



The End of Angkor?

**The Modification and Re-use of
Angkor Wat**

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For my parents

Abstract

Angkor Wat, the largest religious monument in the world, was built in the mid 12th century AD and has been continuously occupied ever since. Angkor Wat was the jewel in the crown of Greater Angkor, the capital of the Khmer Empire. Over 800 years have passed since its construction and during this long period the context of Angkor Wat and Greater Angkor has changed significantly. Once the capital of the Khmer Empire, in the 15th and 16th centuries as the apparatus of the state moved to the Southeast, Greater Angkor came to be on the periphery of the Khmer world. In a similar manner, as Khmer society changed, the originally Vaisnavite temple Angkor Wat came to be hallowed by Theravada Buddhist monks. Throughout these political and social changes Angkor Wat itself has changed – the temple features modifications which postdate the original construction phase. The fourth enclosure wall is one such component which has undergone several modifications. The wall, which clearly demonstrates more than one construction phase, is covered in several thousand postholes. The postholes, which are located along the upper part of the inside face and on top of the wall, have never been studied before. This thesis seeks to answer two questions: 1) What was the purpose of the postholes?, and 2) When were the postholes made? To answer these questions the postholes were surveyed. The results of a detailed survey show that the distribution of and relationship between the postholes is consistent over a considerable distance. The relationship between the postholes and the construction phases of the wall establishes a relative chronology. The nature of the modifications to the wall and the location of the postholes indicate that they were supports for the framework of a defensive platform and palisade. The absolute date of these defensive works is as yet unknown, however the likely historical context suggests they were installed sometime between the late 16th century and the early 17th century AD.

Statement of Authorship

The research described in this thesis, except where referenced, is the original work of the author and was a discrete project supervised by Prof. Roland Fletcher. This thesis contains no material published elsewhere or extracted in whole or in part from a thesis presented by me for another degree or diploma. This thesis has not been submitted for the award of any other degree or diploma in any other tertiary institution. No other person's work has been used without due acknowledgement in the main text of the thesis.

David Brotherson

2011

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1. Angkor Wat – A Monumental Puzzle

Angkor Wat is one of the most famous heritage icons on the planet and is undoubtedly the most famous landmark of the kingdom of Cambodia (Figure 1.1). Currently the monument attracts more than one million visitors every year (Say 2011). The towers of Angkor Wat have been featured on the Cambodian flag since the era of the French Protectorate and have come to symbolise the country itself. Nevertheless, Angkor Wat is but one temple in the urban complex we now know as Greater Angkor. As the most extensive city of the pre-industrial world, this vast low density urban settlement covered an area of about 1000 km² (Figure 1.2). Once the capital of an empire which encompassed much of mainland Southeast Asia the ruins of this city, which had been reclaimed by the jungle to a large extent in the 17th and 18th centuries, present Greater Angkor as a classic example of demise and collapse (Fletcher 2000-1; Buckley et al. 2010).

Developing from smaller polities in the 7th century AD, the Khmer Empire was founded at the start of the 9th century and reached its zenith between the 11th and 13th centuries after which it entered a period of decline. Strife with neighbouring kingdoms, a regional shift in the importance of trade and a severely fluctuating monsoonal climate all contributed to the demise of the Angkorian state. The demise of the urban complex, the capital of the Khmer Empire Angkor, is a phenomenon which is only just beginning to be understood in terms of the archaeological record. For many years the historical record was taken at face value and read to mean that Ayutthaya sacked Angkor in 1431 AD and the city was abandoned only to be briefly reoccupied in the late 16th century. These records, the chronicles of Thailand and Cambodia, are often internally inconsistent, and the chronicles of Cambodia are filled with fabulous events, fictitious reigns and legends (Vickery 1977: 3; Vickery 2010: 273). In addition the texts were interpreted according to the assumptions of European historians in the late 19th century and early 20th, especially the use of a nationalistic viewpoint which saw history as a contest between nations rather than between feudal states. Whatever the interpretation, by the 17th century the centre of the Khmer world had shifted permanently from Angkor to the Phnom Penh region. The abandonment of the capital has too often been considered a wholesale affair, and yet this was not the case. For one, Angkor Wat

itself was never abandoned. During the Middle Period, conventionally dated 1431 – 1863 AD (also known as the post-Angkorian period), Theravada Buddhist monks hallowed the once Hindu temple after that religion had faded from Khmer society. Other Angkorian temples such as Wat Athvea, like Angkor Wat, also became the residence of Theravada Buddhist monks, while others – the Baphuon and the Bakheng – underwent major modifications during the late Angkorian and early Middle Period. Angkor Wat and Wat Athvea are the location of the majority of Middle Period inscriptions in Cambodia (Ewington 2008: Appendix 2, 152). The inscriptions quite often contradict the claims of the above mentioned chronicles (Vickery 1977: 3) and there is almost a complete historical blank spot between the 14th and 16th centuries.

While large tracts of Greater Angkor were left eventually to the encroaching jungle, Angkor Wat and other sections were not: the history of Greater Angkor and Angkor Wat is therefore divergent and problematic. In spite of the attention from scholars and tourists alike, Angkor Wat still presents us with many questions. What was the temple's function? How did people interact with the monument? Which people were even allowed to do so? These questions have typically been asked of the Angkorian period, specifically during the 12th century when the temple was built and then into the 13th century when the Khmer Empire was at its height. However, despite the attention, these enquiries have only recently broadened in scope. In 2010 research carried out by Sonnemann with the Greater Angkor Project (GAP) using ground penetrating radar (GPR) located a previously unknown Angkorian temple which was situated within the outermost fourth enclosure of Angkor Wat (Sonnemann accepted). The excavation carried out by O'Reilly and Stark uncovered the remains of a small temple which was partially covered by the West gopura and the main causeway. Only the lowest levels of the temple's foundations remained. This temple, which was situated on the main axis and aligned perfectly with existing parts of Angkor Wat, was completely removed before the outermost wall and *gopura* (gateway) were built over it (Figure 1.3). It appears to represent part of the temple's early history, dating to the first half of the 12th century, and its use and function are currently unknown.



Figure 1.1 Angkor Wat, facing West (Dago 2010)

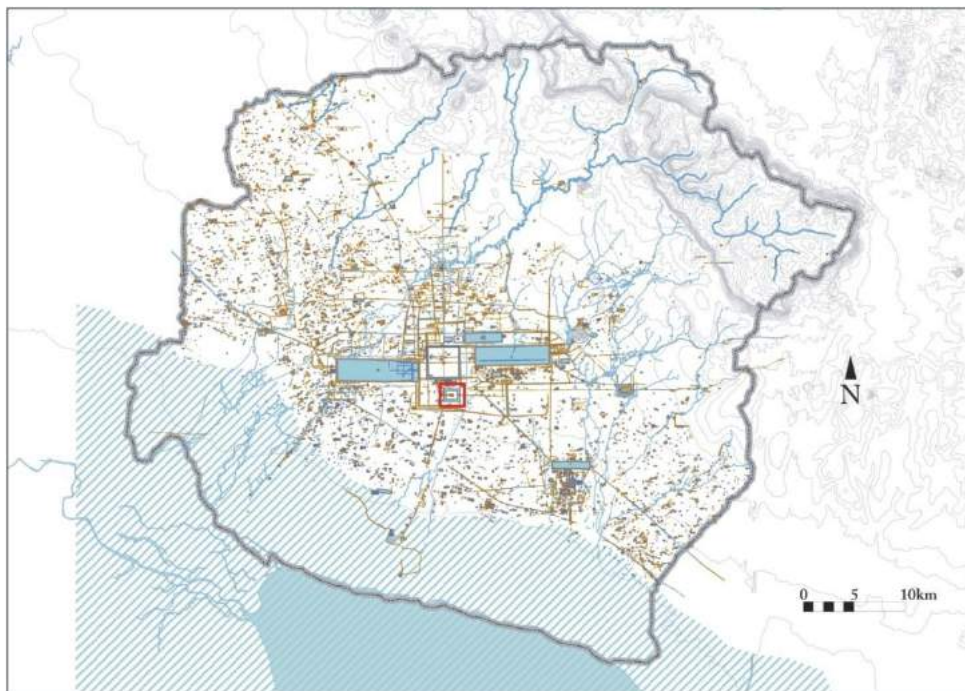


Figure 1.2 - Location of Angkor Wat (red) amidst Greater Angkor (after GAP/Evans 2007)

Over 800 years have passed since that time, of which the subsequent Angkorian period makes up only a fraction. The use, occupation and history of Angkor Wat during the Middle Period present us with just as many questions. Angkor Wat has been modified and repaired numerous times throughout its later history including the remodelling of the central shrine and the repair of the Western causeway. Other such traces of the later use of Angkor Wat include postholes which frame the windows of the inner enclosures (Figure 1.4). The

