0.26	1	0.26	100
23	110	1264	18	0.16	1	0.16	100
24	115	1279	15	0.13	1	0.13	100
25	120	1295	16	0.13	1	0.13	100
26	125	1310	15	0.12	1	0.12	100
27	130	1331	21	0.16	1	0.16	100
28	135	1353	22	0.16	1	0.16	100
29	140	1376	23	0.16	1	0.16	100
30	145	1399	23	0.16	1	0.16	100
31	150	1424	25	0.17	1	0.17	100
32	155	1454	30	0.19	1	0.19	100
33	160	1484	30	0.19	1	0.19	100
34	165	1525	41	0.25	1	0.25	100
35	170	1559	34	0.20	1	0.20	100

36	175	1579	20	0.11	1	0.11	100
37	180	1614	35	0.19	1	0.19	100
38	185	1643	29	0.16	1	0.16	100
39	190	1678	35	0.18	1	0.18	100
40	195	1714	36	0.18	1	0.18	100
41	200	1753	39	0.20	1	0.20	100
42	205	1787	34	0.17	1	0.17	100
43	210	1824	37	0.18	1	0.18	100
44	215	1854	30	0.14	1	0.14	100
45	220	1874	20	0.09	1	0.09	100
46	225	1893	19	0.08	1	0.08	100
47	230	1922	29	0.13	1	0.13	100
48	235	1959	37	0.16	1	0.16	100

Project: Conservation and Restoration of Northern Ancient Staircase of Preah Vihear Temple

Location of Testing: NS.13.1.4.10

Depth of zero point below the surface: 0.000m (The ground under the stair step)

Date of Testing:12/03/2024(After re-compacted)

Material: Recompacted Foundation

No.	Cumulative Num. of Blow	Cumulative Penetration (mm)	Penetration Between Readings(mm)	Penetration per Blow (mm)	Hammer Factor	DCP(mm/blow) DCP Index(mm/blow)	CBR(%)
1	0	0	0	0	0	0	0
2	5	69	69	13.80	1	13.80	15.44
3	10	132	63	6.30	1	6.30	37.16
4	15	184	52	3.47	1	3.47	72.56
5	20	227	43	2.15	1	2.15	100
6	25	281	54	2.16	1	2.16	100
7	30	335	54	1.80	1	1.80	100
8	35	388	53	1.51	1	1.51	100
9	40	420	32	0.80	1	0.80	100
10	45	433	13	0.29	1	0.29	100
11	50	438	5	0.10	1	0.10	100
12	55	445	7	0.13	1	0.13	100
13	60	456	11	0.18	1	0.18	100
14	65	469	13	0.20	1	0.20	100
15	70	480	11	0.16	1	0.16	100
16	75	518	38	0.51	1	0.51	100
17	80	567	49	0.61	1	0.61	100
18	85	621	54	0.64	1	0.64	100
19	90	686	65	0.72	1	0.72	100
20	95	733	47	0.49	1	0.49	100
21	100	786	53	0.53	1	0.53	100
22	105	839	53	0.50	1	0.50	100

23	110	884	45	0.41	1	0.41	100
24	115	906	22	0.19	1	0.19	100
25	120	917	11	0.09	1	0.09	100
26	125	926	9	0.07	1	0.07	100
27	130	931	5	0.04	1	0.04	100
28	135	940	9	0.07	1	0.07	100
29	140	945	5	0.04	1	0.04	100
30	145	950	5	0.03	1	0.03	100

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Project: Conservation and Restoration of Northern Ancient Staircase of Preah Vihear Temple

Location of Testing: NS.13.1.1.5

Depth of zero point below the surface: 0.000m (The ground under the stair step)

Date of Testing:12/03/2024(After re-compacted)

Material: Re-compacted Foundation

No.	Cumulative Num. of Blow	Cumulative Penetration (mm)	Penetration Between Readings(mm)	Penetration per Blow (mm)	Hammer Factor	DCP(mm/blow) DCP Index(mm/blow)	CBR(%)
1	0	0	0	0	0	0	0
2	5	43	43	8.60	1	8.60	26.23
3	10	96	53	5.30	1	5.30	45.10
4	15	137	41	2.73	1	2.73	94.69
5	20	183	46	2.30	1	2.30	100
6	25	254	71	2.84	1	2.84	90.71
7	30	343	89	2.97	1	2.97	86.39
8	35	418	75	2.14	1	2.14	100
9	40	572	154	3.85	1	3.85	64.52
10	45	681	109	2.42	1	2.42	100
11	50	727	46	0.92	1	0.92	100
12	55	753	26	0.47	1	0.47	100
13	60	782	29	0.48	1	0.48	100
14	65	819	37	0.57	1	0.57	100
15	70	859	40	0.57	1	0.57	100
16	75	902	43	0.57	1	0.57	100
17	80	944	42	0.53	1	0.53	100
18	85	981	37	0.44	1	0.44	100
19	90	1027	46	0.51	1	0.51	100
20	95	1099	72	0.76	1	0.76	100
21	100	1181	82	0.82	1	0.82	100
22	105	1228	47	0.45	1	0.45	100
23	110	1309	81	0.74	1	0.74	100
24	115	1369	60	0.52	1	0.52	100
25	120	1427	58	0.48	1	0.48	100

26	125	1481	54	0.43	1	0.43	100
27	130	1527	46	0.35	1	0.35	100
28	135	1574	47	0.35	1	0.35	100
29	140	1623	49	0.35	1	0.35	100
30	145	1668	45	0.31	1	0.31	100
31	150	1711	43	0.29	1	0.29	100
32	155	1753	42	0.27	1	0.27	100
33	160	1791	38	0.24	1	0.24	100
34	165	1821	30	0.18	1	0.18	100
35	170	1833	12	0.07	1	0.07	100

Project: Conservation and Restoration of Northern Ancient Staircase of Preah Vihear Temple

Location of Testing: NS.13.1.2.11

Depth of zero point below the surface: 0.000m (The ground under the stair step)

Date of Testing:12/03/2024(After re-compacted)

Material: Re-compacted Foundation

No.	Cumulative Num. of Blow	Cumulative Penetration (mm)	Penetration Between Readings(mm)	Penetration per Blow (mm)	Hammer Factor	DCP(mm /blow) DCP Index(mm/blow)	CBR(%)
1	0	0	0	0	0	0	0
2	5	46	46	9.20	1	9.20	24.32
3	10	68	22	2.20	1	2.20	100
4	15	122	54	3.60	1	3.60	69.55
5	20	186	64	3.20	1	3.20	100
6	25	215	29	1.16	1	1.16	100
7	30	255	40	1.33	1	1.33	100
8	35	308	53	1.51	1	1.51	100
9	40	361	53	1.33	1	1.33	100
10	45	403	42	0.93	1	0.93	100
11	50	444	41	0.82	1	0.82	100
12	55	487	43	0.78	1	0.78	100
13	60	530	43	0.72	1	0.72	100
14	65	586	56	0.86	1	0.86	100
15	70	642	56	0.80	1	0.80	100
16	75	715	73	0.97	1	0.97	100
17	80	799	84	1.05	1	1.05	100
18	85	850	51	0.60	1	0.60	100
19	90	892	42	0.47	1	0.47	100
20	95	910	18	0.19	1	0.19	100
21	100	933	23	0.23	1	0.23	100
22	105	960	27	0.26	1	0.26	100
23	110	991	31	0.28	1	0.28	100

24	115	1026	35	0.30	1	0.30	100
25	120	1088	62	0.52	1	0.52	100
26	125	1150	62	0.50	1	0.50	100
27	130	1217	67	0.52	1	0.52	100
28	135	1269	52	0.39	1	0.39	100
29	140	1321	52	0.37	1	0.37	100
30	145	1359	38	0.26	1	0.26	100
31	150	1400	41	0.27	1	0.27	100
32	155	1442	42	0.27	1	0.27	100
33	160	1449	7	0.04	1	0.04	100
34	165	1457	8	0.05	1	0.05	100
35	170	1460	3	0.02	1	0.02	100

Annex 8: Conservation and restoration of section 12

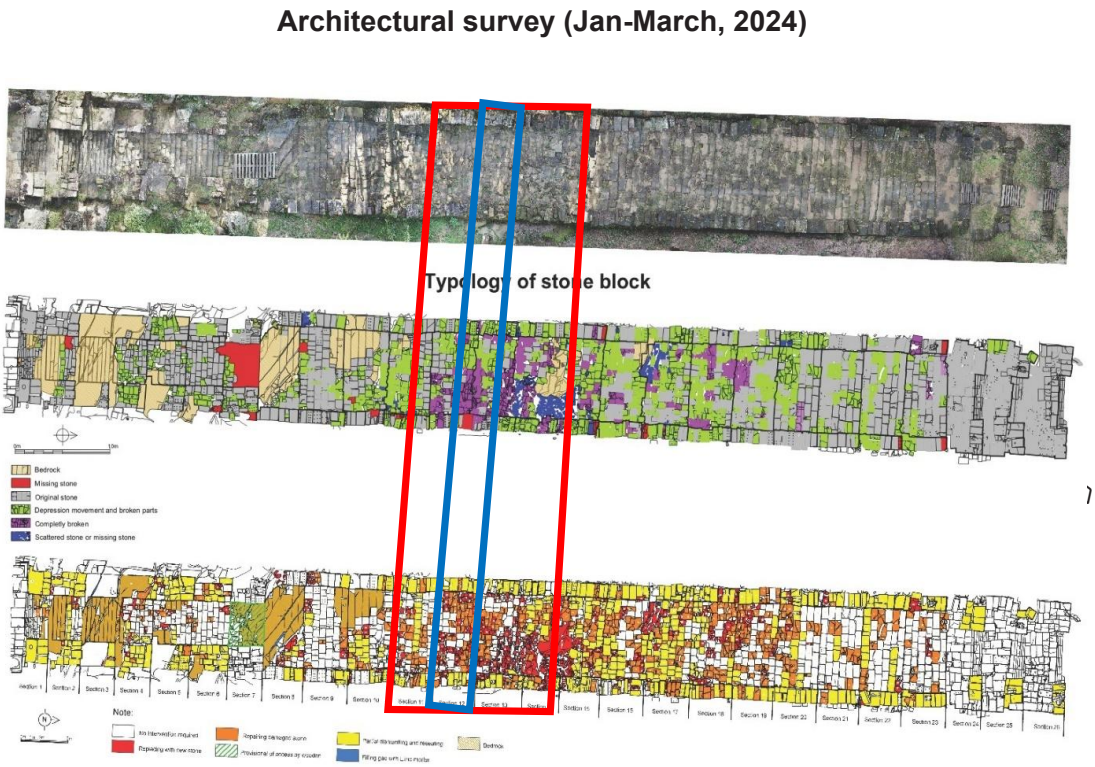


Figure 158: The plan showing location of section 12




Figure 159: topography survey




Figure 160: Survey of architectural plan and leveling stones before restoration

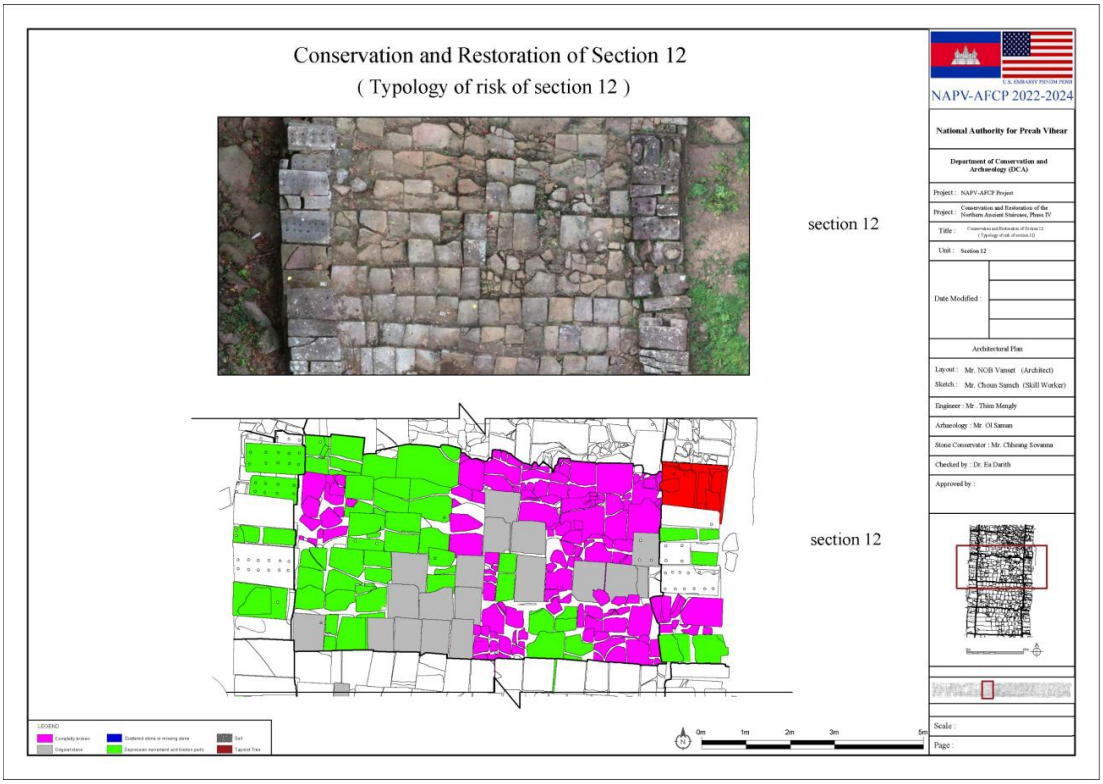


Figure 160: Typology of risk at section 12 (top view)

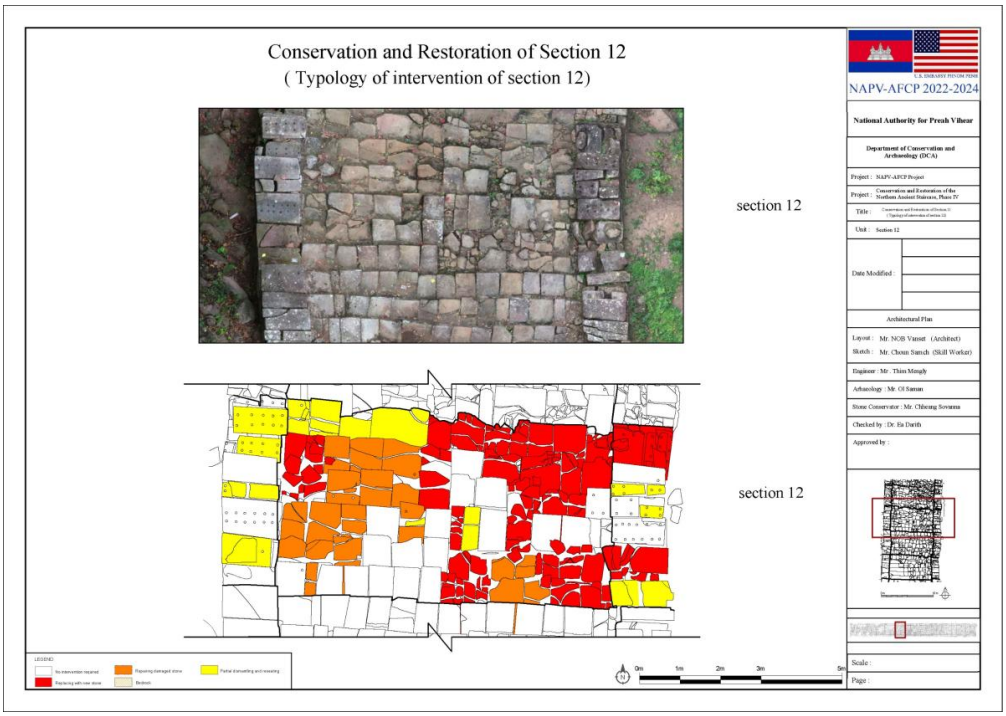


Figure 161: Typology of intervention at section 12 (top view)

Restoration of the west stair wall



Figure 162: General damage condition of west wall at section 12 (east view)



Figure 163: General damage condition of west wall at section 12 (north view)



Figure 164: Dismantled stone blocks at the west wall from original location



Figure 165: Removed the tree roots and poor compacted soil

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Figure 166: General damage condition of the layer 5 at the west wall, section 12 (top view)





Figure 167: Restoration activities at the west wall, section 12





Figure 168: General damage condition of the west wall at section 12 from the east view before restoration (left photo) and after restoration (right photo)

Restoration of the east stair wall



Figure 169: General damage condition of the east stair wall at section 12 (north view) before restoration

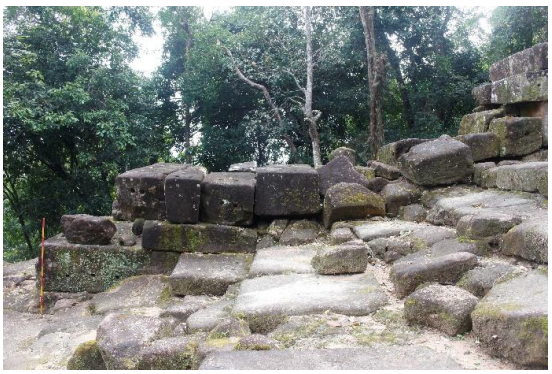


Figure 170: General damage condition of the east wall stair at section 12 (west view) before restoration



Figure 171: Dismantled stone blocks from original place



Figure 172: Removed out of deposit soil and tree roots



Figure 173: General damage condition of the layer 2 at the east stair wall of section 12 (top view)





Figure 174-175: Reassembled stone blocks to original locations and filled lime mortar between stone gaps to prevent water infiltration at east wall, section 12



Figure 176: General damage condition of the east wall at section 12 (west view) before restoration



Figure 177: General condition of the east wall section 12 (west view) after restoration

Restoration of stair steps



Figure 178: General condition of the stair step at section 12 (top view) before restoration



Figure 179: Dismantled stone slabs from original location



Figure 180: The general damage condition of compacted soil foundation of stair steps at section 12 (North view)



Figure 181: Tree root growing into foundation

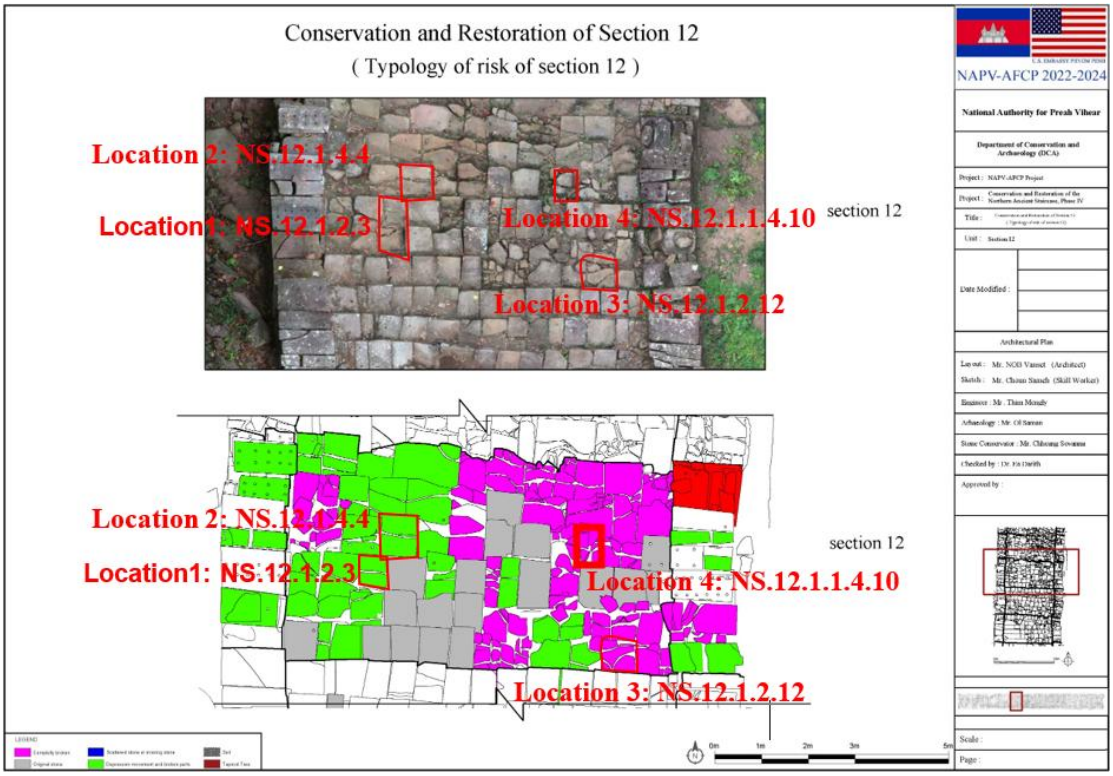


Figure 182: Locations of DCP Test



Figure 183-184: Soil foundation, mixture of yellow sandy clay soil, and sandstone chips with a maximum size of 10 cm to 20 cm



Figure 185-186: The arrangement of sandstone blocks in line under the stair step 3 of section 12.