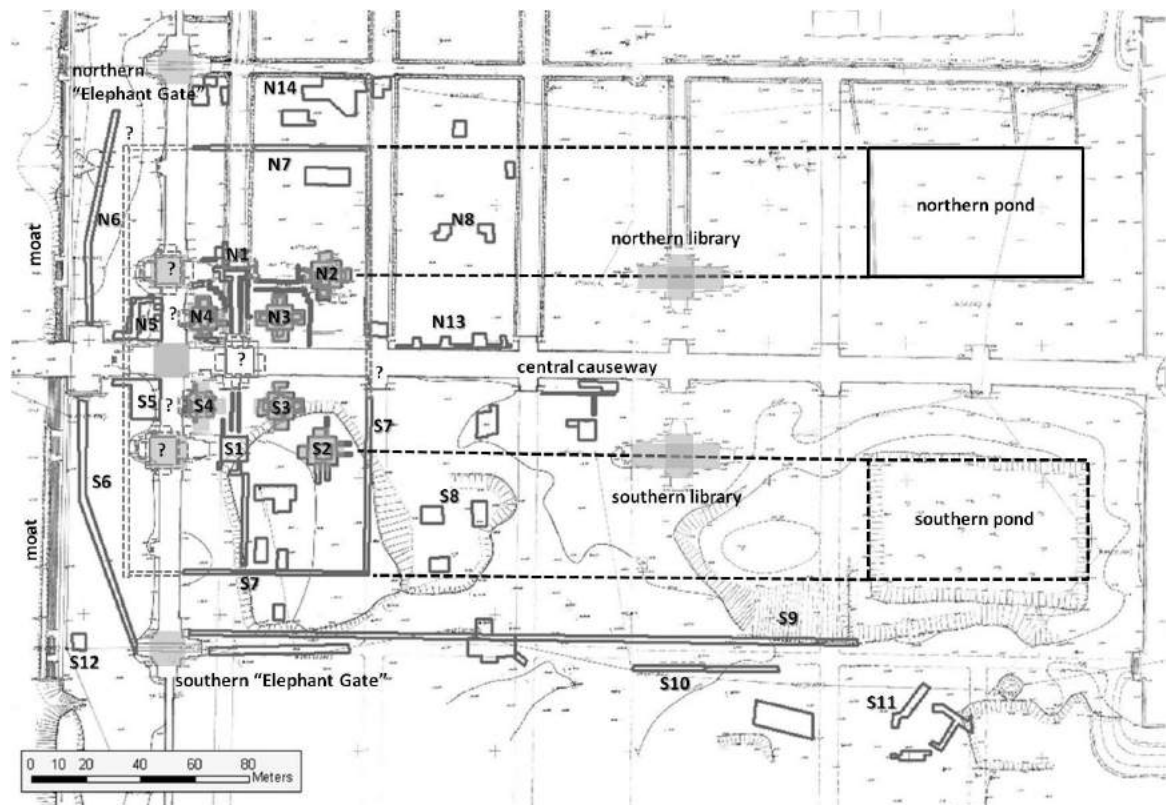
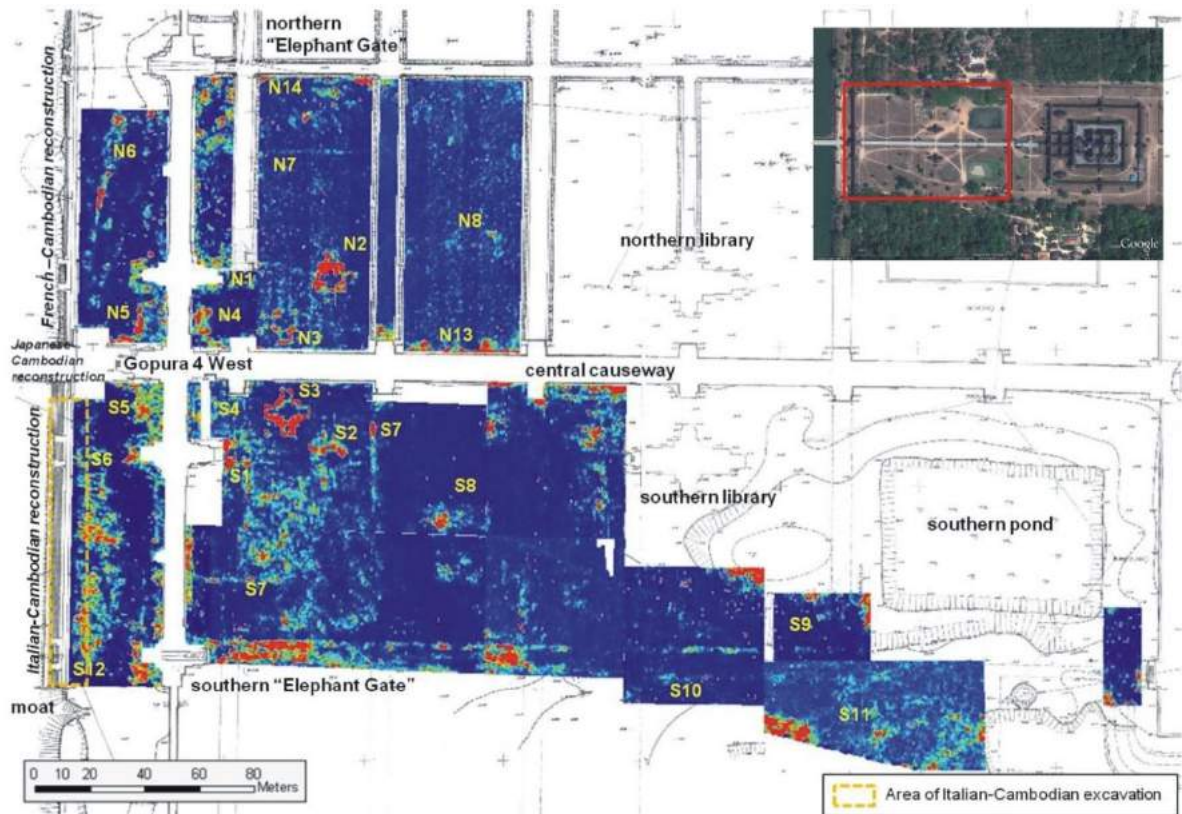


Figure 1.3 - Results of GPR survey (above) showing location (inset), and the alignment of the demolished structures with existing features (below) (Sonnemann 2011).

postholes interrupt the decorative patterning so it is argued they substantially postdate it. Because these postholes are only associated with real windows – the false ones do not feature them – they may in fact be traces of shutters which were used to regulate the available light. The durability of stone presents us with an interpretive dilemma. It is clear that the temples employed a vast amount of timber in the construction of ceilings, doors and other elements which have not survived. Postholes are often the only trace of the use of timber in these buildings. The fourth enclosure wall is covered in several thousand postholes. These are the subject of this thesis.



Figure 1.4 - Postholes on the outside of the central enclosure of Angkor Wat - Note how they interrupt the decorative pattern

The Problem – The Postholes

Angkor Wat has stimulated much research into its origin and function and yet some aspects of the structure have been relatively little considered. This thesis examines one such body of evidence, the temple's outermost fourth enclosure wall. In this enclosure wall there are thousands of postholes of various shapes and sizes. The postholes are found on the upper

part of the inside face (horizontal holes), and on the top of the wall (vertical holes) (Figure 1.5). While these features have no doubt been observed by EFEO conservators, until now – to my knowledge – they have been left unrecorded. As there is no established theory to challenge with regard to these postholes' function and date, this thesis seeks to fill this lacuna by seeking to answer two questions:

1. What was the purpose of the postholes?
2. When were the postholes made?



Figure 1.5 – Postholes in the fourth enclosure wall: horizontal on the inside face (above) and vertical on top (below)

Misconceptions

The history of Angkor is subject to debate and is prone to misconceptions. One such common set of misconceptions about the abandonment of the urban complex is the overall theme of this thesis. This dissertation is by no means the first to deal with this issue as the last thirty years of archaeological research has compiled an ever-growing body of evidence which indicates some continuity of occupation especially in the area South of the old centre of Angkor, along the Siem Reap river. Certainly, the population of the region of Greater Angkor decreased significantly during the later Angkorian period and especially in the Middle Period. This thesis demands a re-appraisal of the history of Angkor Wat as it demonstrates that a large-scale highly systematic programme of modifications was undertaken at some time after the peak of Angkor had passed. No longer just the abode of meditating monks it is argued that the modifications to the outer wall of Angkor Wat, while vastly different to those at the Baphuon and Phnom Bakheng, are of a comparable scale and now place Angkor Wat at the centre of a forgotten chapter of the later occupation and function of Angkor.

Change and Continuity

Much of the research dealing with Angkor Wat focuses on the initial phase of use and occupation, and numerous attempts have been made to comprehend the meaning of its design and decoration (Mannikka 1996; Roveda 2001) as well as what rituals were practiced (Przyluski 1937; Brown 2004). The sheer size and the level of detail of the third enclosure bas-reliefs of Angkor Wat have often made them the focus of attention. However, it has long been known that Angkor Wat's present day condition was not accomplished at the outset. The bas-reliefs in the Northeast section of the temple are a well-known example of this condition as the inscriptions which accompany them state they were completed in the 16th century (see page 109). This thesis argues that the postholes in the outer enclosure wall are another example of modifications to the fabric of Angkor Wat and substantially postdate the initial construction phase.

Walls = Defence Mechanisms?

Moated enclosures (with or without walls) are a feature of Angkorian temples from the 9th century AD onwards. From the largest examples at Angkor Wat and Preah Khan (Kompong Svay) through to the smallest village shrines, moats were used to delimit the sacred space of the temple from that of the profane. During the 12th century walls were added and in some instances seem to have superseded moats, although early temples such as the Bakong (9th century AD) did have boundary walls as well. While large Angkorian temples probably had a small resident population within their enclosure walls, within the enclosure wall of the 12th century structure Angkor Thom there was occupation, numerous temples and a palace. The massive embankment wall around Angkor Thom differs from the rest in this regard as it delimited the urban core, though it was also the enclosure for the great late 12th century state temple, the Bayon, which lies as its centre. The construction of the walls of Angkor Thom was a considerable feat as they were almost eight metres high and about twelve kilometres in perimeter. The walls served to separate space and to channel anyone entering the enclosure through the gateways, albeit in a grand and symbolic fashion.

The conceptual framework of the Western Europeans who encountered these enclosure walls may have led them to believe they were defence mechanisms. Castle strongholds and fortified townships are stereotypical of the history of the Medieval Europe. By contrast however, in Reid's opinion (1988: 122), the typical defence strategy of the defeated party in Southeast Asian warfare was to retreat into the forest and wait for the invading force to tire of plunder and to depart. The lightness and impermanence of most urban structures and the portability of wealth facilitated this strategy. Therefore the Khmer temples of the Angkorian period must be understood in their own terms rather than according to a model of castle and fortified town imported from a Medieval Europe perspective.

A diachronic overview of the different types of enclosures associated with Khmer settlements provides an interesting contrast (see Chapter 3, page 27). Settlement enclosures must be distinguished from temple enclosures because many temples feature an enclosure wall to demarcate the sacred space². The presence of larger settlement enclosure walls which could be considered defence mechanisms only occur during specific periods: for

² 'Linear' temples such as Preah Vihear and Wat Phu do not feature enclosure walls due to their irregular topographies. Situated on the edge of a plateau and at the foot of a mountain respectively, the implementation of a standard Angkorian enclosure wall would have been impractical.

example the early first millennium AD site of Angkor Borei does feature a wall and moat configuration around the settlement. However, from the 7th century AD onwards and throughout most of the conventionally recognised Angkorian period (802 – 1431 AD), Khmer settlements did not have enclosure walls³. The settlement at Preah Khan (Kompong Svay) has a massive 5km square double embankment wall around much of its perimeter, but there are definite breaks in it (Hendrickson 2010: 6). Similarly Banteay Chhmar has a large rectilinear embankment which is only present on three sides. While they clearly delineate space and may have functioned as hydraulic works the fact that these embankments feature significant breaks effectively dismisses a defensive function.

Not until the reign of Jayavarman VII and his restructuring of the urban core of Angkor does a large enclosure around part of a settlement reappear in the form of Angkor Thom. However, even this construction is not an effective defence mechanism (see Chapter 3, page 37) as each of the gateways is exposed and vulnerable. The Chinese ambassador Zhou Daguan also noted specifically that Angkor Thom did not have any crenellations (battlements). The wall around Angkor Thom should be viewed more as a means of mediating and restricting access to the urban centre, not of preventing it completely. The impressive embankment walls were more for show than a purely pragmatic system, though they would have served as a good security measure for the ruler in his palace at the heart of the enclosure who was protecting himself from opponents within his own state.

Only during the later Angkorian or early Middle Period (from 14th to the 17th centuries) are genuine attempts at defensive architecture to be found at Angkor. These take the form of modifications to the gates of Angkor Thom. Each of the five gateways into the enclosure was augmented with the addition of defensive bastions which effectively increased the defenders' field of fire to include the front of the exposed gates. These modifications represent a significant change in the settlement's context. Greater Angkor had been the centre of a great empire for centuries and its lack of defensive installations is perhaps a testament to the security this offered. However, during the late-Angkorian period this secure position no longer existed: in the late 13th century Zhou Daguan remarks on attacks

³ Only at the height of the Khmer Empire did the massive enclosure walls of temples such as Angkor Wat reach such proportions that they could be considered settlement enclosures.

by the state of Ayutthaya into Khmer territory. This dissertation argues that the postholes in the fourth enclosure wall of Angkor Wat were another such attempt at fortification.

Thesis Outline

Following this brief introduction,

Chapter 2 provides the background information on Angkor Wat and Greater Angkor. It considers the Khmer state with respect to its ancestry, its formation and then its capital, Greater Angkor. The chapter continues with the state's structure and operations, its cultural practices and how Angkor Wat relates to these. Chapter 2 concludes with a summary of the later history of Greater Angkor, emphasising the abandonment misconception.

Chapter 3 examines the functions of walls and boundaries with a multi-scalar approach. Beginning with an overview of boundaries in a global context it then proceeds with a diachronic examination of walls, moats and enclosures in the context of Angkorian settlements. The discussion is then contextualised regionally by considering examples from throughout Southeast Asia. The discussion considers and questions the relationship between boundaries and defence.

Chapter 4 describes the survey methodology and the form of the wall. This covers the wall's layout and constituent materials, their manner of assembly and any anomalies observed.

Chapter 5 is the analysis of the survey data. The dimensions and distribution of the two sets of postholes (horizontal and vertical) are examined in their own terms and then in relation to each other. The postholes are then considered relative to the wall and its chronology.

Chapter 6 discusses various hypotheses regarding the postholes' function, highlighting the strengths and weaknesses of each one. It then discusses the chronological possibilities of the interpretation favoured by this dissertation - defence.

Chapter 7 considers the wider implications of the defence hypothesis in terms of the later history of Greater Angkor. The outcomes analysis is applied to emphasise the relationship between the modification of Angkor Wat and other such examples throughout Greater Angkor.

2. Angkor Wat in Context

Angkor Wat marks one of the peaks of Khmer monument construction but it is only a single temple amid the corpus of Greater Angkor. While the events of the Angkorian period are in part known from inscriptions, during the late Angkorian period after the 1280s our primary source – the inscriptions – largely disappear. The demise of Greater Angkor during the late Angkorian and early Middle Period is a mystery which is only just beginning to be understood in terms of the archaeological record. Until the last few decades, when the true scope of Greater Angkor became known, the conventional interpretation of the collapse of Angkor had been based on the chronicles and seen as a cataclysmic event: this is now known to be false. This chapter considers Angkor Wat in its historical and cultural context. For the environmental context see Appendix A.1.

The Khmer State

The city of Angkor was once the capital of an empire which dominated Southeast Asia from the 9th until the 15th century AD. At its height, during the 11th and 12th centuries, it encompassed all of Cambodia, much of lowland Laos and Thailand, parts of southern Vietnam and parts of Myanmar (Figure 2.1). The Khmer state developed from polities which existed in Cambodia during the early 1st millennium AD (O'Reilly 2007).

Ancestry

Much of the early phases of human occupation of Cambodia before the Iron Age is under represented in the archaeological record and generally unknown. The earliest known traces of human habitation in Cambodia are limited but consistent with the Hoabinhian culture which existed throughout Southeast Asia during the Holocene (Stark 2004: 92). Numerous circular earthworks situated in the country's Southeast (Figure 2.2) bear similarities to the moated sites of northeast Thailand (see Chapter 3, page 41) and were occupied from the late Neolithic until the start of the Iron Age. Excavations at Krek 52/62 (Figure 2.2) and other such sites have produced ceramics and ground stone tools generally similar to other Southeast Asian pre-Iron Age sites and radiocarbon dates ranging from 2300 BC to 300 BC (Coe 2004: 52).

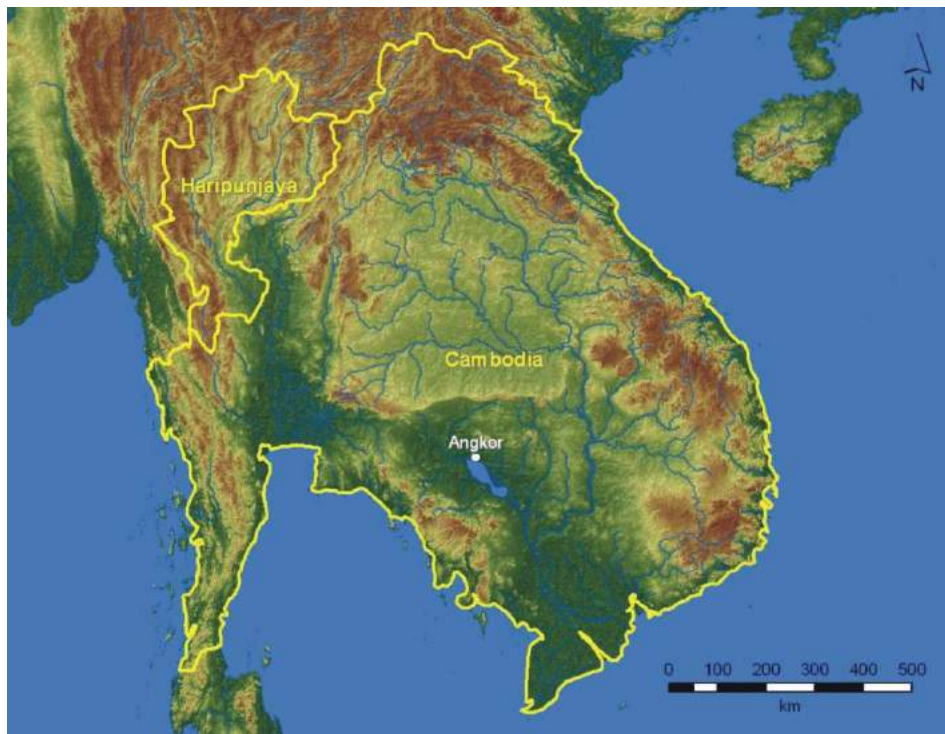


Figure 2.1 Maximum extent of Khmer Empire, 11th – 12th centuries AD - (from Ewington 2008)

Prehistoric settlement has been noted at Angkor with signs of occupation at Baksie Chamkrong (Dagens 2002: 14). Our understanding of the Cambodian Iron Age has improved recently with evidence of wide ranging cultural contacts. Excavations carried out at Phum Snay have produced signs of militarisation (O'Reilly 2007: 6) as well as indicated a potential network of interaction that stretched across the Dang Raek due to the presence of Phimai Black pottery (O'Reilly 2004: 132). The burials excavated at both Phum Snay and Phum Sophy have produced numerous examples of intentional dental modification, that is filing of the teeth, which bear both similarities and distinct differences to contemporary sites in Northeast Thailand (Domett et al. 2011).