Figure 187: Activities of foundation restoration

Table 7: Database of stone blocks/stone slabs at section 12

Number of stone blocks dismantled at section 12 in the west					
Layer	**Total stone blocks on western wall**	**Total stone blocks dismantled**	**Good ancient stone blocks**	**minor broken stone blocks-restorable**	**Severely broken stone blocks**
1	5	5	2	3	0
2	7	7	4	3	0
3	10	10	8	2	0
4	9	9	6	3	0
5	13	6	1	3	2
6	3	3		1	2
7	2	0	0	0	0
Total	49	40	21	15	4
Number of stone blocks reassembled at section 12 in the west					

Layer	Total stone blocks reassembled	Good ancient stone blocks	restored broken stone blocks	New stone blocks	Stone piece for foundation restoration
1	5	2	3	0	0
2	10	4	3	2	1
3	19	8	2	1	8
4	13	6	3	1	3
5	11	1	3	1	6
6	3	0	1	2	
Total	**61**	**21**	**15**	**7**	**18**
Number of stone blocks dismantled at section 12 in the east					
Layer	**Total stone blocks on eastern wall**	**Total stone blocks dismantled**	**Good ancient stone blocks**	**minor broken stone blocks-restorable**	**Severely broken stone blocks**
1	16	16	12	4	0
2	9	7	5	2	0
3	8	7	4	3	0
4	12	8	4	4	0
5	13	4	3	1	0
Total	58	42	28	14	0
Number of stone blocks reassembled at section 12 in the east					
Layer	**Total stone blocks reassembled**	**Good ancient stone blocks**	**restored broken stone blocks**	**New stone blocks**	**Stone piece for foundation restoration**
1	16	12	4	0	0
2	12	5	2		5
3	18	4	3	1	10
4	9	4	4	1	0
5	4	3	1	0	0
Total	59	28	14	2	15
Number of stone slabs dismantled at section 12					
Step	**Total stone slabs on stair steps**	**Total stone slabs dismantled on stair steps**	**Good ancient stone slabs**	**minor broken stone slabs-restorable**	**Severely broken stone slabs**
1	14	14	9	1	4
2	14	14	7	3	4
3	13	13	5	5	3
4	13	13	3	4	6
5	11	11	1	5	5
6	11	11	1	8	2
Total	76	76	25	18	22
Number of stone slabs reassemble at section 12					

Step	Total stone slabs	Good ancient stone slabs	Restored ancient stone slabs	New stone slabs	Stone for foundation
1	16	9	1	6	0
2	17	7	3	5	2
3	14	5	4	4	1
4	15	3	3	4	5
5	18	1	6	6	5
6	14	1	8	2	3
Total	**94**	**26**	**25**	**27**	**16**

Table 8: Data of DCP test of the original foundation of stair step

Location of Testing: NS.12.1.2.3

Depth of zero point below the surface: 0.000m (The ground under the stair step)

Date of Testing: 28/06/2024(Before re-compacted)

Material: Original Foundation (Compacted Soil)

No.	Cumulative Num. of Blow	Cumulative Penetration (mm)	Penetration Between Readings(mm)	Penetration per Blow (mm)	Hammer Factor	DCP Index(mm/blow)	CBR(%)
1	0	0	-	-	-	-	-
2	5	160	160	32.00	1	32.00	6.02
3	10	372	212	21.20	1	21.20	9.55
4	15	459	87	5.80	1	5.80	40.77
5	20	516	57	2.85	1	2.85	90.36
6	25	546	30	1.20	1	1.20	100
7	30	581	35	1.17	1	1.17	100
8	35	623	42	1.20	1	1.20	100
9	40	643	20	0.50	1	0.50	100
10	45	662	19	0.42	1	0.42	100
11	50	684	22	0.44	1	0.44	100
12	55	714	30	0.55	1	0.55	100
13	60	749	35	0.58	1	0.58	100
14	65	788	39	0.60	1	0.60	100
15	70	852	64	0.91	1	0.91	100
16	73	853	1	0.01	1	0.01	100
17	78	993	140	1.79	1	1.79	100
18	83	1009	16	0.19	1	0.19	100
19	88	1021	12	0.14	1	0.14	100
20	93	1031	10	0.11	1	0.11	100
21	98	1043	12	0.12	1	0.12	100
22	103	1053	10	0.10	1	0.10	100
23	108	1060	7	0.06	1	0.06	100

Location of Testing: NS.12.1.4.4

Depth of zero point below the surface: 0.000m (The ground under the stair step)

Date of Testing:28/06/2024(Before re-compacted)

Material: Original Foundation (Compacted Soil)

No.	Cumulative Num. of Blow	Cumulative Penetration (mm)	Penetration Between Readings(mm)	Penetration per Blow (mm)	Hammer Factor	DCP Index(mm/blow)	CBR(%)
1	0	0	0	0	0	0	0
2	5	181	181	36.20	1	36.20	5.24
3	10	270	89	8.90	1	8.90	25.24
4	15	370	100	6.67	1	6.67	34.88
5	20	491	121	6.05	1	6.05	38.89
6	25	703	212	8.48	1	8.48	26.64
7	30	852	149	4.97	1	4.97	48.51
8	35	1085	233	6.66	1	6.66	34.94
9	40	1184	99	2.48	1	2.48	100
10	45	1245	61	1.36	1	1.36	100
11	50	1259	14	0.28	1	0.28	100
12	55	1271	12	0.22	1	0.22	100
13	60	1281	10	0.17	1	0.17	100
14	65	1291	10	0.15	1	0.15	100
15	70	1300	9	0.13	1	0.13	100
16	75	1309	9	0.12	1	0.12	100
17	80	1316	7	0.09	1	0.09	100
18	85	1324	8	0.09	1	0.09	100
19	90	1331	7	0.08	1	0.08	100
20	95	1339	8	0.08	1	0.08	100
21	100	1347	8	0.08	1	0.08	100
22	105	1353	6	0.06	1	0.06	100
23	110	1359	6	0.05	1	0.05	100
24	115	1364	5	0.04	1	0.04	100
25	120	1366	2	0.02	1	0.02	100
26	125	1376	10	0.08	1	0.08	100
27	130	1382	6	0.05	1	0.05	100

Location of Testing: NS.12.1.2.12

Depth of zero point below the surface: 0.000m (The ground under the stair step)

Date of Testing:28/06/2024(Before re-compacted)

Material: Original Foundation (Compacted Soil)

No.	Cumulative Num. of Blow	Cumulative Penetration (mm)	Penetration Between Readings(mm)	Penetration per Blow (mm)	Hammer Factor	DCP Index (mm/blow)	CBR(%)
1	0	0	0	0	0	0	0
2	1	50	50	50.00	1	50.00	3.65
3	2	98	48	24.00	1	24.00	8.31

4	3	132	34	11.33	1	11.33	19.25
5	4	161	29	7.25	1	7.25	31.75
6	5	182	21	4.20	1	4.20	58.53
7	6	200	18	3.00	1	3.00	85.31
8	7	223	23	3.29	1	3.29	77.05
9	8	244	21	2.63	1	2.63	99.07
10	9	271	27	3.00	1	3.00	85.31
11	10	303	32	3.20	1	3.20	79.36
12	11	334	31	2.82	1	2.82	91.50
13	12	372	38	3.17	1	3.17	80.30
14	13	399	27	2.08	1	2.08	100
15	14	426	27	1.93	1	1.93	100
16	15	462	36	2.40	1	2.40	100
17	16	508	46	2.88	1	2.88	89
18	17	548	40	2.35	1	2.35	100
19	18	577	29	1.61	1	1.61	100
20	19	610	33	1.74	1	1.74	100
21	20	642	32	1.60	1	1.60	100
22	21	672	30	1.43	1	1.43	100
23	22	710	38	1.73	1	1.73	100
24	23	742	32	1.39	1	1.39	100
25	24	775	33	1.38	1	1.38	100
26	25	791	16	0.64	1	0.64	100
27	26	807	16	0.62	1	0.62	100
28	27	821	14	0.52	1	0.52	100
29	28	835	14	0.50	1	0.50	100
30	29	857	22	0.76	1	0.76	100
31	30	886	29	0.97	1	0.97	100
32	31	915	29	0.94	1	0.94	100
33	32	941	26	0.81	1	0.81	100
34	33	961	20	0.61	1	0.61	100
35	34	980	19	0.56	1	0.56	100
36	35	1010	30	0.86	1	0.86	100
37	36	1032	22	0.61	1	0.61	100
38	37	1050	18	0.49	1	0.49	100
39	38	1082	32	0.84	1	0.84	100
40	39	1114	32	0.82	1	0.82	100
41	40	1150	36	0.90	1	0.90	100
42	41	1172	22	0.54	1	0.54	100
43	42	1192	20	0.48	1	0.48	100
44	43	1209	17	0.40	1	0.40	100
45	44	1220	11	0.25	1	0.25	100
46	45	1226	6	0.13	1	0.13	100
47	46	1233	7	0.15	1	0.15	100
48	47	1240	7	0.15	1	0.15	100
49	48	1246	6	0.13	1	0.13	100

50	49	1254	8	0.16	1	0.16	100
51	50	1256	2	0.04	1	0.04	100
52	51	1270	14	0.27	1	0.27	100
53	52	1281	11	0.21	1	0.21	100
54	53	1295	14	0.26	1	0.26	100
55	54	1310	15	0.28	1	0.28	100
56	55	1326	16	0.29	1	0.29	100
57	56	1344	18	0.32	1	0.32	100
58	57	1364	20	0.35	1	0.35	100
59	58	1382	18	0.31	1	0.31	100
60	59	1399	17	0.29	1	0.29	100
61	60	1416	17	0.28	1	0.28	100
62	61	1433	17	0.28	1	0.28	100
63	62	1451	18	0.29	1	0.29	100
64	63	1469	18	0.29	1	0.29	100
65	64	1486	17	0.27	1	0.27	100
66	65	1503	17	0.26	1	0.26	100
67	66	1518	15	0.23	1	0.23	100
68	67	1532	14	0.21	1	0.21	100
69	68	1545	13	0.19	1	0.19	100
70	69	1560	15	0.22	1	0.22	100
71	70	1575	15	0.21	1	0.21	100
72	71	1596	21	0.30	1	0.30	100
73	72	1611	15	0.21	1	0.21	100
74	73	1627	16	0.22	1	0.22	100
75	74	1646	19	0.26	1	0.26	100
76	75	1662	16	0.21	1	0.21	100
77	76	1678	16	0.21	1	0.21	100
78	77	1693	15	0.19	1	0.19	100
79	78	1713	20	0.26	1	0.26	100
80	79	1737	24	0.30	1	0.30	100
81	80	1765	28	0.35	1	0.35	100
82	81	1794	29	0.36	1	0.36	100

Location of Testing: NS.12.1.1.4.10

Depth of zero point below the surface: 0.000m (The ground under the stair step)

Date of Testing:28/06/2024(Before re-compacted)

Material: Original Foundation (Compacted Soil)

No.	Cumulative Num. of Blow	Cumulative Penetration (mm)	Penetration Between Readings(mm)	Penetration per Blow (mm)	Hammer Factor	DCP Index(mm/blow)	CBR(%)
1	0	0	0	0	0	0	0
2	1	38	38	38.00	1	38.00	4.97
3	2	76	38	19.00	1	19.00	10.79
4	3	116	40	13.33	1	13.33	16.05

5	4	141	25	6.25	1	6.25	37.50
6	5	153	12	2.40	1	2.40	100
7	6	166	13	2.17	1	2.17	100
8	7	197	31	4.43	1	4.43	55
9	8	209	12	1.50	1	1.50	100
10	9	225	16	1.78	1	1.78	100
11	10	247	22	2.20	1	2.20	100
12	11	266	19	1.73	1	1.73	100
13	12	296	30	2.50	1	2.50	100
14	13	328	32	2.46	1	2.46	100
15	14	360	32	2.29	1	2.29	100
16	15	396	36	2.40	1	2.40	100
17	16	432	36	2.25	1	2.25	100
18	17	470	38	2.24	1	2.24	100
19	18	505	35	1.94	1	1.94	100
20	19	546	41	2.16	1	2.16	100
21	20	577	31	1.55	1	1.55	100
22	21	600	23	1.10	1	1.10	100
23	22	619	19	0.86	1	0.86	100
24	23	639	20	0.87	1	0.87	100
25	24	660	21	0.88	1	0.88	100
26	25	682	22	0.88	1	0.88	100
27	26	708	26	1.00	1	1.00	100
28	27	730	22	0.81	1	0.81	100
29	28	759	29	1.04	1	1.04	100
30	29	786	27	0.93	1	0.93	100
0	30	811	25	0.83	1	0.83	100
31	31	835	24	0.77	1	0.77	100
32	32	860	25	0.78	1	0.78	100
33	33	893	33	1.00	1	1.00	100
34	34	923	30	0.88	1	0.88	100
35	35	950	27	0.77	1	0.77	100
36	36	963	13	0.36	1	0.36	100
37	37	983	20	0.54	1	0.54	100
38	38	1005	22	0.58	1	0.58	100
39	39	1030	25	0.64	1	0.64	100
40	40	1039	9	0.23	1	0.23	100
41	41	1047	8	0.20	1	0.20	100
42	42	1056	9	0.21	1	0.21	100
43	43	1066	10	0.23	1	0.23	100
44	44	1085	19	0.43	1	0.43	100
45	45	1096	11	0.24	1	0.24	100
46	46	1106	10	0.22	1	0.22	100
47	47	1115	9	0.19	1	0.19	100
48	48	1116	1	0.02	1	0.02	100
49	49	1122	6	0.12	1	0.12	100



50	50	1127	5	0.10	1	0.10	100
51	51	1131	4	0.08	1	0.08	100
52	52	1136	5	0.10	1	0.10	100
53	53	1145	9	0.17	1	0.17	100
54	54	1153	8	0.15	1	0.15	100
55	55	1164	11	0.20	1	0.20	100
56	56	1178	14	0.25	1	0.25	100
57	57	1191	13	0.23	1	0.23	100
58	58	1204	13	0.22	1	0.22	100
59	59	1217	13	0.22	1	0.22	100
60	60	1241	24	0.40	1	0.40	100
61	61	1268	27	0.44	1	0.44	100
62	62	1293	25	0.40	1	0.40	100
63	63	1314	21	0.33	1	0.33	100
64	64	1331	17	0.27	1	0.27	100
65	65	1347	16	0.25	1	0.25	100
66	66	1360	13	0.20	1	0.20	100
67	67	1380	20	0.30	1	0.30	100
68	68	1395	15	0.22	1	0.22	100
69	69	1409	14	0.20	1	0.20	100
70	70	1422	13	0.19	1	0.19	100
71	71	1435	13	0.18	1	0.18	100
72	72	1447	12	0.17	1	0.17	100
73	73	1458	11	0.15	1	0.15	100
74	74	1468	10	0.14	1	0.14	100
75	75	1476	8	0.11	1	0.11	100
76	76	1490	14	0.18	1	0.18	100
77	77	1509	19	0.25	1	0.25	100
78	78	1527	18	0.23	1	0.23	100
79	79	1552	25	0.32	1	0.32	100
80	80	1582	30	0.38	1	0.38	100
81	81	1621	39	0.48	1	0.48	100
82	82	1661	40	0.49	1	0.49	100
83	83	1679	18	0.22	1	0.22	100
84	84	1684	5	0.06	1	0.06	100
85	85	1686	2	0.02	1	0.02	100
86	86	1688	2	0.02	1	0.02	100
87	87	1690	2	0.02	1	0.02	100
88	88	1692	2	0.02	1	0.02	100
89	89	1695	3	0.03	1	0.03	100
90	90	1696	1	0.01	1	0.01	100
91	91	1700	4	0.04	1	0.04	100
92	92	1702	2	0.02	1	0.02	100
93	93	1705	3	0.03	1	0.03	100
94	94	1707	2	0.02	1	0.02	100

Annex 9: Conservation and restoration of staircase of section 11

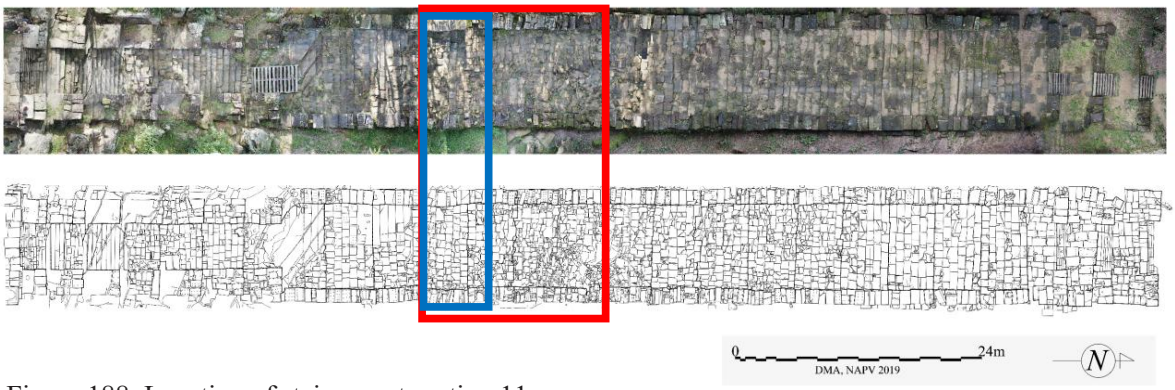


Figure 188: Location of staircase at section 11

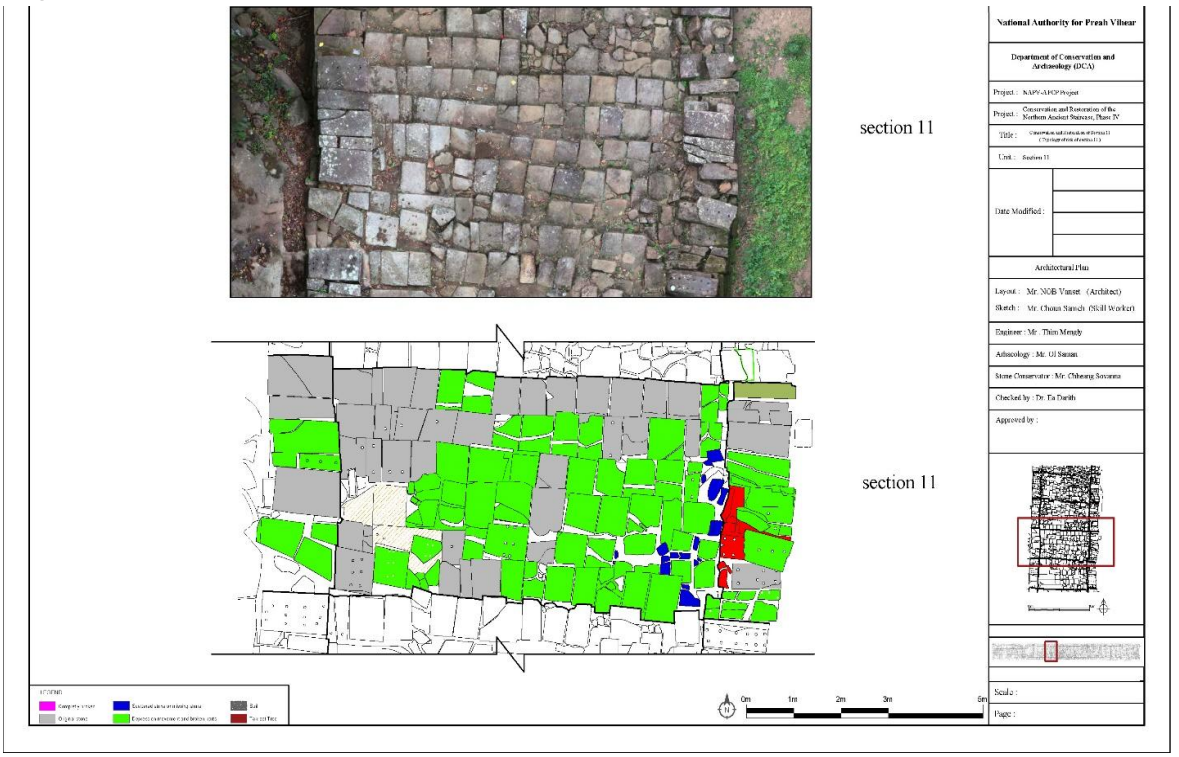


Figure 189: Typology of risk of staircase at section 11 (top view)