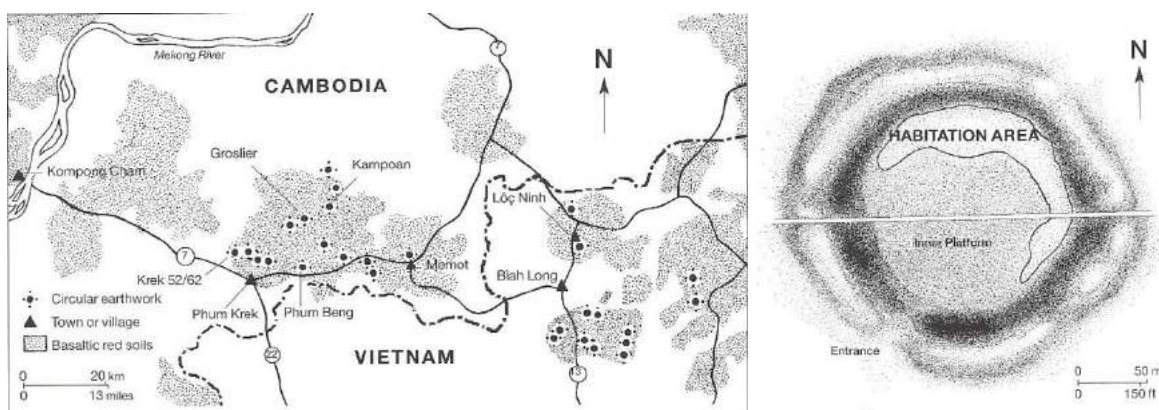


Figure 2.2 Distribution of circular earthwork sites (left) and site plan of Krek 52/62 (right) (Coe 2004)

The earliest polities in Cambodia were situated to the South near the Mekong delta. These settlements, whose main occupation phase was during the first half of the first millennium AD, were known to Chinese trade emissaries who referred to them as the “Kingdom of Funan” (Stark 2004: 98). The capital of this polity was probably Angkor Borei, although this is debated (O'Reilly 2007: 93). Angkor Borei is a small town lying within a 300 hectare enclosure formed by a 4m high wall which is moated on both sides (Figure 2.3) (O'Reilly 2007: 102). It is situated on a confluence of rivers and is located immediately to the north of Phnom Da, the source of some of the finest examples of early Khmer art (Figure 2.4). Angkor Borei is also connected by canal to the coastal settlement Oc Eo, another site featuring moats and ramparts. Oc Eo was an *entrepot* in the 1st and 2nd centuries AD which was within reach of the merchant ships which plied the coasts forming a network which spanned from China to the Mediterranean: it has yielded finds from as far afield as the Roman empire (O'Reilly 2007: 97).



Figure 2.3 Angkor Borei showing the extent of the visible wall fragments (red) (GoogleEarth)



Figure 2.4 Examples of Phnom Da sculpture (ARTstor)

During this period evidence of cultural contact with India begins to intensify. Earlier signs of Indian cultural contact, or “Indianisation”, included techniques for working precious stones and making glassware, the presence of certain bronze vessels and rouletted pottery, and in particular the use of Sanskrit (Bellina and Glover 2004). During the late Iron Age the diversity of artefacts decreases but their number increase. The current understanding of how this process took place was through the transition of goods and cultural markers: that is, through trade rather than migration or colonisation.

The focus then shifts further to the North to a region the Chinese knew as Chenla. During this period, the 7th and 8th centuries, the influence of Indian culture increased. Prominent centres from this period include Sambor Prei Kuk (central Cambodia) and Wat Phu (Southern Laos), both of which feature enclosure walls. Inscriptions tell us that the rulers of Sambor Prei Kuk, which was then known as Isanapura, extended their control to the Thai coast (Stark 2004: 100). Although its prominence diminished in the late 8th century Sambor Prei Kuk continued to be inhabited throughout the Angkorian period. Similarly, at Wat Phu was one of the most venerated Angkorian ritual sites lying at the foot of the Lingaparvata mountain (Coe 2004: 76). An early centre in the vicinity of Angkor was established at Ak Yum (now buried by the West Baray) in the 7th century (Figure 2.5).

Foundation

Our knowledge of the foundation of the Khmer Empire is derived mainly from an inscription which post-dates the event by two centuries. This inscription (K235) was found at Sdok Kak Thom (Thailand) and it relates how in 802 AD the king Jayavarman II, on the Kulen hills, carried out a ceremony based on Indic texts. In this ceremony he declared himself *cakravartin*, that is universal monarch, and initiated the cult of the *devaraja* (O'Reilly 2007: 123), both terms being derived from Sanskrit. The actual nature of the *devaraja* is debated, with theories including the deified king himself, a special mobile image of a protective deity, a kind of sacred fire (Harris 2005: 11,12), or a kind of earth spirit, akin to *neak ta* (see below). This event established the Angkorian monarchy. Jayavarman's son and successor Jayavarman III relocated his capital Hariharalaya on the edge of Tonle Sap in the early 9th century. This site which is now known as Roluos is approximately 16 km to the southeast of Angkor Wat (Figure 2.5).

The Formation and Layout of the Capital - Greater Angkor

The late 9th ruler Yasovarman I moved the centre of the state capital to Phnom Bakheng (Figure 2.5), a natural hill halfway between Ak Yum and Hariharalaya. He was the eponymous ruler of the city which was known as Yasodharapura until the end of the Angkorian period. Yasovarman was responsible for numerous other constructions including temples on the three nearby hills (Phnom Krom, Phnom Bok and Phnom Dei), an *asrama* at Preah Vihear, and most notably began construction of the East Baray (Yasodharatataka) (Briggs 1951: 106-110). Essentially an artificial lake, the East Baray is a rectangular reservoir (1.7 x 7 km) orientated East-West which is located to the East of the urban centre.

The reigns of these early monarchs established a precedent which would be repeated by subsequent kings in their respective construction programmes. Yasovarman tied Ak Yum and Hariharalaya to Phnom Bakheng creating the vast dispersed multi-centre urban complex which we now know as Greater Angkor (Fletcher & Pottier pers. comm.) The complex expanded, especially to the West and North, in the following three centuries. The expansion of the capital was no doubt driven by the empire's wealth and growth but an important factor was the tendency for Angkorian monarchs to build new state temples.

Unlike the complex sanctuaries of India whose developments generally proceeded through several rulers, Angkorian temples were built during one reign⁴ (O'Naghten 2000: 67).

Although there are examples of temples being completed by successors, most Angkorian kings commissioned a new one. While Angkor is widely known for its array of religious structures and great reservoirs, what lies around and amidst these landmarks is a complex network of infrastructure which has only begun to be truly understood. The nature of this network is complicated because it was not all built at once and various changes in its function occurred over time (Fletcher et al. 2008; Fletcher et al. 2008). These infrastructural components can be categorised as water features, linear features, rice fields and residential space (Evans 2002).

Angkorian water features are generally rectilinear and like the East *baray* are orientated East-West (Evans 2002: 13). The four great *baray* – the Indratataka, Yasodharatataka (East Baray), the West Baray and the Jayatataka – functioned as water storage and redistribution mechanisms and the arrangement of their inlets and outlets maintained a consistent maximum level of water. The *baray* also fulfilled an important symbolic role: each *baray* had an artificial island (*mebon*) at its centre which represented the heavens amidst the cosmic ocean⁵. The placement of the inlets and outlets relative to the gradient of the terrain ensured the *mebon* were neither inundated nor marooned. In addition to the *baray*, a vast array of smaller *trapeang* (ponds and dams) and moats around shrines litter the landscape. Unlike the *baray* they are typically rain fed and unrelated to the hydraulic network. Many of these have fallen into disuse and now function as rice fields but they are still identifiable by their raised banks (Evans 2002: 14).

⁴ At least in their initial form.

⁵ This symbolic relationship is echoed right down to the smallest shrines with their encircling moats.

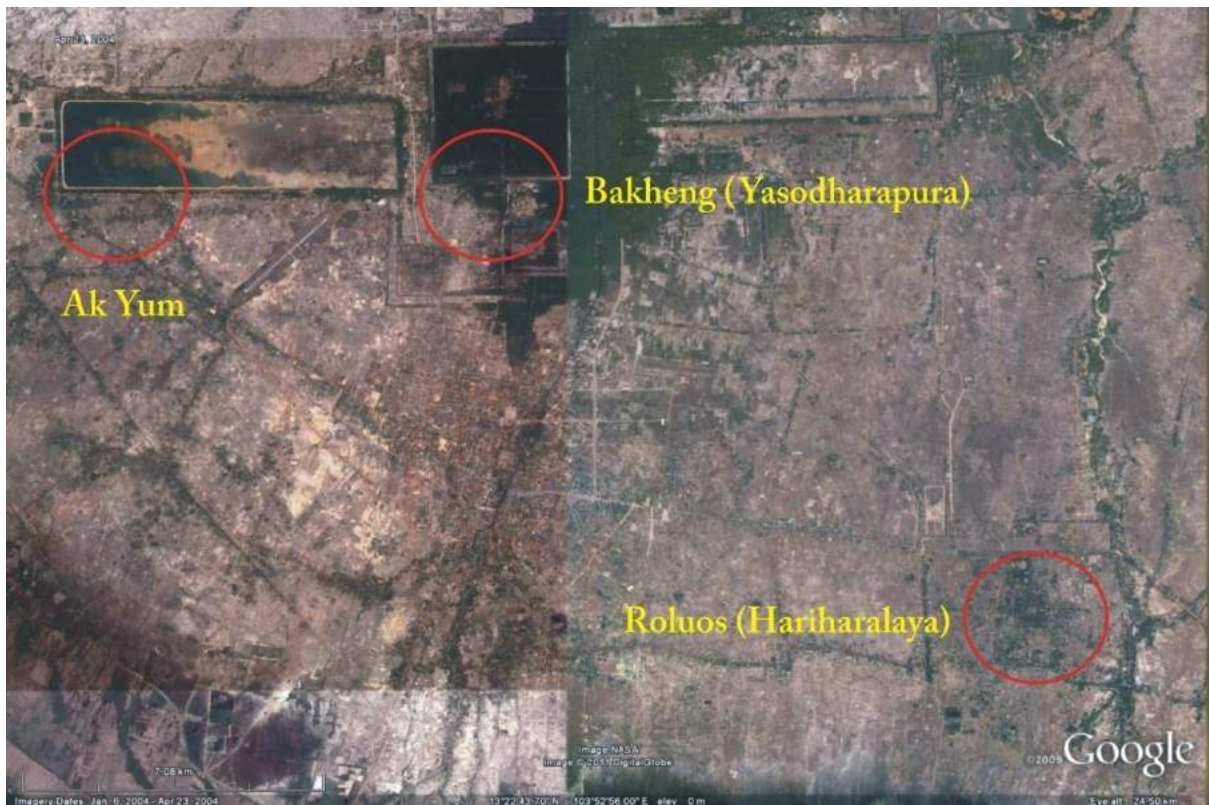


Figure 2.5 - Ak Yum, Bakheng and Roluos (GoogleEarth)

The linear features which traverse the Angkorian landscape consist of canals and dykes. These features work to impede and redistribute the water flow across the landscape, in effect increasing access to water for some areas at the expense of others (Evans 2002: 16). In addition, the dykes also fulfilled a crucial role as raised roadways during seasonal flooding (Fletcher et al. 2008: 662).