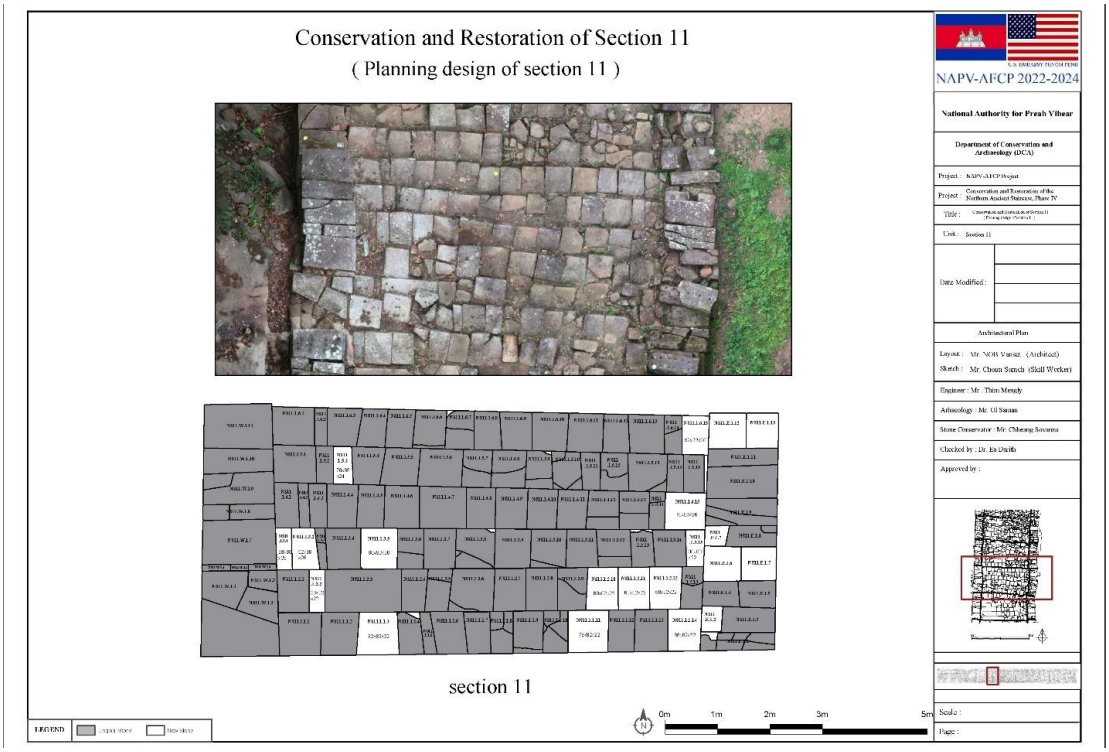


Figure 190: Planning design of new sandstone the staircase at section 11

Restoration of the west stair wall



Figure 191: Damage condition of the west stair wall, section 11 (view from



Figure 192: Damage condition of the west stair wall, section 11 (view from

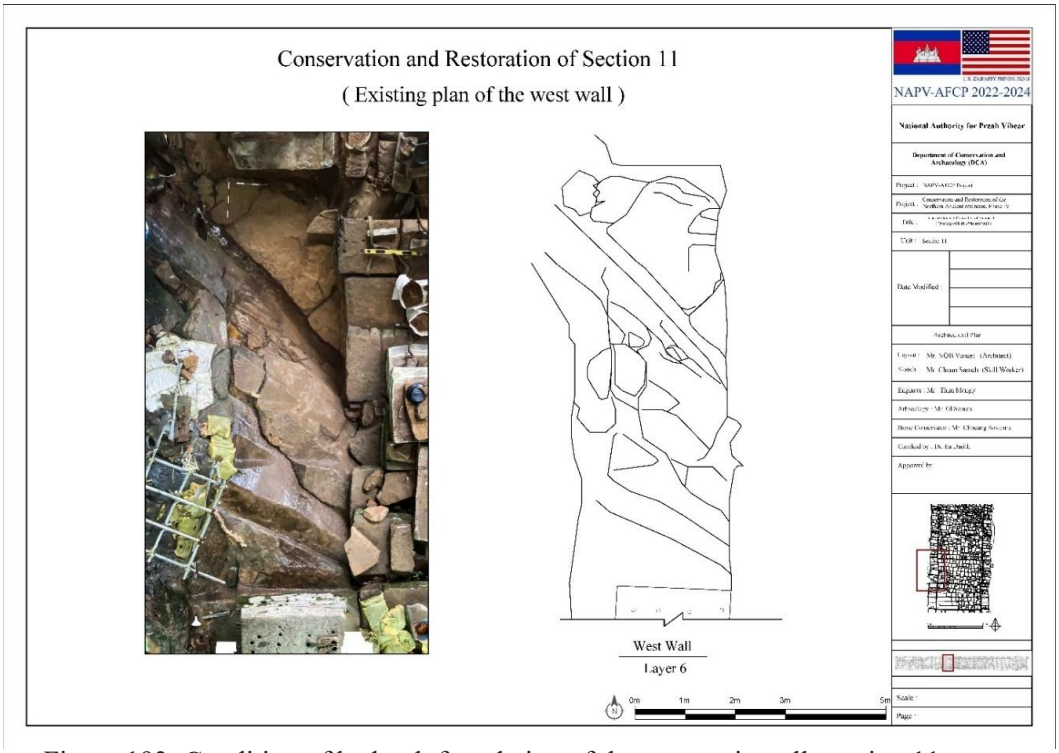


Figure 193: Condition of bedrock foundation of the west stair wall, section 11

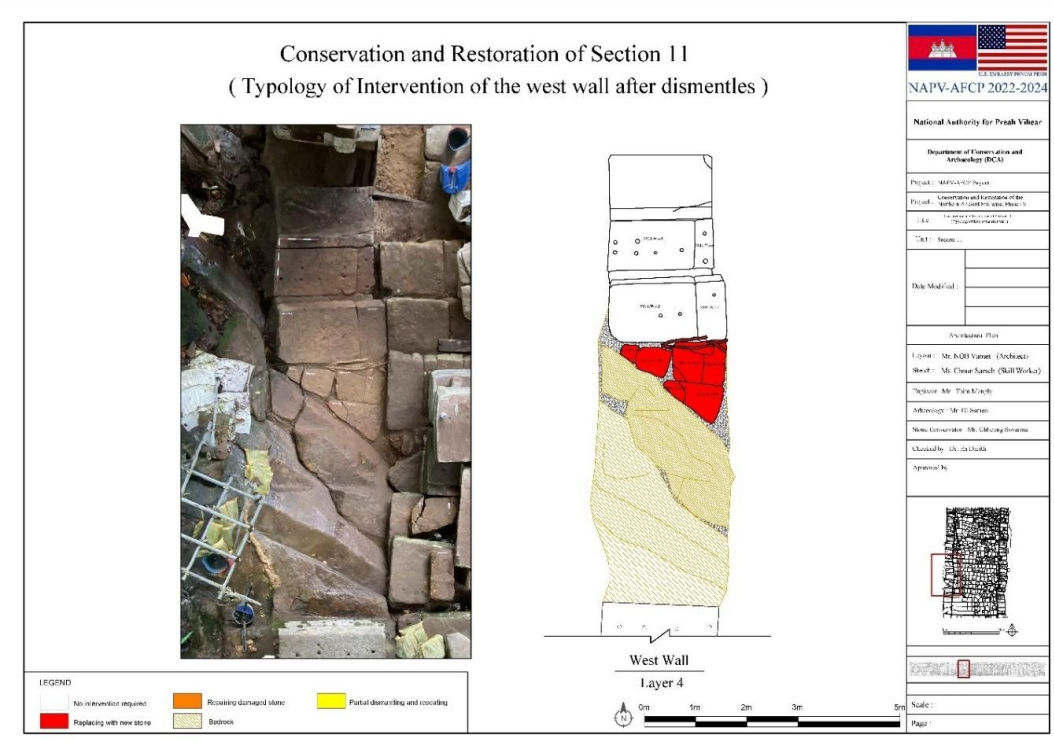


Figure 194: Damage condition on layer 4 of the west stair wall



Figure 195: Dismantling activities of stone blocks from their original positions at the west stair wall



Figure 196: Restoration and reinforcement of the west stair wall



Figure 197: Reassembling stone blocks to their original positions



Figure 198: Reassembling stone blocks of west stair wall to the original positions



Figure 199: Front view of the west wall before restoration (left side) and after restoration (right side)



Figure 200: East view of the west wall before restoration (left side) and after restoration (right side)

Restoration of the east stair wall



Figure 201: Damage condition of the west star wall (view from the west)



Figure 202: Damage condition of the west stair wall (view from the east)

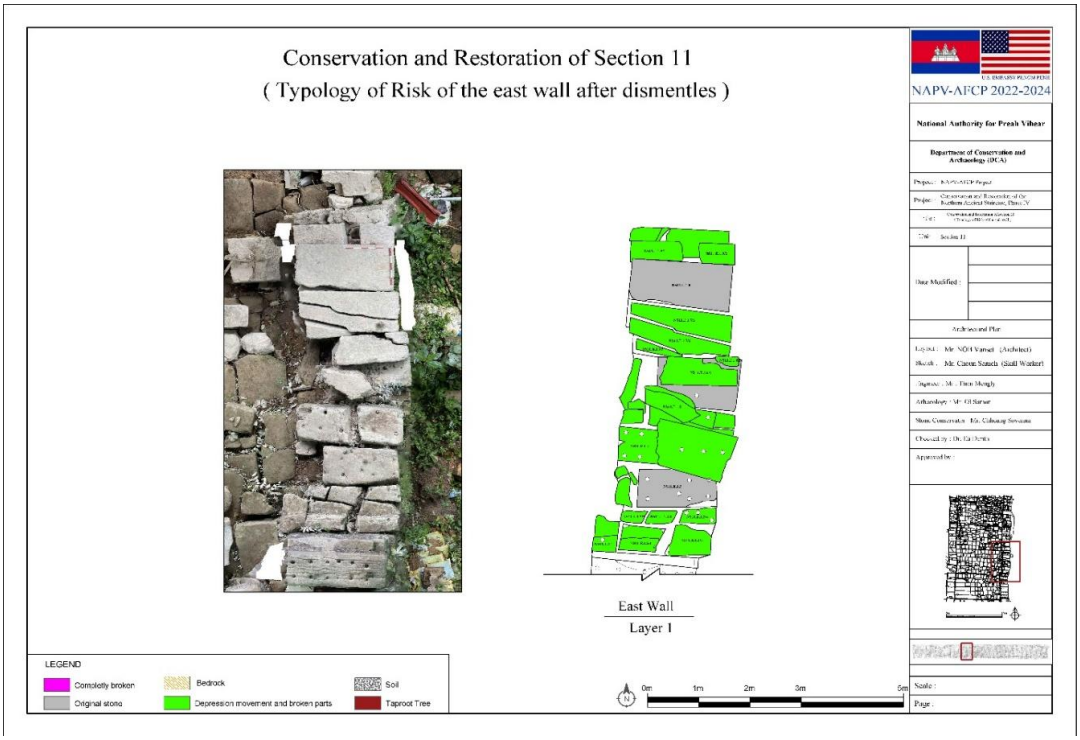


Figure 203: Photo and plan drawing showing risk typology of stone blocks on layer one of the east stair wall (view from top)

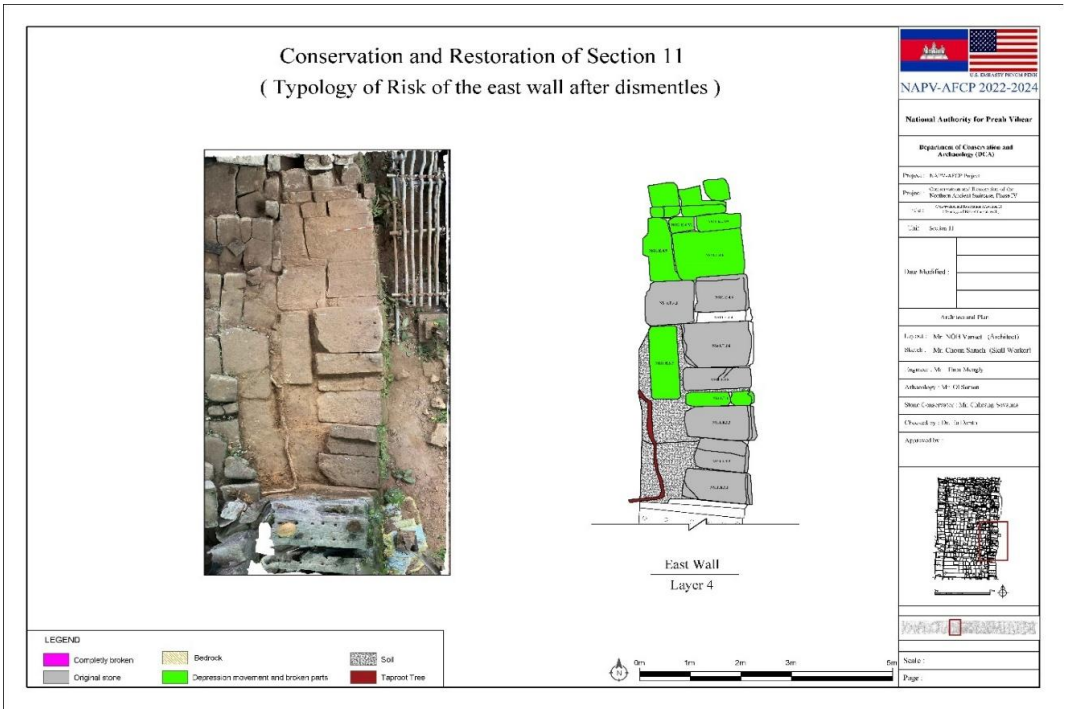


Figure 204: Photo and plan drawing, showing damage of stone blocks on layer 4 of the east stair wall (view from top)



Figure 205: Dismantling activities of stone blocks from their original



Figure 206: Cleaning surface of foundation bedrock and reassembling activities to their original





Figure 207: Reassembling stone blocks of the east wall to the original position

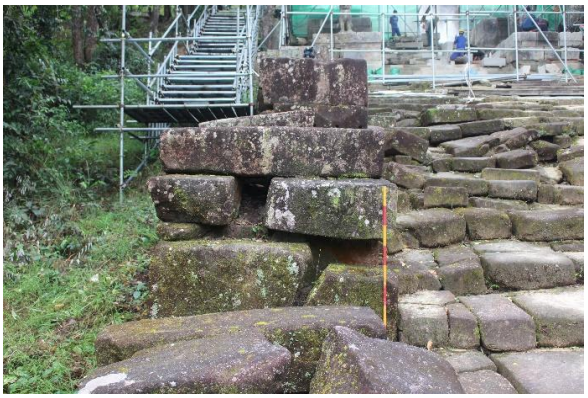




Figure 208: Condition of the east stair wall before and after restoration (North view)



Figure 209: Condition of the east stair wall before and after restoration (West view)

Restoration of stair step



Figure 2010: General damage condition of stair steps at section 11 before restoration (North view)

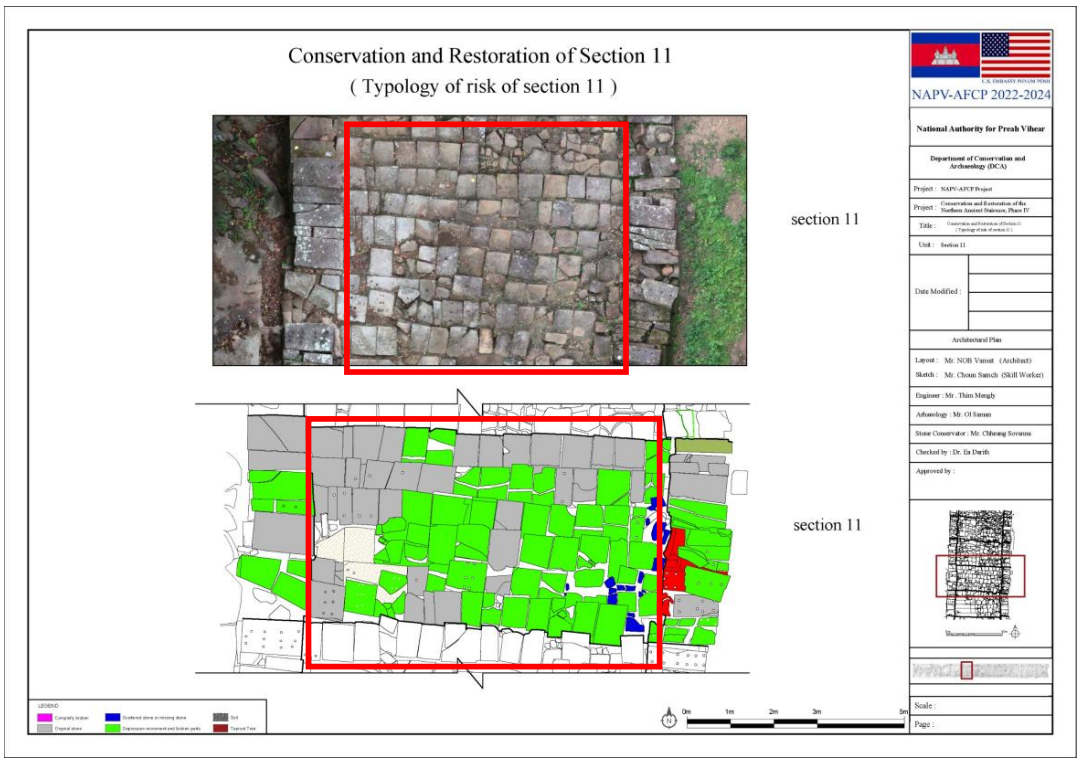


Figure 2011: Typology of risk of stair steps at section 11 before restoration (Top