State Structure and Operations

The operation of the state was based on the acquisition of labour and resources. Labour was deployed in the construction and maintenance of public works and for the defence of the empire while resources were used in the upkeep and maintenance of the temple network (Coe 2004: 134).

Labour and Resources

Corvée labour built the Khmer Empire and its infrastructure. When required, regional lords would submit their obliged amount of men to do the king's bidding. The Khmer system of government was both centralised and regionalised (Stark 2004: 108). That is, although territory far afield from the capital was part of the Khmer Empire, it was probably not under close or direct central control. Rather, the rulers of those outlying territories were probably autonomous to an extent, but would still pay tribute and muster manpower for whichever task was called for by the rulers in Angkor. Between the core and the periphery of the empire, tribute would have taken the form of staple crops, precious goods and foreign exotica.

The material resources of the Angkorian economy included fish, salt, iron, copper, tin, and precious metals and stones, but the primary resource of the empire was rice (Hendrickson 2007). The Khmer had no currency other than measures of silver and gold so taxes were paid in the form of primary produce, especially rice (Higham 2002: 335). At a local level a system of rice taxation took place in which each village had to pay a portion of their crop to the state, and the inscriptions inform us that the temples played an important role in the collection and redistribution of this (Evans 2002: 12). One such dedicatory inscription from Ta Prohm refers to 12,640 people who worked in its daily service, and a further 66,625 people in 3140 villages who were obliged to supply rice in order to maintain the temple and support its staff (Coedès 1942: 48). The larger temples often had staffs of several thousand people who were involved in the running, upkeep and maintenance of the monument.

Temple Construction

The importance of the temple to the state's operations ensured that they were equipped with their requisite staff of priests and subordinates for their maintenance. Angkorian state temples took the form of tiered pyramids, or temple-mountains, which embodied their function as a display of power (O'Naghten 2000: 71). Early temple-mountains featured a single central shrine located on the upper tier while later examples incorporated a quincunx of towers at the summit. Khmer temples were quite literally built as a home for the gods on Earth. The builders endeavoured to create a replica of the heavens on Earth so that the gods might desire to live there (O'Naghten 2000: 67). The layout and configuration of a

temple was the embodiment of Brahmanic cosmological symbolism: the moat represented the cosmic ocean while the temple's towers and the enclosure wall symbolised the sacred peaks of Mt Meru and the encircling mountain chain *cakravala* respectively (Harris 2005: 19).

The desire for a permanent abode for the gods compelled the Khmer to use durable materials for the construction of their temples: early examples were made primarily of brick, while later ones utilised both sandstone and laterite⁶. However, durable materials were not used exclusively in temple construction. The vast majority of Angkorian temples were composite structures consisting of stone, wooden and ceramic elements together in what Parmentier called mixed architecture (Dumarçay 1973: 3). Wooden elements constituted numerous components in Khmer temples such that the temples we see today can be thought of as just the skeletons of the original structure. Wood was used to build structures which adjoined the entrances and galleries of temples, for doors and doorframes, and for ceiling panels. It was also utilised in the construction of roofs, although this could also be achieved in stone with the corbel vault. When a roof was made with wood, ceramics were often used for roof tiles and finials (Dumarçay 1973). All that remains of the wooden elements, except in limited cases (see Uchida et al. 2008), are the traces of their lodgings in the stone; that is, the postholes.

Angkorian Religions

Angkorian temples all have certain common features in their morphology but their decoration and adornment differed due to the plurality of religions in the Khmer state. The two main religions practiced during the Angkorian period were Brahmanism and Mahayana Buddhism, both of which originated in India (Coe 2004). These religions were not transplanted wholesale from India, rather they were selectively adopted and overlaid on the indigenous rituals of the Cambodians which were essentially a form of animism (Chandler 2008: 15). Animism is a cultural practice which recognises the presence of the spiritual world in every living thing and inanimate object. In Khmer these spirits are called *neak ta* and they are associated with natural phenomena such as mountains, rivers and trees. Other *neak ta* are ancestral spirits while others still are derived from Brahmanical gods and

⁶ In contrast, secular buildings are built almost exclusively in ephemeral materials.

mythical heroes (Harris 2005: 53). Consequently the manifestations of Brahmanism and Mahayana Buddhism in Angkorian Cambodia were different to those in India, and likewise different to those across the rest of Southeast Asia. There is evidence of the coexistence of both religious frameworks in Cambodia from at least the 5th century AD (Harris 2005: 5) and throughout most of the Angkorian period. During the late 13th century the Chinese ambassador Zhou Daguan (see below) noted the presence of both Buddhists and Shaivites (Smithies 2001: 29)

Brahmanic temples were dominant in the Khmer Empire and were typically dedicated to either Shiva or Vishnu. The worship of Shiva was preeminent for much of the Angkorian period and centred on the gods association with fertility. Shaivite rituals focused on the *linga*, a phallic symbol normally manifest in stone (Boisselier 1966: 286-287). Shaivite temples are orientated to the East and feature amongst their decorative iconography Shiva's mount, Nandi the bull. Alternatively, temples dedicated to Vishnu were orientated to the West. Vaishnavite worship revolved around his association with the afterlife. Vishnu's mount is the *garuda* but otherwise his associated iconography is diverse due to his many different avatars. Angkor Wat is a Vaishnavite temple and faces the West for that reason. While the majority of Angkorian temples were devoted primarily to either one god or the other, in reality their iconography was deployed liberally and intermixed.

Mahayana Buddhism did not take hold as early as Brahmanism in the Khmer Empire. While earlier references to the Buddha do exist (Vickery 1998: 140-141; Harris 2005), Mahayana iconography starts to appear in Angkorian temples from the second half of the 10th century AD in which episodes of the Buddha's life are depicted on lintels (Harris 2005: 15). Like Shaivite structures Mahayana Buddhist temples are orientated to the East. The deities worshipped in Mahayana, although headed by the Buddha, are supplemented by numerous other demi-gods known as *bodhisattvas* or "Buddhas to be". These *bodhisattvas* represent people who, although successful on their path to enlightenment, chose not to achieve nirvana but rather opted to forego it in order to guide others in their quest. The chief of these was Avolokitesvara, who features prominently in Khmer Mahayanist art, recognisable with a third eye in his forehead.

The later history of Angkor witnessed significant changes in religious practices. At the end of the 12th century Jayavarman VII (see below) upset the longstanding dominance of Brahmanism by endorsing Mahayana Buddhism as the state religion (Harris 2005: 226). Although temples had been dedicated to the Buddha previously, a state temple had not. The endorsement by the state did not proselytise everyone as the iconoclastic backlash of Brahmanism devotees occurred at some later stage (see below). Eventually Theravada Buddhism, the dominant religion in Cambodia today, came to replace both Brahmanism and Mahayana Buddhism. Inscription K754, which dates to 1308 AD and shows that Theravada Buddhism was instituted as a royal cult, demonstrates continuities in the form of royal titles and its structure with a Pali introduction followed by the Khmer text (as opposed to Sanskrit followed by Khmer).

Angkor Wat

The construction of Angkor Wat took place in the first half of the 12th century AD and was commissioned by Suryavarman II. While not the only public work undertaken during Suryavarman's reign, Angkor Wat was the most significant. The design of Angkor Wat differs significantly from earlier Khmer temples because it features both a quincunx pyramid and several galleried enclosures. However, typical of Khmer temples it has a substantial moat within which lies the fourth (outmost) enclosure wall. These features are huge with the fourth enclosure enveloping over 83 hectares of space while the inner three enclosures are much smaller. Along its outside face the third enclosure features the famous bas-relief carvings which depict epic scenes from Hindu mythology including the epic poem Ramayana. The central sanctuary originally housed a statue of Vishnu. The exact function of Angkor Wat is still debated, with evidence to suggest that in addition to honouring Vishnu it also housed the tomb of Suryavarman II (Przyluski 1937). A small inscription located on the West sector of the South gallery bas-reliefs which must date to the time of Suryvarman's death records his posthumous name as Paramavishnuloka (Pakdeekham 2008: 39). The original name of Angkor Wat is unknown.

The Later History of Angkor

The later history of Angkor can be considered to begin with Jayavarman VII (1181- c1218 AD). When Jayavarman VII took the throne he commissioned enormous public works which effectively remodelled much of the centre of the city. The main feature of these additions to the urban landscape was the construction of an immense enclosure to create a walled urban centre for the first time since the 7th century AD. The square enclosure is surrounded on each side by a 3km embankment wall almost eight metres in height, all of which is surrounded by a moat. Today this structure is known as Angkor Thom. The new enclosure neatly incorporated the existing structures of the earlier urban centres within it including the Royal Palace, the Phimeanakas and the Baphuon. At its centre Jayavarman VII commissioned his own state temple, the Bayon. Outside Angkor Thom several other massive temples were built, including Preah Khan and Ta Prohm. Jayavarman VII's building programme was not limited to Greater Angkor as it included a major temple to the Northwest of Angkor at Banteay Chhmar as well as many rest houses built along the empire's roads.

The construction programme he commissioned was heavily focused on the Mahayana Buddhist pantheon. Furthermore, Jayavarman VII associated himself with the Buddha through the dedication of temples to both Buddhist deities and his parents. He dedicated Preah Khan, the Bayon and Ta Prohm to Lokeshvara (the *bodhisattva* of infinite compassion and mercy), the Buddha and Prajnaparamita (the mother of the Buddhas) respectively. Likewise, the inscriptions at Preah Khan and Ta Prohm commemorate Jayavarman's father and mother respectively, and from this it is surmised that the Bayon commemorates himself (Woodward 1981: 58).

After Jayavarman VII's reign our knowledge of the Khmer Empire begins to dwindle. The exception to this trend is the account of the Chinese ambassador Zhou Daguan who visited Angkor for a year in 1296/7 AD. His account makes it clear that although the empire may have been past its zenith, the capital was still powerful and wealthy, referring to Cambodia as "the rich and noble" (Pelliot 1993: 2).

One well-known event from the later history of Angkor which is poorly understood was the great iconoclasm against Mahayana Buddhism. When exactly this took place is uncertain. The scale of the reaction against Buddhist imagery is staggering. Images of the meditating Buddha were either converted into *rishis* (Hindu ascetics) or *linga*, or chiselled out completely. Every single Buddha which crowned the enclosure walls of Preah Khan, Ta Prohm and Banteay Kdei, some 45,000 images spanning 8.5 kilometres, were systematically removed (Coe 2004: 128).

New evidence concerning the climate of the late Angkorian period has emerged. A dendrochronological study in South Vietnam has shown severe climatic variation – severe droughts interspersed with heavy monsoons – in the late 14th and early 15th centuries. These fluctuations are also evident in studies conducted in China and India and suggest the phenomenon was region wide (Buckley et al. 2010). These events are considered to be the cause of heavy erosion and the rapid siltation of different parts of the canal network.

Following the attack by Ayutthaya in 1431 AD the ruler of Angkor was replaced by the son of the Ayutthayan king. Little is known of this event which marks the formal end of the conventional Angkorian period and the start of the Middle Period. While cultural markers such as inscriptions and temple construction had been in decline and then absent for over two hundred years, the archaeological record makes it clear that during this period Angkor was still inhabited. Although the state had restructured and relocated there is evidence of continuity of cultural traditions and knowledge of the past. The first Middle Period inscription which mentions Angkor Wat (IMA2) refers to it as “Brah Visnuloka” (Pakdeekham 2008: 40), a clear derivation of Suryavarman II’s posthumous name Paramavishnuloka (Lewitz 1967: 429). The corpus of Middle Period inscriptions is the main source of cultural evidence for continued activity: over 75% of them are found at Angkor (Ewington 2008). Additional archaeological evidence includes radiocarbon dates and palynological data. Sediments obtained from core samples taken from the moats of Angkor suggest continued maintenance (dredging) of some of these features well into the 16th century AD which would imply the presence of large and perhaps even centrally organised work forces (Penny et al. 2007: 393). Core samples and palynological sequences obtained from the moat of the Bakong (Roluos) indicate no changes in land use during the 15th century AD (Penny et al. 2006: 612). What it does show is the presence of intense agriculture until the capital

relocated to Yasodharapura (late 9th century AD) after which the intensity of land use declined and this was no doubt due to Roluos' new context on the periphery of the urban centre. Recent radiocarbon dates from the excavations within Angkor Wat show the last main occupation layer within the enclosure dates from the mid 15th to early 17th centuries (Fletcher pers. comm.).

Conclusions

Greater Angkor was the capital of the Khmer Empire from the 9th to the 14th century. Its growth was the product of continued – though not constant – imperial expansion. Angkorian power peaked between the 11th and 13th centuries after which it started to decline. Angkor was attacked by Ayutthaya in 1431 AD but this event, which has conventionally been labelled the end of the Angkorian period, had little impact in the archaeological record. Rather, this dated interpretation was an embellishment of the chronicles and a misunderstanding of the size of Greater Angkor. Throughout much of Greater Angkor – particularly along the Siem Reap river – the palynological record remains unchanged during the 15th century. The abandonment of Greater Angkor is a complicated issue and involves erratic climate change from the 1350s into the 16th century. While the apparatus of the state undoubtedly shrank to a fraction of its former self, the daily activities of rice farming and agriculture continued unabated throughout much of Greater Angkor. The “re-occupation” of Angkor during the 16th century was simply the return of some of the Khmer elite and their state officials. This thesis proposes that the actual abandonment of Greater Angkor followed the installation of defensive works at Angkor Wat.

3. Boundaries: Function and Form

Boundaries are created in various ways and serve varied purposes. Generally speaking, boundaries serve to separate and order space, to mediate knowledge through constraint and to expedite the exercise of power. An examination of boundaries in Khmer settlements throughout the first millennium and the first half of the second millennium AD demonstrates numerous common features. A high degree of variation also exists in the size and morphology of these boundaries with regard to the restriction of movement and visibility, and as such also represents a variation in function. The issue which has to be addressed is the relationship between boundaries and defence.

The Global Perspective – The Boundary’s Function

Boundaries are an everyday occurrence in our lives. They affect peoples’ behaviour and have the ability to create tension. The degree to which this tension can mount is exemplified by two recent examples from the modern era: the Berlin Wall and the West Bank barrier built by Israel. These modern cases are perhaps extreme examples due to the advent of modern technology and its implementation in boundary defence. What is unaffected by the level of technology is that boundaries work 1) to separate and order space, 2) to mediate knowledge through constraint and 3) to reinforce systems of power and authority (Samson 1992). These three aspects are examined here.

Separation and Ordering of Space

The separation of space is perhaps the most intuitive function of a boundary. In the context of an enclosure this separation constitutes an inside and an out. In their most basic form boundaries break the continuity of open space. Typically boundaries separate space by dividing it into parts. As such boundaries form an ambiguous liminal zone between spaces as they are neither the one nor the other (Samson 1992: 27). This ambiguity creates tension between those who are associated with the liminal zone (Ganster and Lorey 2005: xi). When taken to the extreme, the liminal zone which divides the space is so pronounced that it becomes insurmountable: that is, a barrier suitable for defence.

Knowledge and Constraint

Boundaries restrict access to information as well as imparting it. This overview is concerned with boundaries rather than walls because the latter represents a subset of the former. While a boundary may not physically prevent one trespassing into a certain area, it can still ensure that one is conscious of the act of doing so. For example, Offa's dyke (Figure 3.1) along much of the modern border between Wales and England, offered little resistance to a pedestrian. However, if one traversed it the physical actions needed to do so were taken as an indisputable sign of cognition that a threshold had been crossed (Samson 1992: 29). As Samson (1992: 32) states, "the greater the effort or more unusual the actions necessary to overcome the barrier, particularly if destruction is necessary, the greater the 'guilt' generally imputed to the action". Likewise, enclosures also convey knowledge to those within the delimited space. By constricting and confining passage, walls gave rulers the power of knowledge, knowledge of who was going where with what, and knowledge of their intent (Samson 1992: 34).



Figure 3.1 Offa's dyke, Wales (<http://www.offasdyke.demon.co.uk/J6014121.JPG>)

Power and Authority

What follows from the separation of space is its management. The presence of a boundary allows those with authority to exercise control. For example the gates in a wall become essential points of negotiation for those who wish to cross the boundary in a socially

recognised way. The effort involved in the construction of a boundary is related to the effort required to circumvent it. Boundaries can be thought of as a form of static effort which is at the disposal of those with authority. Thus it is the social structures within which it is placed, as well as the barrier itself, which gives the barrier its power. This point is exemplified when control of the boundary changes in context. For example, the wars of Scottish independence against the English were marked by the Scottish campaign of destroying their own castles once retaken from the English (Samson 1992: 32).

While boundaries may hinder the movement from one place to another quite often they also apply limits to the exercise of power. For example the *vallum* of medieval monasteries not only represented the border between sacred and profane space, it also marked the boundary of the abbot's claim to authority over the monks of the religious house (Samson 1992: 28). In a similar fashion, inscriptions in Cambodia, Java and Champa sometimes specify officials – apparently tax collectors – who are not allowed to enter the space delimited by the *sima* stones (Miksic 2007: 342). The *sima* stones of a Theravada Buddhist *vihara* do not form a physical barrier as they are simply the cornerstones which define or mark the limits of sacred space. Their presence does however limit the authority of state officials.

Boundaries in Khmer Settlements

Khmer settlements have a long and varied history of boundary demarcation. Both early and later examples exhibit evidence of what could be called fortification, but the Angkorian period presents a significant break in this phenomenon.

Early Khmer Settlements

The prehistoric circular earthworks of the Southeast are perhaps the earliest examples of resource expenditure for the creation of large-scale physical boundaries in Cambodia. However, these were not formidable defence mechanisms and more likely served to keep domesticated animals in and wild animals out of the domestic residential area.

By the early first millennium AD the large urban centres of the Funan period, Oc Eo and Angkor Borei, both feature large moated urban centres. Angkor Borei has a 4m high brick

enclosure wall which is moated on both sides and encircles an area of some 300 hectares (see Figure 2.3, page 13). Although the wall is discontinuous it is only broken by the three arms of the confluence on which it is located: the effort required to breach the enclosure at these points would be significant. On the other hand, the earthen ramparts and canals of Oc Eo are only present on three sides. Although it may have been a continuous barrier during antiquity, the existent earthworks at Oc Eo suggest a different approach to settlement delimitation compared to that of Angkor Borei.