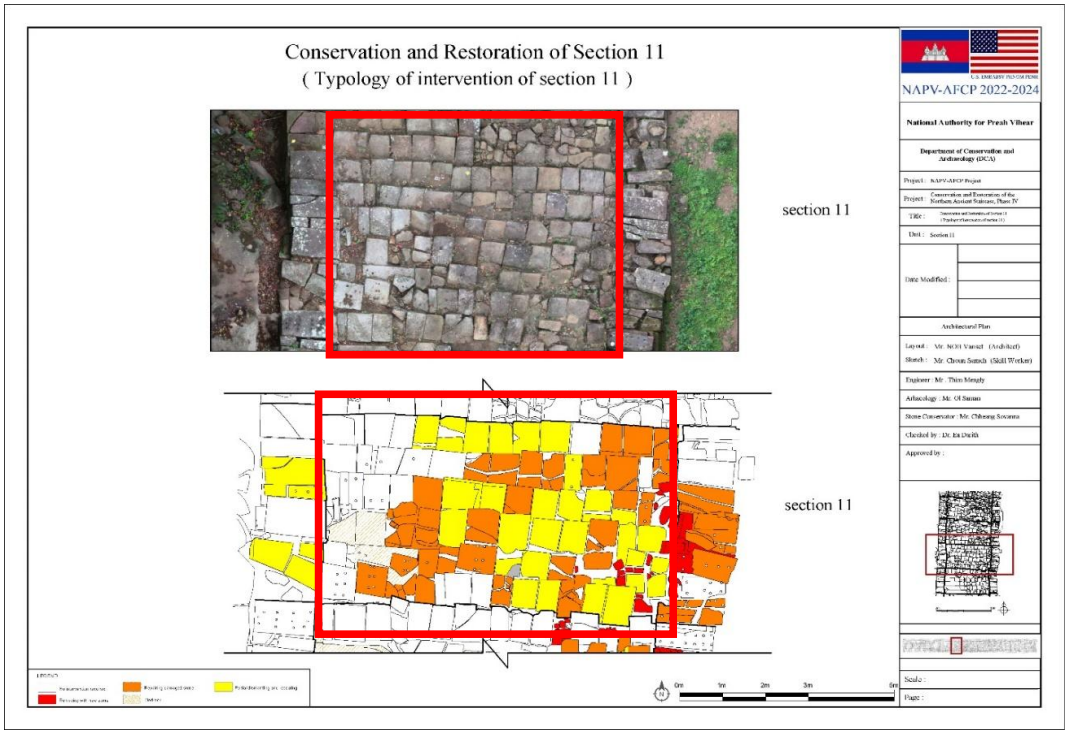


Figure 212: Typology of intervention of stair step at section 11 before restoration



Figure 213: Dissembling stone slabs from original positions



Figure 214: Condition of foundation of stair steps at section 11 after stone slabs were dissembled

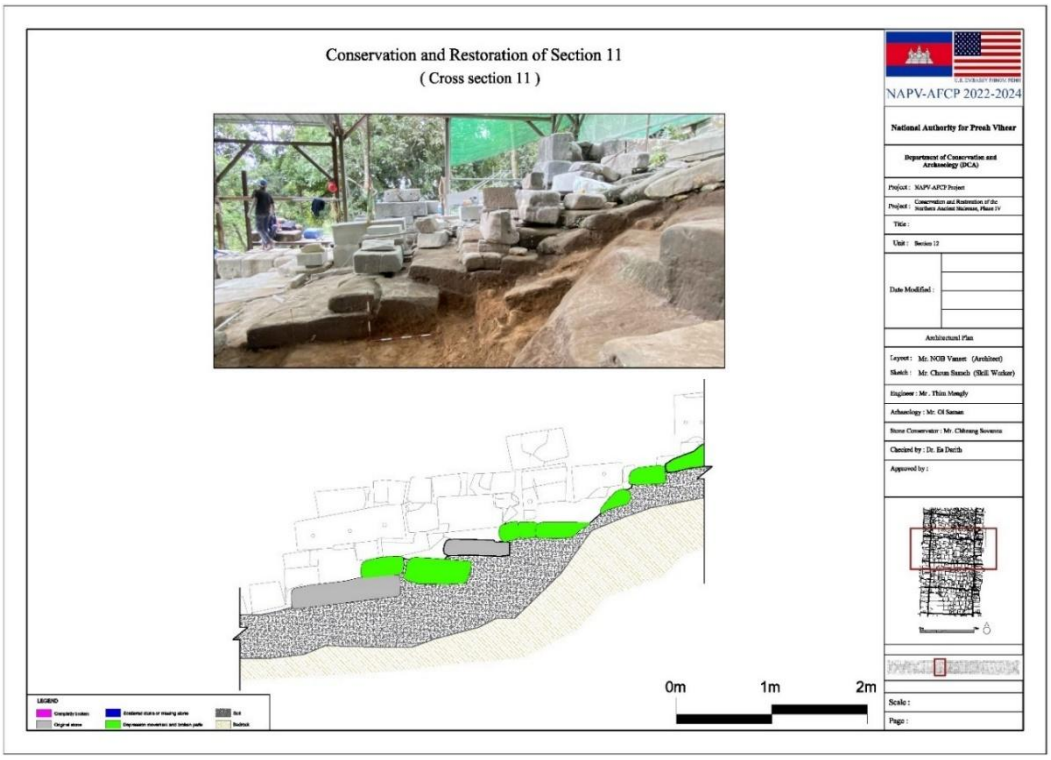


Figure 215: Cross section of stair step at section 11 showing damage condition

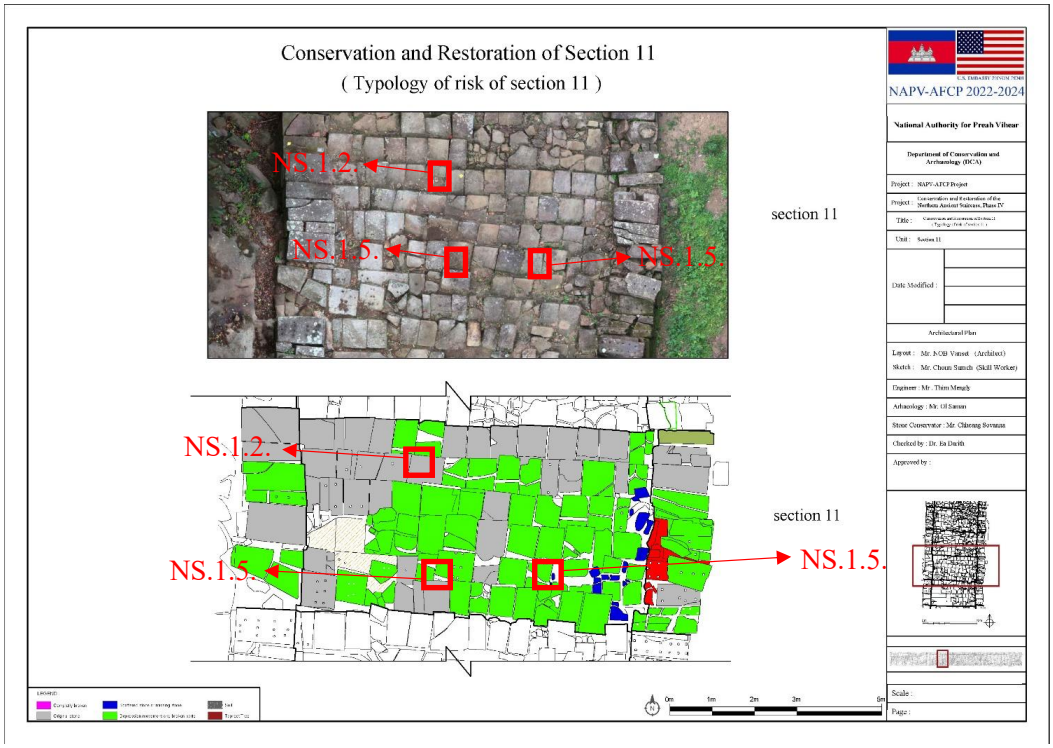


Figure 216: Locations of DCPT at section 11



Figure 217: Conducting DCP test of foundation before restoration



Figure 218: Removing debris and weak layer of the soil-compacted



Figure 219: Conducted DCPT after restoration





Figure 220: Restoration activities of the stair steps



Figure 221: General condition of stair steps at section 11 before restoration (North view)



Figure 222: General condition of stair steps at section 11 after restoration (North view)

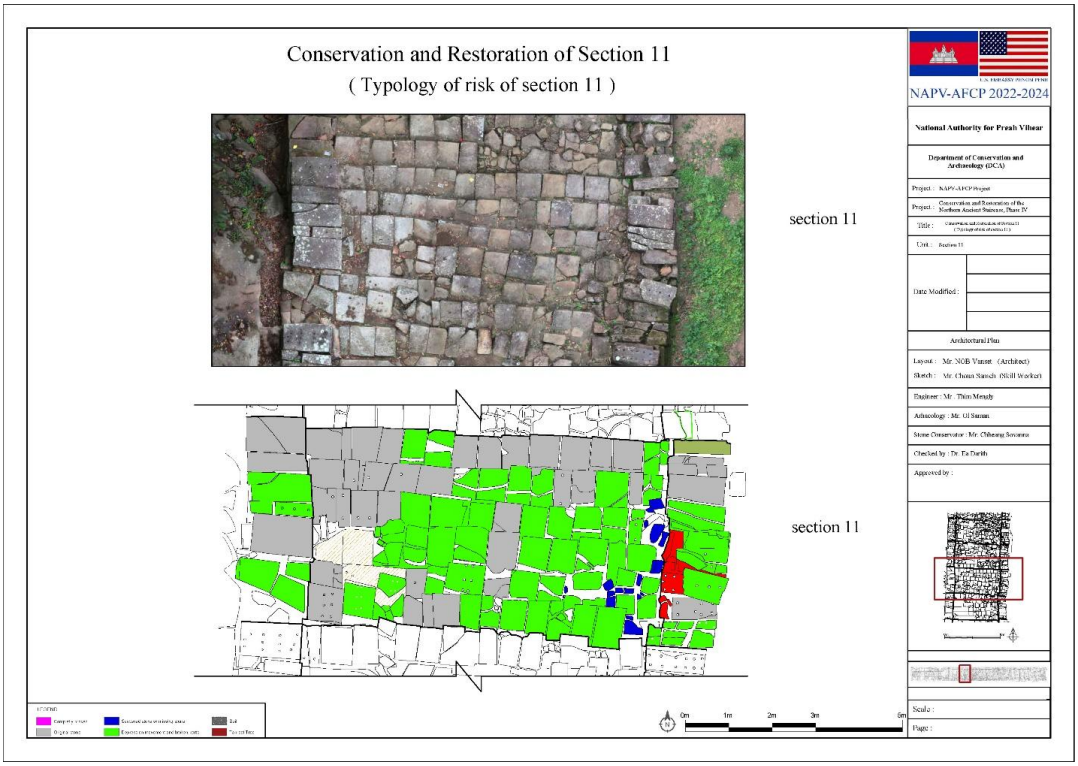


Figure 223: General condition of section 11 before restoration (Top view)



Figure 224: General condition of section 11 after restoration (Top view)

Table 9: Database of stone blocks/stone slabs at section 11

Number of stone blocks reassembled at the west stair wall					
Layer	**Total stone blocks reassembled**	**Good ancient stone blocks**	**restored broken stone blocks**	**New stone blocks**	**Stone piece for foundation restoration**
1	14	9	2	1	2
2	15	9	2	0	4
3	15	7	1	1	6
4	6	2	3	1	0
5	7	4	2	1	0
6	8	4	0	4	0
Total	**65**	**35**	**10**	**8**	**12**
Number of stone blocks dismantled at section 11 in the east					
Layer	**Total stone blocks on eastern wall**	**Total stone blocks dismantled**	**Good ancient stone blocks**	**minor broken stone blocks-restorable**	**Severely broken stone blocks**
1	9	9	4	4	1
2	15	15	6	3	6
3	15	15	10	5	0
4	11	11	8	3	0
Total	**50**	**50**	**28**	**15**	**7**
Number of stone blocks reassembled at section 11 in the east					
Layer	**Total stone blocks reassembled**	**Good ancient stone blocks**	**restored broken stone blocks**	**New stone blocks**	**Stone piece for foundation restoration**
1	7	4	2	1	0
2	18	6	3	9	0
3	15	10	5	0	0
4	11	8	3	0	0
Total	**51**	**28**	**13**	**10**	**0**
Number of stone slabs dismantled at section 11					
Step	**Total stone slabs on stair steps**	**Total stone slabs dismantled on stair steps**	**Good ancient stone slabs**	**minor broken stone slabs-restorable**	**Severely broken stone slabs**
1	14	14	8	4	2
2	13	13	5	4	4
3	15	15	6	5	4
4	15	15	11	4	0
5	15	15	8	7	0
6	15	15	11	4	0
Total	**87**	**87**	**49**	**28**	**10**

Number of stone slabs reassemble at section 11					
Step	**Total stone slabs**	**Good ancient stone slabs**	**Restored ancient stone slabs**	**New stone slabs**	**Stone for foundation**
1	15	8	4	2	1
2	15	5	3	6	1
3	15	6	5	4	0
4	16	11	4	1	0
5	17	8	7	1	1
6	16	11	4	1	0
Total	**94**	**49**	**27**	**15**	**3**

Table 10: Data of the DCP test of the stair step's foundation at section 11 before restoration

The data of the DCP test of the original foundation:

Project: Conservation and Restoration of Northern Ancient Staircase of Preah Vihear Temple

Location of Testing: NS.11.1.2.4

Depth of zero point below the surface: 0.000m (The ground under the stair step)

Date of Testing: 11/11/2024 (Before re-compacted)

Material: Original Foundation (Compacted Soil)

No.	Cumulative Num. of Blow	Cumulative Penetration (mm)	Penetration Between Readings(mm)	Penetration per Blow (mm)	Hammer Factor	DCP Index(mm/blow)	CBR (%)
1	0	0	0	0	0	0	0
2	5	195	195	39	1	39	4.82
3	10	348	153	15.3	1	15.3	13.76
4	15	431	83	5.53	1	5.53	42.98
5	20	480	49	2.45	1	2.45	100
6	25	528	48	1.92	1	1.92	100
7	30	621	93	3.1	1	3.1	82.24
8	35	736	115	3.29	1	3.29	77.05
9	40	850	114	2.85	1	2.85	90.36
10	45	956	106	2.36	1	2.36	100
11	50	1120	164	3.28	1	3.28	77
12	55	1285	165	3	1	3.00	85.31
13	57	1330	45	0.79	1	0.79	100
14	62	1436	106	1.71	1	1.71	100
15	67	1550	114	1.70	1	1.70	100
16	72	1638	88	1.22	1	1.22	100
17	77	1698	60	0.78	1	0.78	100
18	82	1720	22	0.27	1	0.27	100
19	87	1729	9	0.10	1	0.10	100
20	92	1739	10	0.11	1	0.11	100

Project: Conservation and Restoration of Northern Ancient Staircase of Preah Vihear Temple

Location of Testing: NS.11.1.5.3

Depth of zero point below the surface: 0.000m (The ground under the stair step)

Date of Testing: 11/11/2024 (Before re-compacted)

Material: Original Foundation (Compacted Soil)

No.	Cumulative Num. of Blow	Cumulative Penetration (mm)	Penetration Between Readings(mm)	Penetration per Blow (mm)	Hammer Factor	DCP Index(mm/ blow)	CBR (%)
1	0	0	0	0	0	0	0
2	5	224	224	44.8	1	44.8	4.13
3	10	327	103	10.3	1	10.3	21.43
4	15	444	117	7.8	1	7.8	29.26
5	20	524	80	4	1	4	61.81
6	25	629	105	4.2	1	4.2	58.53
7	30	686	57	1.9	1	1.9	100
8	35	739	53	1.51	1	1.51	100
9	40	797	58	1.45	1	1.45	100
10	45	848	51	1.13	1	1.13	100
11	50	873	25	0.5	1	0.5	100
12	55	897	24	0.44	1	0.44	100
13	60	936	39	0.65	1	0.65	100
14	65	992	56	0.86	1	0.86	100
15	70	1020	28	0.4	1	0.4	100
16	75	1030	10	0.13	1	0.13	100
17	80	1039	9	0.11	1	0.11	100
18	85	1049	10	0.12	1	0.12	100
19	90	1056	7	0.08	1	0.08	100
20	95	1060	4	0.04	1	0.04	100
21	100	1067	7	0.07	1	0.07	100
22	105	1073	6	0.06	1	0.06	100
23	110	1078	5	0.05	1	0.05	100
24	115	1082	4	0.03	1	0.03	100
25	120	1087	5	0.04	1	0.04	100
26	125	1090	3	0.024	1	0.024	100
27	130	1093	3	0.02	1	0.02	100
28	135	1095	2	0.01	1	0.01	100
29	140	1098	3	0.02	1	0.02	100

Project: Conservation and Restoration of Northern Ancient Staircase of Preah Vihear Temple

Location of Testing: NS.11.1.5.7

Depth of zero point below the surface: 0.000m (The ground under the stair step)

Date of Testing: 11/11/2024 (Before re-compacted)

Material: Original Foundation (Compacted Soil)

No.	Cumulative Num. of Blow	Cumulative Penetration (mm)	Penetration Between Readings(mm)	Penetration per Blow (mm)	Hammer Factor	DCP Index(mm/blow)	CBR (%)
1	0	0	0	0	0	0	0
2	5	124	124	24.8	1	24.8	8.01
3	10	235	111	11.1	1	11.1	19.71
4	15	325	90	6	1	6	39.25
5	20	451	126	6.3	1	6.3	37.16
6	25	590	139	5.56	1	5.56	42.75
7	30	718	128	4.27	1	4.27	57.50
8	35	865	147	4.2	1	4.2	58.53
9	40	967	102	2.55	1	2.55	100
10	45	1033	66	1.47	1	1.47	100
11	50	1133	100	2.00	1	2.00	100
12	55	1216	83	1.51	1	1.51	100
13	60	1300	84	1.40	1	1.40	100
14	65	1369	69	1.06	1	1.06	100
15	70	1382	13	0.19	1	0.19	100
16	75	1389	7	0.09	1	0.09	100
17	80	1396	7	0.09	1	0.09	100
18	85	1402	6	0.07	1	0.07	100
19	90	1405	3	0.03	1	0.03	100
20	95	1415	10	0.11	1	0.11	100
21	100	1422	7	0.07	1	0.07	100
22	105	1428	6	0.06	1	0.06	100
23	110	1432	4	0.04	1	0.04	100
24	115	1435	3	0.03	1	0.03	100
25	120	1440	5	0.04	1	0.04	100
26	125	1445	5	0.04	1	0.04	100
27	130	1450	5	0.04	1	0.04	100
28	135	1455	5	0.04	1	0.04	100
29	140	1458	3	0.02	1	0.02	100

The data of the DCP test After Restoration Foundation:

Project: Conservation and Restoration of Northern Ancient Staircase of Preah Vihear Temple

Location of Testing: NS.11.1.2.4

Depth of zero point below the surface: 0.000m (The ground under the stair step)

Date of Testing: 4/12/2024 (After re-compacted)

Material: Foundation (After Re-compacted Soil)

No.	Cumulative Num. of Blow	Cumulative Penetration (mm)	Penetration Between Readings(mm)	Penetration per Blow (mm)	Hammer Factor	DCP Index(mm/blow)	CBR(%)
1	0	0	0	0	0	0	0
2	5	80	80	16	1	16	13.08
3	10	120	40	4	1	4	61.81
4	15	160	40	2.67	1	2.67	97.34
5	20	230	70	3.5	1	3.5	71.78
6	25	280	50	2	1	2	100
7	30	350	70	2.33	1	2.33	100
8	35	410	60	1.71	1	1.71	100
9	40	420	10	0.25	1	0.25	100
10	45	440	20	0.44	1	0.44	100
11	50	480	40	0.8	1	0.8	100
12	55	585	105	1.91	1	1.91	100
13	60	680	95	1.58	1	1.58	100
14	65	725	45	0.69	1	0.69	100
15	70	755	30	0.43	1	0.43	100
16	75	805	50	0.67	1	0.67	100
17	80	870	65	0.81	1	0.81	100
18	85	940	70	0.82	1	0.82	100
19	90	975	35	0.39	1	0.39	100
20	95	1000	25	0.26	1	0.26	100
21	100	1035	35	0.35	1	0.35	100
22	105	1115	80	0.76	1	0.76	100
23	110	1125	10	0.09	1	0.09	100
24	115	1135	10	0.09	1	0.09	100
25	120	1155	20	0.17	1	0.17	100
26	125	1175	20	0.16	1	0.16	100
27	130	1185	10	0.08	1	0.08	100
28	135	1195	20	0.15	1	0.15	100
29	140	1195	10	0.07	1	0.07	100

Project: Conservation and Restoration of Northern Ancient Staircase of Preah Vihear Temple

Location of Testing: NS.11.1.5.3

Depth of zero point below the surface: 0.000m (The ground under the stair step)

Date of Testing: 04/12/2024 (After re-compacted)

Material: Original Foundation (After re-compacted Soil)

No.	Cumulative Num. of Blow	Cumulative Penetration (mm)	Penetration Between Readings(mm)	Penetration per Blow (mm)	Hammer Factor	DCP Index(mm/blow)	CBR (%)
1	0	0	0	0	0	0	0



2	5	79	79	15.8	1	15.8	13.27
3	10	91	12	1.2	1	1.2	100
4	15	139	48	3.2	1	3.2	79.36
5	20	199	60	3	1	3	85.31
6	25	239	40	1.6	1	1.6	100
7	30	270	31	1.03	1	1.03	100
8	35	290	20	0.57	1	0.57	100
9	40	308	18	0.45	1	0.45	100
10	45	330	22	0.49	1	0.49	100
11	50	356	26	0.52	1	0.52	100
12	55	385	29	0.53	1	0.53	100
13	60	416	31	0.52	1	0.52	100
14	65	452	36	0.55	1	0.55	100
15	70	485	33	0.47	1	0.47	100
16	75	527	42	0.56	1	0.56	100
17	80	593	66	0.825	1	0.83	100
18	85	661	68	0.8	1	0.8	100
19	90	717	56	0.62	1	0.62	100
20	95	760	43	0.45	1	0.45	100
21	100	830	70	0.7	1	0.7	100
22	105	882	52	0.50	1	0.50	100
23	110	911	29	0.26	1	0.26	100
25	115	959	48	0.42	1	0.42	100
26	120	1009	50	0.42	1	0.42	100
27	125	1048	39	0.31	1	0.31	100
28	130	1075	27	0.21	1	0.21	100
29	135	1111	36	0.27	1	0.27	100
30	140	1148	37	0.26	1	0.26	100
31	145	1195	47	0.32	1	0.32	100
32	150	1239	44	0.29	1	0.29	100
33	155	1283	44	0.28	1	0.28	100
34	160	1332	49	0.31	1	0.31	100
35	165	1380	48	0.29	1	0.29	100
36	170	1418	38	0.22	1	0.22	100
37	175	1437	19	0.11	1	0.11	100
38	180	1448	11	0.06	1	0.06	100
39	185	1455	7	0.04	1	0.04	100
40	190	1461	6	0.03	1	0.03	100
41	195	1465	4	0.02	1	0.02	100
42	200	1469	4	0.02	1	0.02	100
43	205	1473	4	0.02	1	0.02	100
44	210	1475	2	0.01	1	0.01	100
45	215	1478	3	0.01	1	0.01	100
46	220	1479	1	0.00	1	0.00	100
47	225	1483	4	0.02	1	0.02	100
48	230	1485	2	0.01	1	0.01	100

49	235	1487	2	0.01	1	0.01	100
50	240	1488	1	0.00	1	0.00	100

Project: Conservation and Restoration of Northern Ancient Staircase of Preah Vihear Temple

Location of Testing: NS.11.1.5.7

Depth of zero point below the surface: 0.000m (The ground under the stair step)

Date of Testing: 4/12/2024 (After re-compacted)

Material: Original Foundation (After re-compacted Soil)

No.	Cumulative Num. of Blow	Cumulative Penetration (mm)	Penetration Between Readings(mm)	Penetration per Blow (mm)	Hammer Factor	DCP Index(mm/blow)	CBR (%)
1	0	0	0	0	0	0	0
2	5	156	156	31.2	1	31.2	6.19
3	10	256	100	10	1	10	22.15
4	15	311	55	3.67	1	3.67	68.14
5	20	395	84	4.2	1	4.2	58.53
6	25	475	80	3.2	1	3.2	79.36
7	30	618	143	4.77	1	4.77	50.79
8	35	710	92	2.63	1	2.63	98.92
9	40	782	72	1.8	1	1.8	100
10	45	895	113	2.51	1	2.51	100
11	50	994	99	1.98	1	1.98	100
12	55	1083	89	1.62	1	1.62	100
13	60	1141	58	0.97	1	0.97	100
14	65	1178	37	0.57	1	0.57	100
15	70	1210	32	0.46	1	0.46	100
16	75	1243	33	0.44	1	0.44	100
17	80	1274	31	0.39	1	0.39	100
18	85	1286	12	0.14	1	0.14	100
19	90	1293	7	0.08	1	0.08	100
20	95	1303	10	0.11	1	0.11	100
21	100	1308	5	0.05	1	0.05	100
22	105	1313	5	0.05	1	0.05	100
23	110	1318	5	0.05	1	0.05	100
24	115	1323	5	0.04	1	0.04	100
25	120	1325	2	0.02	1	0.02	100
26	125	1333	8	0.06	1	0.06	100
27	130	1335	2	0.02	1	0.02	100

Annex 10: Conservation and restoration of damaged stones

Reinforcement and restoration of damaged stone blocks and stone slabs at section 14



Figure 225: Drilling holes into stone blocks and stone slabs and join with fiberglass and glue to reuse for reassembling stair step



Figure 226: The activities applying lime mortar to cracking area and in the gaps between pieces of stone blocks and stone slabs to prevent from water ingress

Table 11: Conservation and restoration of section 14 (Stone blocks at the west stair wall)

No	Stone code	Type	Typology	Risk	Condition	Restoration	Dowels	Others
Western staircase wall								
2	NS14.W.1.4	Sandstone	Western wall	Medium	Break Out into 2 pieces	Drilling hole put Fiberglass with glue	Ø=18mm=40cm Ø=18mm=40cm	
2	NS13.W.2.7	Sandstone	Western wall	Medium	Break Out into 2 pieces		Ø=12mm=34cm Ø=12mm=34cm	
3	NS14.W.2.5	Sandstone	Western wall	Medium	Cracks nearly break out		Ø=12mm=17cm Ø=12mm=17cm Ø=12mm=17cm Ø=12mm=17cm	
4	NS14.W.4.4	Sandstone	Western wall	Medium	Break Out into 2 pieces		Ø=12mm=16cm Ø=12mm=16cm	

Table 12: restored and reused stone slabs from section 14 (stair seps 1-6)

No	Stone code	Type	Typology	Risk	Condition	Restoration	Dowells	Others
Stair step								
1	NS14.1.1.3	Sandstone	Step	Meduim	Break Out into 3 pieces	Drilling hole put Fiberglass with glue	Ø=12mm=30cm Ø=12mm=30cm Ø=12mm=30cm	
2	NS14.1.1.4	Sandstone	Step	Meduim	Break Out into 3 pieces		Ø=12mm=25cm Ø=18mm=30cm	
3	NS14.1.1.5	Sandstone	Step	Meduim	Break Out into 2 pieces		Ø=12mm=30cm Ø=12mm=30cm	
4	NS14.1.1.5	Sandstone	Step	Meduim	Break Out into 2 pieces		Ø=12mm=25cm	
5	NS14.1.2.1	Sandstone	Step	Meduim	Break Out into 2 pieces		Ø=16mm=20cm Ø=16mm=20cm	
6	NS14.1.2.7	Sandstone	Step	Meduim	Break Out into 2 pieces		Ø=12mm=30cm Ø=12mm=30cm	
7	NS14.1.2.12	Sandstone	Step	Meduim	Break Out into 2 pieces		Ø=16mm=20cm Ø=16mm=20cm	
8	NS14.1.3.6	Sandstone	Step	Meduim	Break Out into 2 pieces		Ø=12mm=30cm Ø=12mm=30cm	
9	NS14.1.3.9	Sandstone	Step	Meduim	Break Out into 2 pieces		Ø=12mm=30cm Ø=12mm=30cm	
10	NS14.1.3.14	Sandstone	Step	Meduim	Break Out into 2 pieces		Ø=16mm=30cm Ø=16mm=30cm	
11	NS14.1.4.2	Sandstone	Step	Meduim	Break Out into 2 pieces		Ø=12mm=18cm	
12	NS14.1.4.4	Sandstone	Step	Meduim	Break Out into 2 pieces		Ø=12mm=30cm Ø=12mm=30cm	
13	NS14.1.4.6	Sandstone	Step	Meduim	Break Out into 2 pieces		Ø=12mm=30cm Ø=12mm=30cm	
14	NS14.1.4.8	Sandstone	Step	Meduim	Break Out into 3 pieces		Ø=12mm=30cm Ø=12mm=30cm	
15	NS14.1.5.2	Sandstone	Step	Meduim	Break Out into 2 pieces		Ø=12mm=30cm	
16	NS14.1.5.3	Sandstone	Step	Meduim	Break Out into 2 pieces		Ø=12mm=30cm Ø=12mm=30cm	
17	NS14.1.5.4	Sandstone	Step	Meduim	Break Out into 2 pieces		Ø=12mm=30cm Ø=12mm=30cm	
18	NS14.1.5.7	Sandstone	Step	Meduim	Break Out into 2 pieces		Ø=12mm=30cm Ø=12mm=30cm	
19	NS14.1.6.1	Sandstone	Step	Meduim	Break Out into 2 pieces		Ø=12mm=25cm Ø=12mm=25cm	
20	NS15.W.1.1	Sandstone	Step	Meduim	Break Out into 2 pieces		Ø=12mm=25cm	
21		Sandstone	Step	Meduim	Break Out into 2 pieces		Ø=12mm=16cm Ø=12mm=16cm	
Eastern wall								
1	NS14.E.1.5	Sandstone	East wall	Meduim	Break Out into 2 pieces	Drilling hole put Fiberglass with glue	Ø=12mm=40cm Ø=12mm=40cm	
2	NS14.E.4.1	Sandstone	East wall	Meduim	Break Out into 2 pieces		Ø=16mm=15cm Ø=16mm=cm	
3	NS14.E.4.3	Sandstone	East wall	Meduim	Break Out into 2 pieces		Ø=12mm=40cm Ø=12mm=40cm	
4	NS14.E.4.8	Sandstone	East wall	Meduim	Break Out into 2 pieces		Ø=12mm=30cm Ø=12mm=30cm	
5	NS14.E.1.5	Sandstone	Western wall	Meduim	Break Out into 2 pieces		Ø=12mm=40cm Ø=12mm=40cm	

Reinforcement and Restoration of stone blocks and stone slabs at section 13



Figure 227: Activities of reinforcement and restoration of stone blocks from section 13 - drilling into stone block and insert iron bar and glue to fix pieces of stone

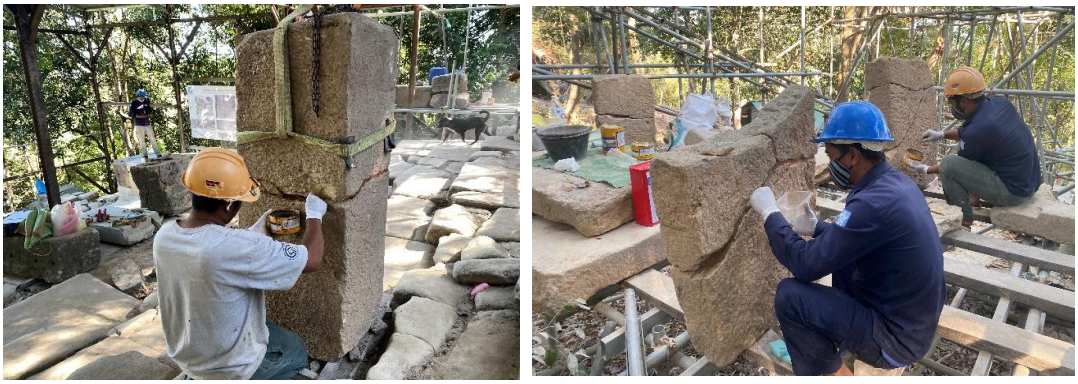


Figure 228: Activities of filling in the gaps and joined areas of pieces of stone blocks and stone slabs with lime mortar to enhance strength and prevent them from penetration of rain water.

Table 13: Database of restored stones, section 13

No	Stone code	Fragments	Type	Typology	Risk	Condition	Restoration	Dowels
	West wall							
1	NS13.W.1.3	2	Sandstone	Western wall	Medium	Broke into 2pieces and small cracks	drilling hold to put stainless steel and glue	Ø=12mm=20cm Ø=12mm=20cm
2	NS13.W.1.4	2	Sandstone	Western wall	Medium	Broke into 2pieces and small cracks	Reattaching pieces with Epoxy glue	
3	NS13.W.1.5	5	Sandstone	Western wall	Medium	The stone was broken into 5 pieces; therefore, the stone fragment is in good condition	drilling hold to put stainless steel and glue	Ø=12mm=20cm Ø=12mm=20cm Ø=12mm=20cm
4	NS13.W.1.6	2	Sandstone	Western wall	Medium	Broke into 2pieces and small cracks on the surface	drilling hold to put stainless steel and glue	Ø=12mm=20cm Ø=12mm=20cm

5	NS13.W.1.7	8	Sandstone	Western wall	Medium	The stone broken into 8 pieces and cracks	Reattaching pieces with Epoxy glue and drilling hole to put stainless steel dowels Reattaching pieces with Epoxy glue	Ø=12mm=20cm Ø=12mm=20cm
6	NS14.W.1.13	2	Sandstone	Western wall	Medium	Break Out into 2 pieces	drilling hold to put stainless steel and glue	Ø=12mm=20cm Ø=12mm=20cm
7	NS13.W.2.8	3	Sandstone	Western wall	Medium	The stone broken into 3 pieces and missing pieces at the west	drilling hold to put stainless steel and glue	Ø=12mm=20cm Ø=12mm=20cm
8	NS13.W.3.3	2	Sandstone	Western wall	Medium	broken into 2 pieces but the fragments are good condition the pieces at corner of stone was breakout	drilling hold to put stainless steel and glue	Ø=12mm=20cm Ø=12mm=20cm Ø=12mm=20cm
	East wall							
No	**Stone code**	**Fragments**	**Type**	**Typology**	**Risk**	**Condition**	**Restoration**	**Dowells**
1	NS13.E.1.1	7	sandstone	wall	medium	broke into 7 pieces and crack. But the stone still good condition	Reattaching pieces with Epoxy and drilling hole to put stainless steel dowels Reattaching pieces with Epoxy glue	Ø=12mm=20cm Ø=12mm=20cm
2	NS13.E.1.2		sandstone	wall	medium	The stone was broken many pieces, but still in good condition	Reattaching pieces with Epoxy glue	
3	NS13.E.1.4	3	sandstone	wall	medium	broken into 3 pieces and missing at corner	Reattaching pieces with Epoxy and drilling hole to put stainless steel dowels Reattaching pieces with Epoxy glue	Ø=12mm=20cm Ø=12mm=20cm
4	NS13.E.1.6	6	sandstone	wall	medium	broken into 6 pieces and missing at corner	Reattaching pieces with Epoxy glue	
5	NS13.E.1.12	2	sandstone	wall	medium	broken into 2 pieces, but still in good condition	Reattaching pieces with Epoxy glue	Ø=12mm=20cm Ø=12mm=20cm
6	NS13.E.2.15	2	sandstone	wall	medium	broken into 2 pieces, therefore stone still good condition	Reattaching pieces with Epoxy glue	Ø=12mm=20cm Ø=12mm=20cm
7	NS13.E.2.7	2	sandstone	wall	medium	broken into 2 pieces, however stone fragments good condition	consolidation and reattaching stone pieces together with glue	
8	NS13.E.2.14	2	sandstone	wall	medium	broken into 2 pieces, however stone fragments good condition	consolidation and reattaching stone pieces together with glue	

Reinforced and restored damaged stones

Table 14: Database of restored stone slabs, section 13

No	Stone code	Fragments	Type	Typology	Risk	Condition	Restoration	Dowells
Step								
1	NS13.1.1.10	5	Sandstone	Step		The stone has broken to 5 pieces, small cracks on the surface. The stone 70% is good so we can reuse	Drilling hole to put stainless steel dowels with Epoxy glue	Ø12mm=30cm Ø12mm=30cm Ø12mm=30cm Ø12mm=30cm Ø12mm=30cm Ø12mm=30cm
2	NS13.1.1.4	3	Sandstone	Step	Medium	The stone has broken into 3 pieces, cracks on the surface and covered by biology. The stone still good condition	Drilling hole to put stainless steel dowels with Epoxy glue	Ø12mm=20cm Ø12mm=20cm Ø12mm=20cm
3	NS13.1.1.4.	2	Sandstone	Step	Medium	Broke 2 pieces and cracks at the bottom of the stone	Drilling hole to put stainless steel dowels with Epoxy glue	Ø12mm=30cm Ø12mm=30cm
4	NS13.1.1.5	4	Sandstone	Step	Medium	The stone has broken into 4 pieces, small cracks at the front of stone. We can reuse it cause the all pieces of stone still good qualities	Drilling hole to put stainless steel dowels with Epoxy glue	Ø12mm=15cm Ø12mm=15cm
5	NS13.1.1.8	4	Sandstone	Step	Medium	The stone was broken into 4pieces, cracks at the top and covered biology but the stone still good qualities	Drilling hole to put stainless steel dowels with Epoxy glue	Ø12mm=30cm Ø12mm=30cm
6	NS13.1.2.1	2	Sandstone	Step	Medium	The stone was broken into pieces and missing at middle part	Replacing new sandstone at the middle part and reconnecting stone pieces by drilling hole put stainless steel with Epxy glue	Ø12mm=25cm Ø12mm=25cm
7	NS13.1.2.10	2	Sandstone	Step	Medium	The stone was broken into 2pieces	Drilling hole to put stainless steel dowels with Epoxy glue	Ø12mm=30cm Ø12mm=30cm