From the middle of the first millennium AD the situation changed. Walled enclosures still existed but not on the same scale or in the same context as previously. The pre-Angkorian sites of Sambor Prei Kuk, Wat Phu and Ak Yum show no signs of defence orientated architecture. Sambor Prei Kuk does have a large enclosure wall but this is only present on three sides with the fourth (East) side open to the river (Figure 3.2). Wat Phu which has a three sided earthen embankment bound by the Mekong is a complex of enclosures more like specific delimiters of space than true fortifications. The shrines of Sambor Prei Kuk do feature concentric enclosures but these mark out the sacred space of the temple (O'Naghten 2000: 59), and are far smaller than the demarcated space of the settlement⁷. Similarly, Ak Yum features nothing evident beyond the standard small enclosure which bounds the sacred space.

Angkorian Settlements

The Angkorian period offers myriad examples of boundary demarcation. These continue the tradition in the form of earthworks, walls and enclosures and include the hydraulic mechanisms which controlled, stored and redistributed water. The temples of the Angkorian period, although having common features in their morphology, exhibit much variation in their size, shape and design. Common features include a moat which envelops the offset concentric enclosures (O'Naghten 2000: 59). One variable in design is the way in which the visibility and luminosity of the enclosure galleries is manipulated by the presence and alternation of windows and solid walls (Pichard 2001). What is crucial to this discussion is that unlike prehistoric and early pre-Angkorian settlements that feature circular moats and walls, the habitation sites of the Angkorian period are largely devoid of defensive architecture (Pottier 2000).

⁷ The settlement wall is almost certainly a later addition to the complex.

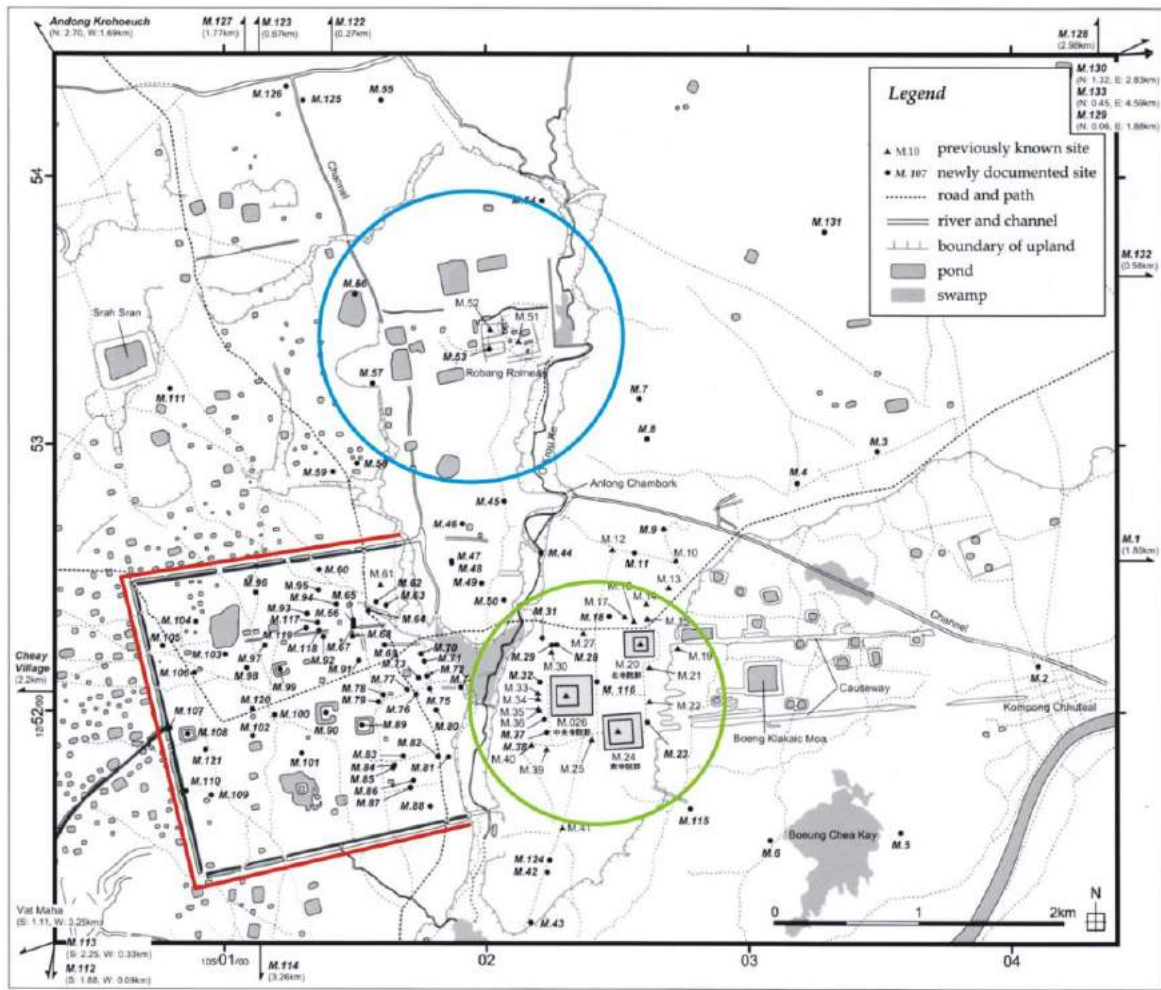


Figure 3.2 Plan of Sambor Prei Kuk showing the royal centre (blue), religious centre (green) and the civic centre (red). Note the civic centre is only walled on three sides (adapted from Pottier)

From the 9th century AD large moated temples start to appear as part of the Angkorian state. The function of the moat was both symbolic (see Chapter 2, page 18) and undoubtedly practical as it is assumed that they also provided a source of water for those who lived nearby. Due to the presence of at least one, sometimes two and even four terrestrial causeways which interrupt them on the principal or cardinal axes, Khmer moats cannot be considered defensive. Khmer temples typically feature a solid outermost wall which is only interrupted by the *gopura* and thus forms an introverted system. The outer *gopura* have an ambivalent presence as, although marking the liminal zone between the sacred and the profane, they allow the transition between the two. Perhaps representing the importance of this transition, the simple gateways of the pre-Angkorian era give way in the 9th century to truly monumental entrance pavilions (O'Naghten 2000: 62). Again,

although many of these outer enclosure walls are substantial in height, others such as Preah Ko and Banteay Srei – at around one metre in height – are anything but a defensive barrier.

As one moves inwards through a temple a change is noted between the single solid walls of the outermost enclosure and the inner enclosures which are more or less open (Pichard 2001: 15). It is these inner enclosures which demonstrate considerable variation in their layout and design in the context of Angkorian temples. As Pichard (2001: 16) writes of moving within the interior of a temple, “whether through a doorway or the presence of windows, a subtle ambiguous game then plays out between symmetry, introversion and extraversion”. The interplay of doors, walls and windows presents numerous different combinations in the architecture of Angkorian temples. For example, the third enclosure of the Baphuon is a gallery consisting of a solid wall on the outside and one punctuated with windows on the inside. The second enclosure is a gallery with windows both inside and out. The first enclosure, of which only traces remain, was a unique system which consisted of a central partitioning wall punctuated with balustered windows with a colonnade on either side (Boisselier 1966: 83) (Figure 3.3).