8	NS13.1.2.4	2	Sandstone	Step	Medium	The stone has broken 2 pieces, we can reuse cause the stone still good qualities	Drilling hole to put stainless steel dowels with Epoxy glue	Ø12mm=20cm Ø12mm=20cm Ø12mm=20cm
9	NS13.1.2.5	3	Sandstone	Step	Medium	The stone has broken 3 pieces, therefor we can reuse cause the stone still good qualities	Drilling hole to put stainless steel dowels with Epoxy glue	Ø12mm=20cm Ø12mm=20cm Ø12mm=20cm
10	NS13.1.2.6	3	Sandstone	Step	Medium	The stone has broken into 3 pieces, lost stone parts at the back side and the left side. The stone still good qualities we can reuse	Drilling hole to put stainless steel dowels with Epoxy glue	Ø12mm=20cmØ12mm=20cmØ12mm=20cmØ12mm=20cm
11	NS13.1.2.6	4	Sandstone	Step	Medium	The stone has broken 4 pieces, cracks at the right side and breakout at left side, so we can reuse cause the stone still good qualities	some pieces we reattach with gur and some pieces we drilling hole to put stainless steel dowels with Epoxy glue	Ø12mm=20cm Ø12mm=20cm Ø12mm=20cm Ø12mm=20cm
12	NS13.1.2.7	2	Sandstone	Step	Medium	Brok into 2pieces, the stone still good qualities	Drilling hole to put stainless steel dowels with Epoxy glue	Ø12mm=30cm Ø12mm=30cm
13	NS13.1.2.9	2	Sandstone	Step	Medium	Break 2 pieces and covered by biology but can reuse cause stone qualities still good	Drilling hole to put stainless steel dowels with Epoxy glue	Ø12mm=30cm Ø12mm=30cm
	NS13.1.2.8	2	Sandstone	Step	Medium	Break 2 pieces and covered by biology but can reuse cause stone qualities still good	Drilling hole to put stainless steel dowels with Epoxy glue	Ø12mm=30cm Ø12mm=30cm
14	NS13.1.3.1	2	Sandstone	Step	Medium	The stone has 2 pieces, cracks at left side. But the stone still good qualities	Drilling hole to put stainless steel dowels with Epoxy glue	Ø12mm=15cm Ø12mm=15cm Ø12mm=15cm
15	NS13.1.3.10	2	Sandstone	Step	Medium	The stone was broken into 2 pieces, covered by soil and biology. The stone is good quality	Drilling hole to put stainless steel dowels with Epoxy glue	Ø12mm=30cm Ø12mm=30cm

16	NS13.1.3.11	2	Sandstone	Step	Medium	the stone has eroded the top and conner and broke into 2 pieces	Drilling hole to put stainless steel dowels with Epoxy glue	Ø12mm=30cm Ø12mm=30cm
17	NS13.1.3.15	4	Sandstone	Step	Medium	The stone has broken into 4 pieces, cracks on the surface. The stone qualities still good can reuse	Drilling hole to put stainless steel dowels with Epoxy glue	Ø12mm=30cm Ø12mm=30cm Ø12mm=30cm Ø12mm=30cm
18	NS13.1.3.2	5	Sandstone	Step	Medium	The stone has broken into 5 pieces, cracks at the right side, otherwise the stone good qualities	some pieces we reattach with gur and some pieces we drilling hole to put stainless steel dowels with Epoxy glue	Ø12mm=20cm Ø12mm=20cm Ø12mm=20cm
19	NS13.1.3.4	2	Sandstone	Step	Medium	The stone has broken 2 pieces and cracks at the west side; however, the pieces are good qualities	some pieces we reattach with gur and some pieces we drilling hole to put stainless steel dowels with Epoxy glue	Ø12mm=20cmØ12mm=20cmØ12mm=20cmØ12mm=20cm
20	NS13.1.3.5	2	Sandstone	Step	Medium	The stone has broken into 2 pieces, missing stone at front and back side of the stone, although pieces of stone good qualities.	Drilling hole to put stainless steel dowels with Epoxy glue	Ø12mm=30cm Ø12mm=30cm
21	NS13.1.3.7	2	Sandstone	Step	Medium	The stone has broken into 2 pieces, missing stone at left side, although pieces of stone good qualities.	Drilling hole to put stainless steel dowels with Epoxy glue	Ø12mm=25cm Ø12mm=25cm
22	NS13.1.3.8	2	Sandstone	Step	Medium	The stone has broken into 2 pieces, even if the stone good qualities	Drilling hole to put stainless steel dowels with Epoxy glue	Ø12mm=20cm Ø12mm=20cm
23	NS13.1.3.9	2	Sandstone	Step	Medium	The stone broken into 2pieces but the stone is still good	Drilling hole to put stainless steel dowels with Epoxy glue	Ø12mm=30cm Ø12mm=30cm
24	NS13.1.4.1	4	Sandstone	Step	Medium	The stone broken into 4 pieces but still good qualities	Drilling hole to put stainless steel dowels with Epoxy glue	Ø12mm=30cm Ø12mm=30cm Ø12mm=30cm Ø12mm=30cm

25	NS13.1.4.1	3	Sandstone	Step	Medium	The stone has broken into 3 pieces, lost stone parts at the back side. The stone still good qualities we can reuse	Drilling hole to put stainless steel dowels with Epoxy glue	Ø12mm=30cm
26	NS13.1.4.1	2	Sandstone	Step	Medium	The stone has 2 pieces, cracks at left side. But the stone still good qualities	Drilling hole to put stainless steel dowels with Epoxy glue	Ø12mm=30cm
27	NS13.1.4.5	3	Sandstone	Step	Medium	broken 3 pieces, cracks at the surface besides these pieces are good qualities	Drilling hole to put stainless steel dowels with Epoxy glue	Ø12mm=30cm Ø12mm=30cm
28	NS13.1.4.6	3	Sandstone	Step	Medium	The stone has broken into 3 pieces, cracks on the surface and covered by biology. The stone still good condition	Drilling hole to put stainless steel dowels with Epoxy glue	Ø12mm=20cm Ø12mm=20cm Ø12mm=20cm
29	NS13.1.4.7	3	Sandstone	Step	Medium	The stone has broken into 3 pieces, lost stone parts at the back side. The stone still good qualities we can reuse	Drilling hole to put stainless steel dowels with Epoxy glue	Ø12mm=20cmØ12mm=20cmØ12mm=20cm
30	NS13.1.5.10	6	Sandstone	Step		The stone has broken to 6 pieces, small cracks on the surface. The stone is good qualities (70%)	Drilling hole to put stainless steel dowels with Epoxy glue	Ø12mm=30cm Ø12mm=30cm Ø12mm=30cm Ø12mm=30cm Ø12mm=30cm
31	NS13.1.5.1	2	Sandstone	Step	Medium	broken into 2 pieces at comer	reattach stone pieces together with glue	
32	NS13.1.6.1	3	Sandstone	Step	Medium	broken into 2 pieces at comer	reattach stone pieces together with glue	
33	NS13.1.6.4	4	Sandstone	Step	Medium	broken into 2 pieces at corner	reattach stone pieces together with glue	
34	NS13.1.6.5	5	Sandstone	Step	Medium	broken into 2 pieces at corner	reattach stone pieces together with glue	

Reinforced and restored damaged stones at section 12



Figure 229: Cleaning micro-biology on surface of stone blocks





Figure 230: Drilling holes in the stone blocks and connecting pieces of stone block together with support of iron bar and glue

Table 15: Database of restored stone slabs, section 12

No	Coding stone	fragment	Type	Typology	Risk	Condition	Conservation
Western staircase wall section 12							
1	NS12.W.1.2		Sandstone	Wall	Medium	Stone was broken into 2 pieces. Have biology and covered by soil dust. According to observed the stone can reuse back	to drilled put 1 Stainless steel dowels: Ø12mm=25cm used glue 40ml x 80ml
2	NS12.W.1.5/1 NS12.W.1.5/2	34X44X12 33x74x12	Sandstone	Wall	Medium	Stone was broken into 2 pieces. Have biology and covered by soil dust. According to observed the stone can reuse back	to drilled put 1 Stainless steel dowels: Ø12mm=25cm used glue 40ml x 80ml

3	NS12.W.1.7/1 NS12.W.1.7/2	78x40x51 108x80x50	Sandstone	Wall	Medium	The stone broke 2 pieces. Otherwise stone have cracks and covered soil. It's good qualities	To drilled put 3 Stainless steel dowels: Ø12mm=30cm Ø12mm=30cm Ø12mm=30cm Ø12mm=30cm Used glue100ml X200ml
4	NS12.W.2.5	2	Sandstone	Wall	Medium	The stone broke 2 pieces. Otherwise stone have cracks and covered soil. It's good qualities	to drilled put 1 Stainless steel dowels: Ø12mm=25cm used glue 40ml x 80ml
5	NS12.W.2.5						
6	NS12.W.4						
7	NS12.W.3.3/1 NS12.W.3.3/2	30x62x36 03x32x14	Sandstone	Wall	Medium	The stone broke 2 pieces. Otherwise stone have cracks and covered soil. It's good qualities	To drilled put 2 Stainless steel dowels: Ø12mm=30cm Ø12mm=30cm Used glue50ml X100ml
8	NS12.W.3.7/1 NS12.W.3.7/2 NS12.W.3.7/3	20x36x14 20x50x25 20x17x12	Sandstone	Wall	Medium	The stone was broken 3 pieces. Otherwise stone have cracks and covered soil. It's good qualities	To drilled put 3 Stainless steel dowels: Ø12mm=30cm Ø12mm=30cm Ø12mm=30cm Used glue100ml X200ml
9	NS12.W.3.9/1 NS12.W.3.9/2 NS12.w.3.9/3	52x128x35 31x95x33 28x16x25	Sandstone	Wall	Medium	The stone was broken into 3 pieces. Have cracks at the west conner and Biology. Although all Pieces still good qualities and can reused	To drilled put 3 Stainless steel dowels: Ø16mm=30cm Ø16mm=30cm Ø16mm=30cm Used glue50ml X100ml
10	NS12.W.4.9/1 NS12.W.4.9/2	71x60x41 59x69x41	Sandstone	Wall	Medium	The stone was broken 2 pieces. Otherwise stone have cracks and covered soil. It's good qualities	To drilled put 2 Stainless steel dowels: Ø16mm=30cm Ø16mm=30cm Used glue50ml X100ml

11	NS12.W4.8/1 NS12.W4.8/2 NS12.W4.8/3 NS12.W4.8/4	79x53x27 17x12x28 57x54x29 28x14x28	Sandstone	Wall	Medium	The stone was broken into 4 pieces. The stone loss of part at the conner, cracks, soil and covered by biology. More over all pieces still good, so we can reuse it	To drilled put 2 Stainless steel dowels: Ø16mm=30cm,Ø16mm=30cm Used glue50ml X100ml
12	NS12.W.4.7	2	Sandstone	Wall	Medium	The stone was broken 2 pieces. Otherwise stone have cracks and covered soil. It's good qualities	to drilled put 1 Stainless steel dowels:Ø12mm=30cmused glue 40ml x 80ml
13	NS12.W.5.11/1 NS12.W.5.11/1	67x59x23 33x23x23 23x30x23	Sandstone	Wall	Medium	The stone was broken big 3 pieces and many small pieces. The small pieces bad condition and covered by soil dust. So only 3 big pieces can reuse	To drilled put 3 Stainless steel dowels: Ø12mm=25cm Ø12mm=25cm Ø12mm=18cm Used glue100ml X200ml
14	NS12.W.5.12	2	Sandstone	Wall	Medium	The stone was broken 2 pieces. Otherwise stone have cracks and covered soil. It's good qualities	Re-attacked pieces together with Epoxy sikadur 52 TH
15	NS12.W.6.6	3	Sandstone	Wall	Medium	The stone was broken 2 pieces. Otherwise stone have cracks and covered soil. It's good qualities	to drilled put 1 Stainless steel dowels: Ø12mm=30cm used glue 40ml x 80ml
Eastern staircase wall section 12							
1	NS12.E.1.15/1 NS12.E.1.15/2	109x41x50 30x44x45	Sandstone	Wall	Medium	Stone was broken to 2 big fragment and cracks. Although stone still good can reuse by drill put Stainless steel dowels with glue	To drilled put 4 Stainless steel dowels: Ø12mm=30cm Ø12mm=30cm Ø12mm=30cm Ø12mm=30cm Used glue60ml X120ml
2	NS12.E.1.5/1 NS12.E.1.5/2 NS12.E.1.5/3	26x25x29 29x13x25 35x52x29	Sandstone	Wall	Medium	The stone was broken 3 fragments and pieces have cracks and covered by soil. The pieces are still good condition so can be reused back by reconnecting pieces with drill hold	To drilled put 2 Stainless steel dowels: Ø12mm=25cm Ø12mm=25cm Used glue50ml X100ml

3	NS12.E.3.2/1 NS12.E.3.2/2 NS12.E.3.2/3	64x56x24 61x58x24 23x05x24	Sandstone	Wall	Medium	The stone was broken to 3 pieces. But all pieces still good qualities, so can reuse	To drilled put 2 Stainless steel dowels: Ø12mm=32cm Ø12mm=32cm Used glue100ml X200ml
4	NS12.E.3.3/1 NS12.E.3.3/2	75x46x24 72x82x23	Sandstone	Wall	Medium	The stone was broken 2 pieces. Otherwise stone have cracks and covered soil. It's good qualities	To drilled put 2 Stainless steel dowels: Ø16mm=32cm Ø16mm=32cm Used glue100ml X200ml
5	NS12.E.3.5/1 NS12.E.3.5/2	64x37x43 03x10x10	Sandstone	Wall	Medium	The stone broke to 2pieces (big pieces and small). the qualities of stone still good so can reuse	Re-attacked pieces together with Epoxy sikadur 52 TH(40ml=80ml)
6	NS12.E.3.9/1 NS12.E.3.9/2	29x108x19 43x109x54	Sandstone	Wall	Medium	stone was broken to 2 pieces. All pieces are good condition can reuse just treatment connection pieces together by drilling putting stainless steel	To drilled put 3 Stainless steel dowels: Ø16mm=30cm Ø16mm=30cm Ø16mm=30cm Used glue60ml X120ml
7	NS12.E.4.12/1 NS12.E.4.12/2	28x67x24 85x63x24	Sandstone	Wall	Medium	Stone was broken to 2 big fragments and cracks. Although stone still good can reuse by drill put Stainless steel dowels with glue	Used 2 Stainless steel dowels: Ø12mm=30cm Ø12mm=30cm Used glue120ml X60ml
8	NS12.E.4.10	2	Sandstone	Wall	Medium	Stone was broken to 2 big fragments and cracks. Although stone still good can reuse by drill put Stainless steel dowels with glue	Used 2 Stainless steel dowels:Ø12mm=30cmØ12mm=30cmUsed glue120ml X60ml
9	NS12.E.4.8	2	Sandstone	Wall	Medium	Stone was broken to 2 big fragments and cracks. Although stone still good can reuse by drill put Stainless steel dowels with glue	Used 2 Stainless steel dowels: Ø12mm=30cm Ø12mm=30cm Used glue120ml X60ml
10	NS12.E.4.7	2	Sandstone	Wall	Medium	Stone was broken to 2 big fragments and cracks. Although stone still good can reuse by drill put Stainless steel dowels with glue	Used 2 Stainless steel dowels: Ø12mm=30cm Ø12mm=30cm Used glue120ml X60ml

11	NS12.E.4.5	2	Sandstone	Wall	Medium	Stone was broken to 2 big fragments and cracks. Although stone still good can reuse by drill put Stainless steel dowels with glue	Used 2 Stainless steel dowels: Ø12mm=30cm Ø12mm=30cm Used glue120ml X60ml
12	NS12.E.5.9	2	Sandstone	Wall	Medium	Stone was broken to 2 big fragments and cracks. Although stone still good can reuse by drill put Stainless steel dowels with glue	Used 2 Stainless steel dowels: Ø12mm=30cm Ø12mm=30cm Used glue120ml X60ml
13	NS12.E.5.10	3	Sandstone	Wall	Medium	Stone was broken to 3 big fragments and cracks. Although stone still good can reuse by drill put Stainless steel dowels with glue	Used 3 Stainless steel dowels: Ø12mm=30cm Ø12mm=30cm Ø12mm=30cm Used glue120ml X60ml
14	NS12.E.5.13	5	Sandstone	Wall	Medium	The stone was broke into 5 pieces, therer fore stone fragment still good condition	Reattach pices together with glue

Table 16: Stair step, section 12

No	Coding stone	fragments Size	Type	Typology	Risk	Condition	Conservation
1	NS12.1.1.2/1	27X37X22	Sandstone	Step	Medium	The stone was broken into 2 pieces and cracks at backs side. Otherwise stone can be reused	drilled put Stainless steel Ø16mm=30cm Ø16mm=30cm used glue 50ml x 100ml
	NS12.1.1.2/2	27X47X22					
2	NS12.1.1.2/1	27x46x22	Sandstone	Step	Medium	Stone broke 2 pieces and cracks. As the result stone can reuse after treatment.	drilled put Stainless steel Ø12mm=35cm Ø12mm=35cm used glue 50ml x100ml
	NS12.1.1.2/2	27x46x20					
3	NS12.1.1.12/1	37x26x18	Sandstone	Step	Medium	stone was broke 3 pieces and have cracks. However the stone condition is good so can reuse after treatment	drilled put Stainless steel Ø16mm=25cm Ø16mm=25cm used glue 40ml x 80ml
	NS12.1.1.12/2	73x37x22					
	NS12.1.1.12/3	75x45x22					
4	NS12.1.2.2/1	70X58X27	Sandstone	Step	Medium	Stone was broke 2 pieces and cracks, The stone was bad condition so can't reuse	Replace with new stone
	NS12.1.2.2/2	67X50X27					
5	NS12.1.2.3/1	70X60X28	Sandstone	Step	Medium	The stone broke 2 pieces. The stone is good condition, therefore we can reuse	drilled put Stainless steel Ø16mm=35cm Ø16mm=35cm used glue 50ml x 100ml
	NS12.1.2.3/2	70X50X30					
6	NS12.1.2.1/1	19x41x20	Sandstone	Step	Hight	The stone slab quality is bad and broke 2 pieces. So stone can't use.	replace with new stone
	NS12.1.2.1/2	70x18x21					
7	NS12.1.3.8/1	38x40x24	Sandstone	Step	Medium	Stone was broke 2 pieces and cracks, in spite of this the stone can be reuse after treatment	drilled put Stainless steel Ø16mm=25cm Ø16mm=25cm used glue 40ml x 80ml
	NS12.1.3.8/2	40x62x24					
8	NS12.1.3.3/1	60x37x20	Sandstone	Step	Medium	The stone condition is medium, broke 3 pieces and cracks. How ever the stone can use again after treat	drilled put Stainless steel Ø16mm=30cm Ø16mm=30cm used glue 50ml x100ml
	NS12.1.3.3/2	60x36x21					
	NS12.1.3.3/3	61x58x22					
9	NS12.1.3.1		Sandstone	Step	Medium	The stone condition is medium, broke 2 pieces and	drilled put Stainless steel Ø16mm=35cm

						cracks. How ever the stone can use again after treat	Ø16mm=35cm used glue 50ml x 100ml
10	NS12.1.3.2/1	73x62x21	Sandstone	Step	Medium	stone broke 2 pieces and cracks, but stone can use again after treat.	drilled put Stainless steel Ø16mm=30cm Ø16mm=30cm used glue 50ml x 100ml
	NS12.1.3.2/2	88x66x21	Sandstone	Step	Medium		
11	NS12.1.4.6/1	66x40x18				The stone slab condition is medium and broke 3 pieces, so stone slab can be used again just treatment	drilled put Stainless steel Ø16mm=30cm Ø16mm=30cm used glue 50ml x100ml
	NS12.1.4.6/2	42x38x15					
	NS12.1.4.6/3	73x58x21	Sandstone	Step	Medium		
12	NS12.1.4.3/1	80X52X20	Sandstone	Step	Medium	The stone was broken 2. the stone can reuse again	drilled put Stainless steel Ø16mm=30cm Ø16mm=30cm used glue 50ml x 100ml
	NS12.1.4.3/2	80X38X22					
13	NS12.1.4.4/1	80x43x19	Sandstone	Step	Medium	stone broke 2 pieces and cracks, Although it broke but stone quality still can reuse.	drilled put Stainless steel Ø16mm=30cm Ø16mm=30cm used glue 50ml x100ml
	NS12.1.4.4/2	80x50x20					
14	NS12.1.4.6/1	49x37x17	Sandstone	Step	Medium	The stone state is medium and broke 3 pieces. The stone quality still reuse after treat.	drilled put Stainless steel Ø16mm=30cm Ø16mm=30cm used glue 50ml x100ml
	NS12.1.4.6/2	40x47x21					
	NS12.1.4.6/3	57x61x23					
15	NS12.1.5.9/1	70x40x19	Sandstone	Step	Medium	The stone was broke 2 pieces, cracks and the stone quality is good. According this state stone can reuse after treatment	drilled put Stainless steel Ø16mm=25cm Ø16mm=25cm used glue 50ml x 100ml
	NS12.1.5.9/2	100x64x19					
16	NS12.1.5.8/1	38x22x17	Sandstone	Step	Medium	stone slabs was broke 3 pieces and cracks, but stone quality can reuse after secured	drilled put Stainless steel Ø12mm=25cm Ø12mm=25cm used glue 40ml x 80ml
	NS12.1.5.8/2	101x61x21					
	NS12.1.5.8/3	58x28x16					
17	NS12.1.5.10/1	34x54x22	Sandstone	Step	Medium	Stone condition is medium and broke to 3 pieces. As an effect stone can reuse after treatment	drilled put Stainless steel Ø16mm=30cm Ø16mm=30cm used glue 50ml x100ml
	NS12.1.5.10/2	17x42x16					
	NS12.1.5.10/3	50x70x21					
18	NS12.1.5.4/1	83x43x22				The stone condition is medium and broke 2 pieces.	drilled put Stainless steel Ø16mm=30cm
	NS12.1.5.4/2	84x38x24	Sandstone	Step	Medium		



						As the result stone slab can reuse after treatment.	Ø16mm=30cm used glue 50ml x100ml
19	NS12.1.6.8/1	44x25x20	Sandstone	Step	Medium	Stone quality is medium and broke to 2 pieces. As the result stone can reuse after treatment	drilled put Stainless steel Ø12mm=25cm Ø12mm=25cm used glue 50ml x100ml
	NS12.1.6.8/2	47x50x20					
20	NS12.1.6.3/1	80x39x20				The stone was broke 2 pieces and the stone quality is medium. So according to that result the stone can reuse again just treatment	
	NS12.1.6.3/2	91x80x20	Sandstone	Step	Medium		drilled put Stainless steel Ø16mm=30cm Ø16mm=30cm used glue 50ml x100ml
21	NS12.1.6.2/1	75x52x21	Sandstone	Step	Medium	The stone form is medium and broke 3 pieces.the stone condition can reuse again after treatment.	drilled put Stainless steel Ø12mm=25cm Ø12mm=25cm used glue 50ml x100ml
	NS12.1.6.2/2	73x37x21					
22	NS12.1.6.1/1	50x52x20				The stone slab quality is good but broke 2 pieces. According to behaior of the stone can reuse after treatment.	
	NS12.1.6.1/2	58x62x20	Sandstone	Step	Medium		drilled put Stainless steel Ø12mm=35cm Ø12mm=35cm used glue 50ml x100ml
23	NS12.1.6.10/1	80x70x16	Sandstone	Step	Medium	Stone was broke 2 pieces and cracks at west. The stone quality is good, as the result stone can reuse after treatment	drilled put Stainless steel Ø16mm=30cm Ø16mm=30cm used glue 50ml x 100ml
	NS12.1.6.10/2	80x43x16					
24	NS12.1.6.9/1	61x47x17	Sandstone	Step	Medium	Broke 2 pieces, stone cracks and quality is good. According to this state stone can reuse after treatment	drilled put Stainless steel Ø12mm=30cm Ø12mm=30cm used glue 50ml x100ml
	NS12.1.6.9/2	63x64x17					
25	NS12.1.6.4		Sandstone	Step	Medium	Broke 2 pieces, stone cracks and quality is good. According to this state stone can reuse after treatment	drilled put Stainless steel Ø12mm=30cm Ø12mm=30cm used glue 50ml x100ml





Figure 231: Drilled hole into stone blocks, inserted stainless steel and glue to reattach fragments of stone block together



Figure 232: Lime mortar is used to fill to the joined areas of stone pieces to prevent from water infiltration

Table 17: Database of stone blocks/stone slabs treated at section 11

No	Coding stone	fragment	Type	Typology	Risk	Condition	Conservation
I. Stair step							
1	NS11.1.6.15/1	18x21x19	Sandstone	Stari step	medium	The stone was broke into 2 small pieces, although the stone condition still reuse if we restore	Drilled hold put dowels with Epoxy Sikadure 52TH Ø16mm =30cm
	NS11.1.6.15/2	20x28x19					
2	NS11.1.5.16/1	15x30x20	Sandstone	Stari step	medium	The stone was broke into 3 pieces (2bigs and 1small) and cracks at the front of stone. Conserved by durst and biology. However, the condition still reuse after treatment	Drilled hold put dowels with Epoxy Sikadure 52TH Ø14mm =35cm, Ø14mm =35cm
	NS11.1.5.16/2	27x30x20					
	NS11.1.5.16/3	40x66x28					

3	NS11.1.5.1.6/1	13X16X8	Sandstone	Stari step	medium	The stone slab was broke out in 2 small pieces, therefore stone condition still 70% so we can reuse after treatment	Cleaning and reattaching piecese with Epoxy sikadure 52TH
	NS11.1.5.1.6/2	11X27X8					
4	NS11.1.1.11/1	34X37X22	Sandstone	Stari step	medium	Stone slabs was broke out small pieces. The big fragment in good condition but small bad. So we decided to use big one	cleanin and reput big one to original place
	NS11.1.1.11/2	53X56X23					
	NS11.1.1.11/3	20X35X22					
5	NS11.1.2.8/1	60X68X21	Sandstone	Stari step	medium	stone broke 3 pieces (2bigs and 1 small), therefore stone condition good so we can reuse.	Cleaning and reattaching piecese with Epoxy sikadure 52TH
	NS11.1.2.8/2	65X26X20					
	NS11.1.2.8/3	38X24X16					
6	NS11.2.13/1	40x40x20	Sandstone	Stari step	medium	The stone was broke 4 pieces, although the stone still good condition.	Drilled hold put dowels with Epoxy Sikadure 52TH Ø14mm =45cm, Ø14mm =45cm
	NS11.2.13/2	20x17x20					
	NS11.2.13/3	20x17x20					
	NS11.2.13/4	40x38x20					
7	NS11.1.3.12/1	65x67x25	Sandstone	Stari step	medium	The stone broke 3 pieces and good condition	Drilled hold put dowels with Epoxy Sikadure 52TH Ø16mm =40cm, Ø16mm =40cm
	NS11.1.3.12/2	40x40x25					
	NS11.1.3.12/3	68x50x25					
8	NS11.1.3.9/1	27x20x18	Sandstone	Stari step	medium	The stone was broke 3 pieces. The fragment NS11.1.3.9/3 was broke out but still good condition	Drilled hold put dowels with Epoxy Sikadure 52TH Ø14mm =45cm, Ø14mm =45cm
	NS11.1.3.9/2	72x74x20					

	NS11.1.3.9/3	46x50x19					
9	NS11.1.3.14/1	66x100x24	Sandstone	Stari step	medium	The stone was broke 2 pieces but good condition	Drilled hold put dowels with Epoxy Sikadure 52TH Ø14mm =37cm, Ø14mm =37cm
	NS11.1.3.14/2	37x42x20					
10	NS11.1.4.14/1	30x20x20	Sandstone	Stari step	medium	The stone broke into 2 pieces and good condition	Drilled hold put dowels with Epoxy Sikadure 52TH Ø12mm =25cm, Ø12mm =25cm
	NS11.1.4.14/2	30x73x26					
11	NS11.1.4.13/1	60x46x23	Sandstone	Stari step	medium	The stone broke 2 pieces and good condition	Drilled hold put dowels with Epoxy Sikadure 52TH Ø16mm =45cm, Ø16mm =45cm
	NS11.1.4.13/2	60x60x23					
12	NS11.1.4.12/1	65x55x20	Sandstone	Stari step	medium	The stone broke 2 pieces and good condition	Drilled hold put dowels with Epoxy Sikadure 52TH Ø16mm =45cm, Ø16mm =45cm
	NS11.1.4.12/2	65x60x20					
13	NS11.1.4.11/1	60x87x22	Sandstone	Stari step	medium	The stone broke 2 pieces and good condition	Drilled hold put dowels with Epoxy Sikadure 52TH Ø16mm =30cm, Ø16mm =30cm
	NS11.1.4.11/2	60x40x22					
14	NS11.1.1.5/1	34x50x19	Sandstone	Stari step	medium	The stone broke 2 pieces and good condition	Drilled hold put dowels with Epoxy Sikadure 52TH Ø16mm =40cm, Ø16mm =40cm
	NS11.1.1.5/2	46x80x25					
15	NS11.1.5.9/1	53x55x22	Sandstone	Stari step	medium	The stone broke 2 pieces and good condition	Drilled hold put dowels with Epoxy Sikadure 52TH Ø16mm =40cm, Ø16mm =40cm
	NS11.1.5.9/2	56x56x22					
16	NS11.1.5.15/1	15x39x20	Sandstone	Stari step	medium	The stone was broke 3 pieces. The stone fragment(NS11.1.5.15/2)	Drilled hold put dowels with Epoxy Sikadure 52TH Ø14mm =30cm, Ø14mm =30cm
	NS11.1.5.15/2	30x30x20					

	NS11.1.5.15/3	90x67x20				was crack, but stone still good.	
17	NS11.1.5.10/1	50x60x17	Sandstone	Stari step	medium	The stone was broke 3 pieces. The stone fragments(NS11.1.5.10/1) was crack, but stone still good.	Drilled hold put dowels with Epoxy Sikadure 52TH Ø14mm =35cm, Ø14mm =35cm
	NS11.1.5.10/2	25x41x17					
	NS11.1.5.10/3	35x49x15					
18	NS11.1.6.10/1	41x47x25	Sandstone	Stari step	medium	The stone broke 2 pieces and good condition	Drilled hold put dowels with Epoxy Sikadure 52TH Ø16mm =37cm, Ø16mm =37cm
	NS11.1.6.10/2	50x60x22					
19	NS11.1.6.6/1	60x38x17	Sandstone	Stari step	medium	The stone was broke 3 pieces but good condition	Drilled hold put dowels with Epoxy Sikadure 52TH Ø12mm =40cm, Ø12mm =40cm
	NS11.1.6.6/2	18x24x8					
	NS11.1.6.6/3	64x81x22					
20	NS11.1.6.5/1	52x66x22	Sandstone	Stari step	medium	The stone broke 2 pieces and good condition	Drilled hold put dowels with Epoxy Sikadure 52TH Ø16mm =40cm, Ø16mm =40cm
	NS11.1.6.5/2	56x46x22					
21	NS11.1.5.7/1	40x19x18	Sandstone	Stari step	medium	The stone broke 4 fragments, all fragments still good condition	Drilled hold put dowels with Epoxy Sikadure 52TH Ø16mm =45cm, Ø16mm =45cm
	NS11.1.5.7/2	43x43x23					
	NS11.1.5.7/3	28x27x21					
	NS11.1.5.7/4	56x77x24					
22	NS11.1.6.7/1	50x54x26	Sandstone	Stari step	medium	The stone was broke into 2 pieces and all pieces were good condition	Drilled hold put dowels with Epoxy Sikadure 52TH Ø16mm =40cm, Ø16mm =40cm
	NS11.1.6.7/2	57x62x29					

23	NS11.1.2.5/1	44x27x19	Sandstone	Stari step	medium	The stone broke into 2 fragmentss but are good condition	Drilled hold put dowels with Epoxy Sikadure 52TH Ø12mm =35cm, Ø12mm =35cm
	NS11.1.2.5/2	43x56x18					
24	NS11.3.8/1	64x47x16	Sandstone	Stari step	medium	The stone was broke into 4pieces, but the stone quilities still good	Drilled hold put dowels with Epoxy Sikadure 52TH Ø12mm =35cm, Ø12mm =35cm
	NS11.3.8/2	25x54x16					
	NS11.3.8/3	20x20x16					
	NS11.3.8/4	30x19x16					
25	NS11.1.6//1	59x50x24	Sandstone	Stari step	medium	The stone was broke into 2 pieces and all pieces were good condition	Drilled hold put dowels with Epoxy Sikadure 52TH Ø16mm =40cm, Ø16mm =40cm
	NS11.1.6//2	60x36x24					
26	NS11.1.3.7/1	76X64X20	Sandstone	Stari step	medium	The stone was broke 3 pieces. The small one is serious damage others still good condition	Drilled hold put dowels with Epoxy Sikadure 52TH Ø16mm =30cm, Ø14mm =36cm
	NS11.1.3.7/2	76X34X20					
	NS11.1.3.7/3	36X29X20					
27	NS11.1.7.7/1	48x50x19	Sandstone	Stari step	medium	The sandstone has broken into two pieces. The sandstone is in good condition and can be reused after treatment.	Drilled hold put dowels with Epoxy Sikadure 52TH Ø16mm =40cm, Ø12mm =40cm
	NS11.1.7.7/2	46x50x19					
28	NS11.1.3.2/1	20x26x17	Sandstone	Stari step	medium	The sandstone has broken into two pieces. The sandstone is in good condition and can be reused after treatment.	Drilled hold put dowels with Epoxy Sikadure 52TH Ø12mm =30cm, Ø12mm =30cm
	NS11.1.3.2/2	18x54x14					
II. West Staircase wall							

1	NS11.W.1.10		sandstone	West wall	Medium	The stone broken into 2 pieces , but stone qualitied is good	Drilled hold put dowels with Epoxy Sikadure 52TH Ø12mm =38cm
2	NS11.W.1.12		sandstone	West wall	Medium	The stone broken into 2 pieces , but stone qualitied is good	Drilled hold put dowels with Epoxy Sikadure 52TH Ø12mm =25cm
3	NS11.W.2.1		sandstone	West wall	Medium	The stone broken into 2 pieces , but stone qualitied is good	Re-attacked with Epoxy glue
4	NS11.W.2.2		sandstone	West wall	Medium	The stone broken into 2 pieces , but stone qualitied is good	Re-attacked with Epoxy glue
5	NS11.W.4.1		sandstone	West wall	Medium	The stone broken into small pieces, but the stone condition good	Re-attacked with Epoxy glue
6	NS11.w.4.2		sandstone	West wall	Medium	The stone broken into small pieces, but the stone condition good	Re-attacked with Epoxy glue
7	NS11.w.4.5		sandstone	West wall	Medium	The stone broken into small pieces, but the stone condition good	Re-attacked with Epoxy glue
8	NS11.W.4.6		sandstone	West wall	Medium	The stone broken into small pieces, but the stone condition good	Re-attacked with Epoxy glue
9	NS11.W.5.4		sandstone	West wall	Medium	The stone broken into 3 pieces. The stone quality is still strong	Re-attacked with Epoxy glue
10	NS11.W.6.4		sandstone	West wall	Medium	The stone broken into small pieces, but the stone condition good	Re-attacked with Epoxy glue
11	NS11.W.6.5		sandstone	West wall	Medium	The stone broken into 3 pieces. The stone quality is still strong	Re-attacked with Epoxy glue
12	NS11.W.6.9		sandstone	West wall	Medium	The stone broken into small pieces, but the stone condition good	Re-attacked with Epoxy glue

III. East staircase wall							
1	NS11.E.1.2		sandstone	East wall	Medium	The stone was broken into 4 pieces, however the stone still good	Drilled hold put dowels with Epoxy Sikadure 52TH Ø12mm =30cm, Ø12mm =35cm Ø12mm =40cm, Ø14mm =42cm
2	NS11.E1.4		sandstone	East wall	Medium	The stone broken into 2 pieces , but stone qualitied good	Drilled hold put dowels with Epoxy Sikadure 52TH Ø16mm =50cm, Ø12mm =50cm
3	NS11.E.1.6		sandstone	East wall	Medium	The stone broken into 2 pieces , but stone qualitied is good	Drilled hold put dowels with Epoxy Sikadure 52TH Ø12mm =35cm, Ø12mm =35cm
4	NS11.E.1.7		sandstone	East wall	Medium	The stone broken into 3 pieces. Therefore stone can used after treatment	Drilled hold put dowels with Epoxy Sikadure 52TH Ø12mm =30cm, Ø12mm =30cm Ø12mm =27cm, Ø14mm =24cm Ø14mm =24cm
5	NS11.E.2.2		sandstone	East wall	Medium	The stone broken into 2 pieces , but stone qualitied good	Drilled hold put dowels with Epoxy Sikadure 52TH Ø12mm =40cm, Ø12mm =40cm
6	NS11.E.2.6		sandstone	East wall	Medium	The stone broken into 2 pieces , but stone qualitied good	Drilled hold put dowels with Epoxy Sikadure 52TH Ø12mm =25cm, Ø12mm =25cm Ø12mm =25cm
7	NS11.E.2.8		sandstone	East wall	Medium	The stone broken into 2 pieces , but stone qualitied good	Drilled hold put dowels with Epoxy Sikadure 52TH Ø12mm =21cm, Ø12mm =21cm
8	NS11.E.3.5		sandstone	East wall	Medium	The stone broken into small 3 pieces	Re-attacked with Epoxy glue

9	NS11.E.3.7		sandstone	East wall	Medium	The sandstone was broken into three large and small pieces. However, the quality of the sandstone was still good and could be reused.	Drilled hold put dowels with Epoxy Sikadure 52TH Ø14mm =34cm, Ø14mm =34cm
10	NS11.E.3.11		sandstone	East wall	Medium	The stone was broke into two pieces, but the quality of the sandstone is still good and can be reused after treatment.	Drilled hold put dowels with Epoxy Sikadure 52TH Ø16mm =50cm, Ø16mm =50cm
11	NS11.E.3.14		sandstone	East wall	Medium	The sandstone was broken into three large and small pieces. However, the quality of the sandstone was still good and could be reused.	Drilled hold put dowels with Epoxy Sikadure 52TH Ø16mm =40cm, Ø16mm =40cm
12	NS11.E.3.15		sandstone	East wall	Medium	The sandstone was broken into three small pieces and crack. However, the quality of the sandstone was still good and could be reused.	Drilled hold put dowels with Epoxy Sikadure 52TH Ø16mm =42cm, Ø16mm =42cm Ø6mm =26cm
13	NS11.E.4.2		sandstone	East wall	Medium	The stone was broken 2 pieces and all pieces all good in shape	Drilled hold put dowels with Epoxy Sikadure 52TH Ø12mm =32cm
14	NS11.E.4.5		sandstone	East wall	Medium	The stone was broken 2 pieces and all pieces all good in shape	Re-attacked with Epoxy glue
15	NS11.E.4.9		sandstone	East wall	Medium	The stone was broken 2 pieces and all pieces all good in shape	Drilled hold put dowels with Epoxy Sikadure 52TH Ø12mm =32cm

Annex 11: Exchange visit

March 04-05, 2023: the activities of exchange visits to Kampong stone workshop in Kampong Thom province



Figure 233: Splitting stone technique



Figure 234: Carving and smoothing sandstone applying small chisel



Figure 235: Technique to apply Mous tool to split sandstone



Figure 236: Equipment used to split sandstone

March 21-23: Exchange visit to conservation and restoration sites at Angkor, Koh Ker and Preah Vihear heritage sites

Angkor site



Figure 237: Restoration site at the western gate of Banteay Kdei temple



Figure 238: Restoration project of the Tenle Sanguot project

Koh Ker site



Figure 239: Visiting restoration site of Linga 3 temple



Figure 240: Visting restoration site at Krachap temple

Preah Vihear site



Figure 241: Restoration project of the northern ancient staircase



Figure 242: Restoration project at causeway between Gopura 2 and Gopura 3

April 23-27, 2023: Exchange visit to conservation and restoration sites and museum

National Museum of Phnom Penh





Figure 243: Visit the National Museum of Phnom Penh to learn about history and art design

Takeo province: Conservation and restoration sites



Figure 244: Rail for stone transport at conservation and restoration site of Phnom Da temple



Figure 245: Conservation and restoration site of brick-built temples at Phnom Chi So temple

Kampong Thom province: Conservation and restoration sites at Sambo Prei Kok heritage site



Figure 246: Excavation trench at Prasat Toa Pir



Figure 247: Conservation and restoration site at Prasat Yeay Poan temple

Siem Reap province: Conservation and restoration sites at Angkor



Figure 248: Restoration site of west Mebon temple



Figure 249: Restoration site of Chao Srei Vibol temple

August 06-10, 2024: Exchange visit to pre-historic site, monastery, and restoration sites in Battambang, Banteay Meanchey and Uddar Meanchey provinces

August, 06, 2024





Figure 250: Visit Battambang museum to learn about history, ancient art objects, collection

August 07, 2024




Figure 251: Visit Wat Poveal to learn about ancient art object, and collection




Figure 252: Visit Boset temple learn about conservation and restoration method of temple tower




Figure 253: Visit Ek Phnom temple to learn about conservation and restoration method

August 08, 2024



Figure 254: Visit pre-historic site of Laang Spean and archaeological excavation trench



Figure 255: Visit East and west Stoeng temples to learn about history, architectural structure, and factors damaging the temples



Figure 256: Visit Banon temple to learn about history, temple structure, intervention method of temple structure, and restoration technique of stairway of the temple

August 09, 2024





Figure 257: Visit Banteay Meanchey museum to learn about collection, history, and ceramic conservation





Figure 258: Visit Banteay Toap to study of temple structure, damage factors, and intervention





Figure 259: Visit Banteay Chhmar to study of temple structure, damage factors and restoration




Figure 260: Visit Mebon temple of Banteay Chhmar to study of temple structure and restoration technique of temple structure

August 10, 2024




Figure 261: Visit Tamoan temple to study its architectural structure

Annex 12: Outreach program

May 22, 2023

Table 18: Outreach program

No	Time	Description
1	7:30-8:00	Teacher and students depart by cars from Khemra Techo high school to conservation building of the northern staircase, Preah Vihear temple.
2	8:00-8:05	Register at the conservation building
3	8:05-8:20	Dr. Ea Darith, department director of conservation and archaeology (DCA) and project manager, welcomes participants and delivers presentation on history of Preah Vihear temple, conservation work of NAPV, conservation and restoration project of the northern ancient staircase
4	8:20-8:35	Break (15 minutes)
5	8:35-8:50	Mr. Ul Sam An, archaeologist of DCA, and archaeological specialist of the project, delivers presentation on archaeological survey at the northern ancient staircase and Preah Vihear temple
6	8:50-9:05	Nob Vansith, architectural staff of DCA, and Architectural specialist of the project, delivers presentation on architectural survey and documentation of architectural plan for supporting conservation and restoration work of the northern staircase
7	9:05-9:15	Break (15 minutes)
8	9:15-9:45	Mr. Chheang Sovanna, deputy department director and Chheurn Vet, stone conservationist, and IT specialist of the project, delivers presentation on survey and documentation method of lion sculpture at the northern ancient staircase.
9	9:45-10:00	Thim Mengly, engineering staff of DCA and engineering specialist of the project, deliver presentation on research method and documentation pertaining to ancient drainage system and restoration method of ancient drainage system and staircase foundation.
10	10:00-12:00	Divide participants into two groups for discussion and answering to general question of the temple of Preah Vihear and NAPV's mandate
11	12:00-12:30	Lunch break
12	12:30-2:30	Students visit the restoration site and listen to the project staff, explaining conservation and restoration technique of the northern staircase
13	2:30-2:55	Interview expression of the project manager, teachers, and students about outreach program pertaining to the conservation and restoration project of the northern ancient staircase of Preah Vihear temple.
14	2:55-3:00	Group photos at the northern staircase (05 minutes)
15	3:00-4:30	Visit Preah Vihear temple from Gopura 5 to Gopura 1, guided by Dr. Ea Darith
16	4:30-5:00	Teachers and students return back to school

Outreach Activities




Figure 262: Lecture the history and restoration activities of the northern staircase




Figure 263: Group discussion to questions and answer



Figure 264: Onsite visit to the restoration site to learn about conservation and restoration method of the northern ancient staircase



Figure 265: Group photo

December 15, 2023

Table 19: attendant list

ព្រះរាជាណាចក្រកម្ពុជា

ជាតិ សាសនា ព្រះមហាក្សត្រ

ការិយាល័យ អប់រំ យុវជន និងកីឡានៃរដ្ឋបាល

ស្រុកជាំក្សាន្ត

វិទ្យាល័យ ស្រអែម

បញ្ជីឈ្មោះសិស្សឡើងភ្នំប្រាសាទព្រះខហារនៅថ្ងៃទី ១៥.១២.២០២៣

ល.រ	គោត្តនាម-នាម	ភេទ	ថ្នាក់ទី	ផ្សេងៗ
១	កាន កាយ	ស	11 B	
២	សុខ រក្សា	ស	11 B	
៣	តាង បរមី	ស	11 B	
៤	ឆាយ នីតា	ស	11 B	
៥	ង៉ាំង ប៊ុនពេជ្រ	ប	11 B	
៦	សឿន ដេវីតសាប៊ូស	ប	11 B	
៧	អោក ឡៃអេង	ស	11 B	
៨	វ៉ែន សុវណ្ណា	ស	11A	
៩	សំណាង កលិកា	ស	11A	
១០	សាយ សីហា	ប	12 B	
១១	បុស ឆាយ	ប	12 B	
១២	ពេជ្រ មករា	ស	12B	
១៣	ឃឿន ប៊ុនធឿន	ប	12 B	
១៤	ហាន លីជីង	ប	12 B	
១៥	ស៊ី សៀវឡេង	ប	12 B	
១៦	សិន សុខណា	ស	12 B	
១៧	សុខុម មករា	ស	12 B	
១៨	វ៉ាត ម៉ីម៉ី	ស	12 B	
១៩	ហឿន សេងហួ	ប	12 B	
២០	លឹម រស្មី	ស	12 B	

សរុប:២០នាក់ ស្រី១២នាក់

ថ្ងៃព្រហស្បតិ៍ ២កើត ខែមិគសិរ ឆ្នាំថោះ បញ្ចស័ក ព.ស.២៥៦៧

វិទ្យាល័យ ស្រអែម ថ្ងៃទី ១៤ ខែធ្នូ ឆ្នាំ២០២៣

គ្រូជីកនាំ

ស៊ឹម សុខលីម

កែម ប៊ុនឡាយ

អានយើញ និង ឯកភាព

នាយកសាលា

ហ៊ឹម យ៉ង្គ

Table 20: Outreach program

No.	Time	Description
1	7:00 -8:00am	Students and lecturer traveled from Sra Em to northern ancient staircase, Preah Vihear temple
2	8:00 -8:05am	Record the presence of lecturers and students
3	8:05 -8:20am	Welcome speech by Mr. Chheang Sovanna, Deputy Director, Department of Conservation and Archaeology, NAPV about history of the site and conservation and restoration of northern ancient staircase (15mn)
4	8:20 -8:35am	Archaeological excavations by Ol Sam An, archaeologist from Department of Conservation and Archaeology (15mn)
5	8:35 -8:50am	Architectural documentation by Nob Vanseth, architect, Department of Conservation and Archaeology (15mn)
6	8:50 -9:05am	Break (15mn)

Outreach activities



Figure 269: Presentation about the history and conservation and restoration of the northern ancient staircase



Figure 270: Site visit about conservation and restoration



Figure 271: Stone restoration



Figure 272: Visiting architecture at Preah Vihear temple

August 29, 2024

Table 21: Outreach program

No	Time	Description
1	7:30-8:00	Teacher and students depart by cars from Sra Em high school to conservation building of the northern staircase, Preah Vihear temple.
2	8:00-8:05	Register at the conservation building
3	8:05-8:20	Mr. Chheang Sovanna, deputy department director of conservation and archaeology (DCA) and project's stone specialist, welcomes participants and delivers presentation on history of Preah Vihear temple, conservation work of NAPV, conservation and restoration project of the northern ancient staircase
4	8:20-8:35	Mr. Ul Sam An, archaeologist of DCA, and archaeological specialist of the project, delivers presentation on archaeological survey at the northern ancient staircase and Preah Vihear temple
5	8:35-8:50	Nob Vansith, architectural staff of DCA, and Architectural specialist of the project, delivers presentation on architectural survey and documentation of architectural plan for supporting conservation and restoration work of the northern staircase
6	8:50-9:05	Break (15 minutes)
7	9:05-9:15	Chheurn Vet, stone conservationist, and IT specialist of the project, delivers presentation on survey and documentation method of lion sculpture at the northern ancient staircase.
8	9:20-9:35	Thim Mengly, engineering staff of DCA and engineering specialist of the project, deliver presentation on research method and documentation pertaining to ancient drainage system and restoration method of ancient drainage system and staircase foundation.
9	9:35-10:05	Divide participants into two groups for discussion and answering to general question of the temple of Preah Vihear and NAPV's mandate
10	10:05-11:30	Lunch break
12	11:30-1:00	Students visit the restoration site and listen to the project staff, explaining conservation and restoration technique of the northern staircase
13	1:00-1:30	Interview expression of Mr. Chheang Sovanna, teachers, and students about outreach program pertaining to the conservation and restoration project of the northern ancient staircase of Preah Vihear temple.
14	1:30-1:45	Group photos at the northern ancient staircase (05 minutes)
15	1:45-3:30	Visit Preah Vihear temple from Gopura 5 to Gopura 1, guided by Mr. Chheang Sovanna
16	4:30-5:00	Teachers and students return back to school

Outreach activities





Figure 273: Lecture about history and restoration method of the northern ancient staircase



Figure 274: Group discussion to questions



Figure 275: Onsite visit at the restoration site



Figure 276: Learn about restoration method of the northern ancient staircase



Figure 277: Group photo at section 7

November 22, 2024

Table 22: Outreach Program

No	Date	Activities
1	7:00-8:00	Teachers and students gathered and traveled by two cars from Phnom Chhat Senchey secondary school towards the northern ancient staircase, Preah Vihear temple
2	8:00-8:05	Gathering and attending the teachers and students at the office near northern ancient staircase
3	8:05-8:20	Welcome and presentation on the history of the temple, the conservation and restoration work of the north ancient staircase by Mr. Chang Sovanna
4	8:20-8:35	Presentation on archaeological research at the north ancient staircase by Mr. Ol Saman, Archaeologist
5	8:35-8:50	Presentation on architectural documents for the conservation and restoration work by Mr. Nob Van Sit, Architect
6	8:50-9:05	**Break (15 minutes)**
7	9:05-9:20	Presentation on restoration of the lion sculptures by Mr. Chhoeurn Vet, Stone Conservation
8	9:20-9:35	Presentation on the restoration of ancient drainage system and ancient staircase foundation by Mr. Thim Meng Ly, Engineer
9	9:35-10:05	Divide the discussion group and answer questions related to general knowledge about temples and NAPV
10	10:05-11:30	**Lunch Break**
11	11:30-13:00	Students visit the office and listen to the presentations of technical staffs of each specialty about the conservation and restoration work of north ancient staircase.
12	13:00-13:30	Interview with the impression of the project manager, teachers, and students who attended the outreach program
13	13:30-13:45	Group photo at the north ancient staircase
14	13:45-15:30	The student visit the Preah Vihear temple from Gopura 5 to Gopura 1, guided by Mr. Cheang Sovanna
15	15:30-16:15	The teacher and students returned to the Phnom Chhat Senchey secondary school

Outreach activities



Figure 278: Presentation of the conservation and restoration work of the northern ancient staircase to local students



Figure 279: Q&A and discussion on the conservation and restoration of the northern ancient staircase



Figure 280: Learning about the techniques of conservation and restoration of staircase



Figure 281: Group photo with students

Annex 13: Training program for students from Royal University of Fine Arts

August 13-27, 2023

Table 23: Training program of 15 days (August 13-27, 2023) to Students from RUFA

Schedule	Activities	Location	Lecturers
13-Aug-2023	Departure from Phnom Penh and welcome to Sra Em, Preah Vihear	Piseth Pich Hotel	Ea Darith
14-Aug-2023 (Department of Conservation and Archaeology)			
14-Aug-2023	Lecture in general on the AFCP project to conserve and restore northern staircase	NAPV Hall	Thim Mengly
9:00-10:00 10:00-11:00	Lectures on archaeological research and ancient water management		Ol Sam An Thim Mengly
11:00-13:00 Lunch break			
13:00-15:00	Compilation of architectural documents	NAPV Hall	Nob Vanseth
15:00-16:00	- Lecture on conservation and restoration of lion and documentation - Division of team work		Chheang Sovanna Chhoeurn Vet
	Dinner	NAPV	
15-18 Aug 2023, training program at northern staircase			
15-Aug-2023	- Study the ancient drainage system - Compilation of documents for restoration of drainage system	Staircase, section 14	Nob Vanseth Thim Mengly
	- Study location and method of excavation	Staircase, section 12	Ol Sam An
16-Aug-2023	- Study on method of survey of northern staircase	Staircase, section 12	Nob Vanseth
	- Archaeological study on the foundation of staircase	Staircase, section 14	Ol Sam An Thim Mengly
17-Aug-2023	- Surveyed the plan of northern staircase	Staircase, sections 11 &12	Nob Vanseth
	- Studied how to restored stones and lion sculpture - Archaeological excavation	Staircase, sections 12-14	Chhoeurn Vet Ol Sam An
18-Aug-2023	- How to transfer drawing plans from hard copy to soft copy in computer and store documents	Staircase, sections 11-12	Nob Vanseth Chhoeurn Vet
	- Restore stones and lion sculpture - Archaeological excavation	Staircase, sections 12-14	Chhoeurn Vet Ol Sam An
19-20-Aug-2023: Office work and storing documents			

21-25-Aug-2023	- Studied on how to restore stones from staircase - Studied how to reinforce the foundation and staircase - Transferred architectural plans to computer and prepared report	Staircase, sections 11-14	All technical team
26-Aug-2023 8:30-11:00 am	- Presentation of results of training program on conservation and restoration of northern ancient staircase by students - Closed the program	NAPV Hall	Students
27-Aug-2023	Departure Sra Em	Phnom Penh	5 students

Activities of the training program from 14 to 26 August 2023



Figure 282: Presentation of AFCP on conservation and restoration of northern staircase



Figure 283: Study on stone inventory



Figure 284: Study on recoding level of stones



Figure 285: Study on excavation at northern staircase



Figure 286: Drawing architectural plan of staircase



Figure 287: DCP Test the foundation of staircase

August 12, 2024

Table24: Training program of 15 days (August 11-24, 2024) to Students from RUFA

Time	Description	Destination	Facilitator/speaker
11-Aug-2024	Departure from Phnom Penh and welcome to Sra Em, Preah Vihear	Sra Em	
12-Aug-2024 8:30-9::00	– Reception – Lecture about conservation and restoration of the northern ancient staircase, general knowledge of conservation and restoration of cultural building (law, convention, case study, etc..)	Northern staircase of Preah Vihear temple	- Excellency KONG Puthikar - Mr. Phin Samnang
9:00-10:00 10:00-11:00	– Lecture about archaeological survey and ancient drainage system	Northern staircase of Preah Vihear temple	Mr. Ol Sam An Mr. Thim Mengly
11:00-14:00 Lunch break			
14:00-15:00	– Lecture about case study and methodology in architectural documentation	Northern staircase of Preah Vihear temple	Nob Vanseth
15:00-16:00	– Lecture about conservation and restoration method of lion sculptures, stone and documentation	Northern staircase of Preah Vihear temple	Chheang Sovanna Chhoeurn Vet
16:00-20:00	Break – dinner reception	NAPV compound	
13-Aug-2024 Practice at the northern ancient staircase of Preah Vihear temple			

130-Aug-2024	– Method to define location for archaeological excavation and excavation activities	Section 11, northern staircase	Ol Sam An
	– Study of ancient drainage system – Study of documentation for restoration of northern ancient staircase	Sections 11 and 12 northern staircase	Nob Vanseth Thim Mengly
14-08-2024	– Plan survey of the northern ancient staircase	Sections 11 and 12 northern staircase	Nob Vanseth
	– Archaeological survey and foundation reinforcement of the northern ancient staircase	Sections 11 and 12 northern staircase	Ol Sam An Thim Mengly
15-08-2024	– Plan survey of the northern staircase	Sections 11 and 12 northern staircase	Nob Vanseth
	– Archaeological excavation	Sections 11 and 12 northern staircase	Ol Sam An
16-Aug-2024	– Archaeological excavation	Sections 11 and 12 northern staircase	Ol Sam An
	– Plan survey of the northern staircase	Sections 11 and 12 northern staircase	Nob Vanseth
17-18-Aug-2024 – Break Saturday and Sunday			
19-22 Aug-2024	– Study of restoration of the ancient staircase – Study of method in conservation of lion sculpture – Study of restoration of foundation and staircase structure – Study of layers of staircase foundation – Data collection and data entry into computer and report preparation	Sections 11, 12, 13 and 14, northern staircase	Chhoeurn Veth Thim Mengly Nob Vanseth Ol Sam An
23-Aug-2024 8:30-11:00	– Presentation of the result of training program and discussion about conservation and restoration methodology of the northern staircase and closing	Headquarter of NAPV	- Project team of the northern staircase - Students
24-Aug-2024	– Departure to Phnom Penh	Phnom Penh	Students

Activities of the training program from 11 to 24 August 2024




Figure 288: Provide lecture to students about conservation and restoration of the northern ancient

August 13, 2024




Figure 289: Study and practice of the use of Level equipment

August 14, 2024




Figure 290: Practice of plan survey method of stone block elevation and grid on section 9

August 15, 2024





Figure 291: Method of plan survey of stone slabs at archaeological trench and numbering technique of stone slabs

August 16, 2024





Figure 292: Archaeological excavation on stair step of section 10 and coloring on plan to categorize rock typology of stone slabs

August 19, 2024





Figure 293: Drawing archaeological trench after excavation and plan survey of section 14 after restoration was completed

August 20, 2024




Figure 294: Study of archaeological trench at Preah Vihear temple, and practice stone conservation method

August 21, 2024




Figure 295: Practice to drill into stone fragment and test bearing capacity of the foundation after the foundation was restored

August 22, 2024




Figure 296: Documenting and making presentation at the office

August 23, 2024



Figure 297: Delivering presentation to NAPV staff about the result attaining from the trainings in both theory and practice