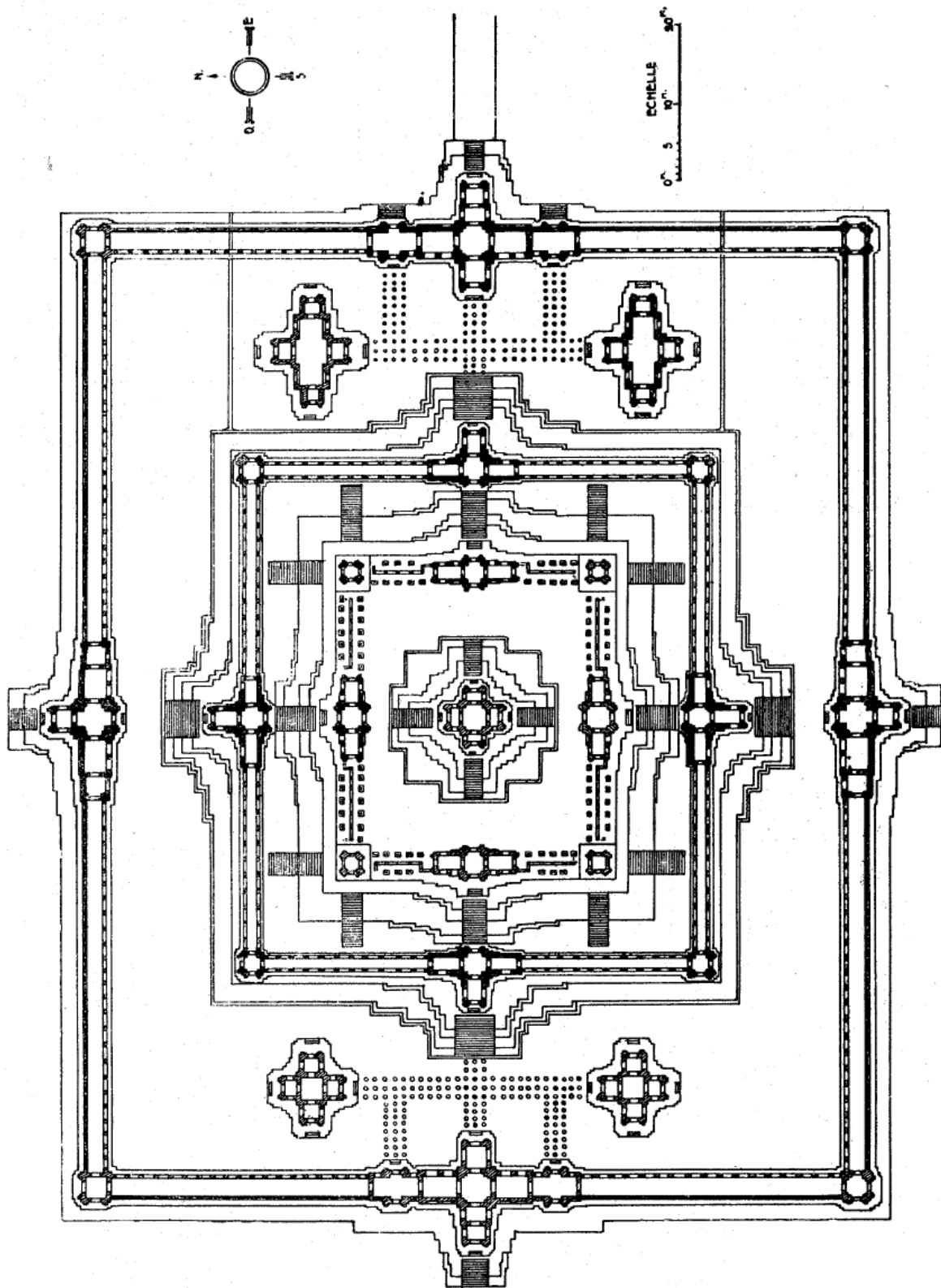


Figure 3.3 - Plan of three inner enclosures of the Baphuon (Glaize 1993, Pl XI)

Angkor Wat

Like the previous examples given, Angkor Wat is encompassed by a moat within which there is a solid outermost (fourth) enclosure wall. The moat is interrupted by causeways on the West and East sides, and each enclosure has *gopura* at the cardinal points. Also like the previous examples, the inner galleries manipulate the fields of visibility and luminosity by presenting different combinations of solid walls, colonnades and both real and false balustered windows (see Figure 3.4).



Figure 3.4 Real (above) and false (below) balustered windows in the inside wall of the second gallery

The third enclosure of Angkor Wat is fully open to the outside. To the interior of the temple it presents a solid wall which is still punctuated by false windows. On the outside face this wall is fully carved with the famous bas-relief sculptures, and running parallel to this is a

double peristyle which supports the roof and provides visibility outwards (Pichard 2001: 20) (Figure 3.5).

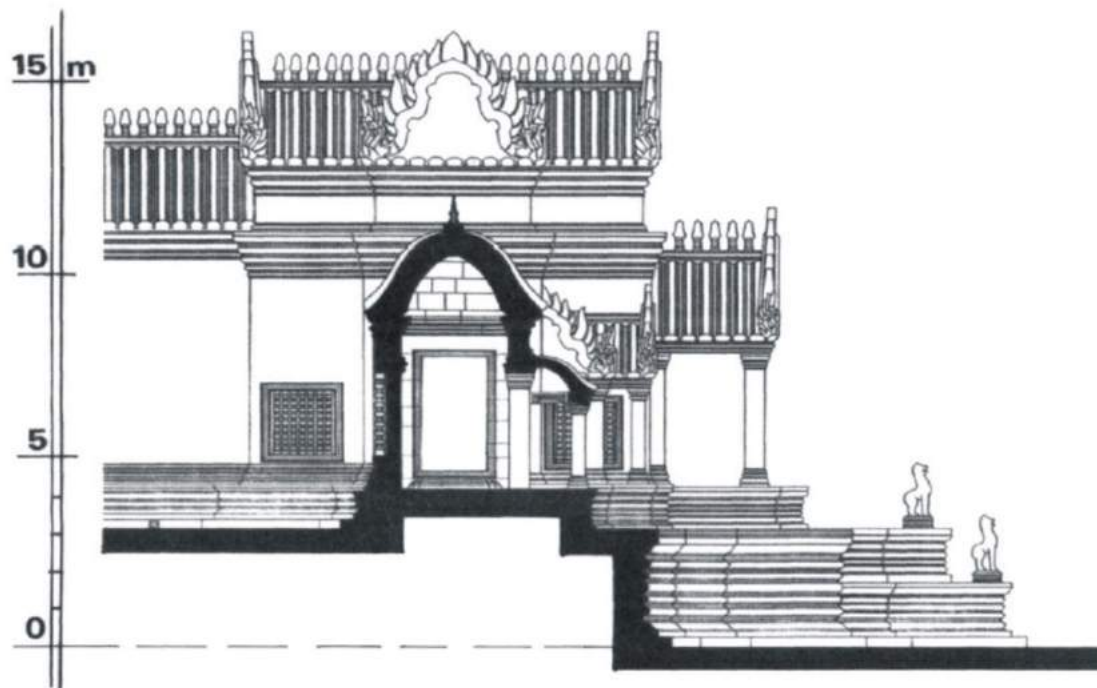


Figure 3.5 - Cross section of the 3rd gallery of Angkor Wat - Note the solid wall with false balustered windows on the inside (left) and the double peri-style colonnade on the outside (right) (after Pichard 2001)

In contrast to the third, the second enclosure is closed to the outside. The gallery's outer wall is solid and features false balustered windows all around its exterior (Figure 3.6) except for one real window which is situated on the south side of the west gallery⁸ (Pichard 2001: 18). The inner wall presents a variety of configurations of real and false balustered windows (Figure 3.7). While the West gallery is composed completely of false windows, the windows of the North and East galleries are all real. Finally, the South gallery features a regular alternating pattern of false and real windows, three to one. In addition to the *gopura* at the cardinal points, the North and South galleries each permit access to the interior by two additional doorways (Pichard 2001: 19, 20). The first enclosure is open to both the interior and the exterior. Its gallery features real balustered windows around the outside and a

⁸ Note the difference between the rooms of the *gopura* which, although lengthy (especially on the West side) are distinguished from the galleries which connect them: the outside walls of the *gopura* do in fact feature real windows.

double colonnade peristyle around the inside (Pichard 2001: 18) (Figure 3.8). The central shrine itself is connected to the enclosure by open colonnaded walkways (Figure 3.9).

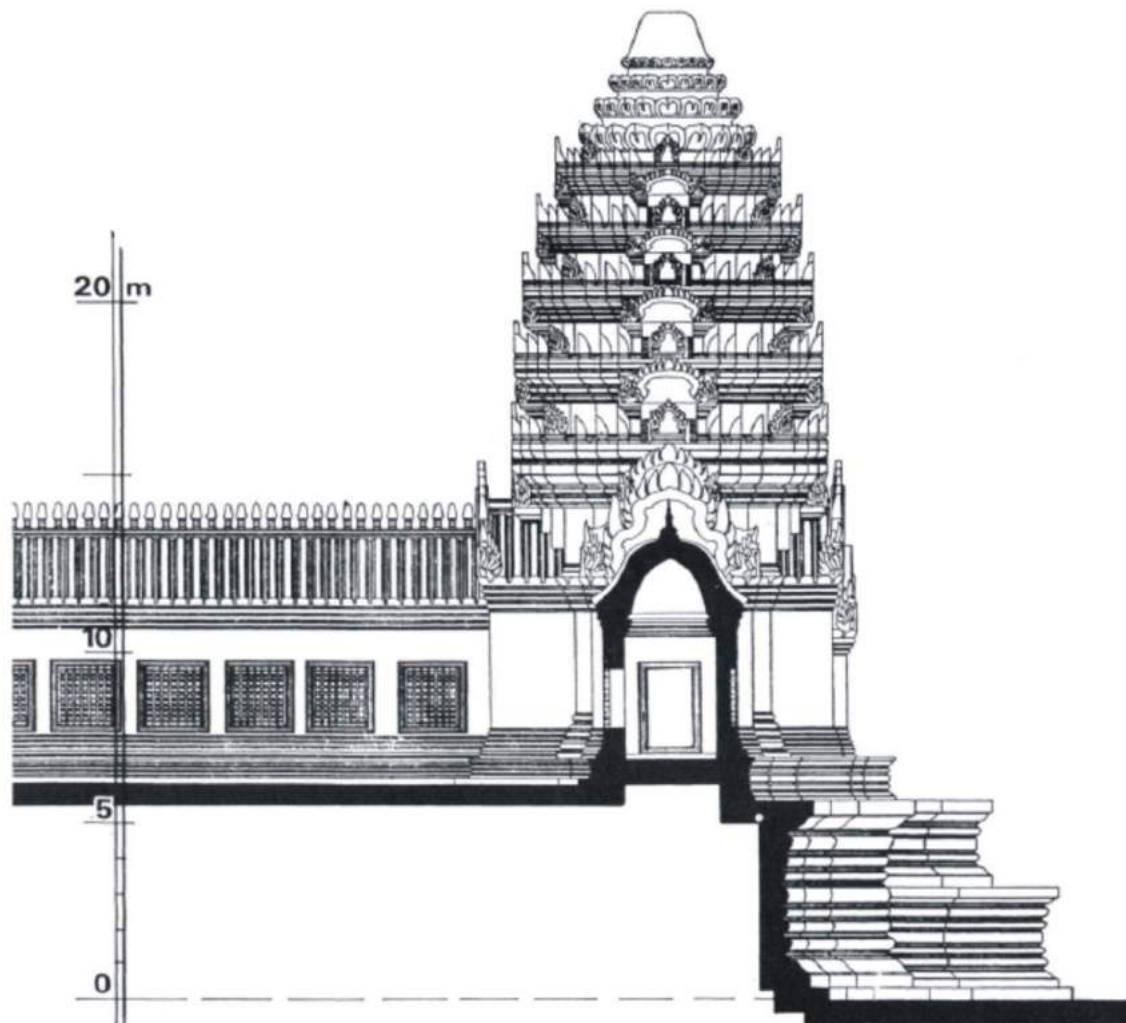
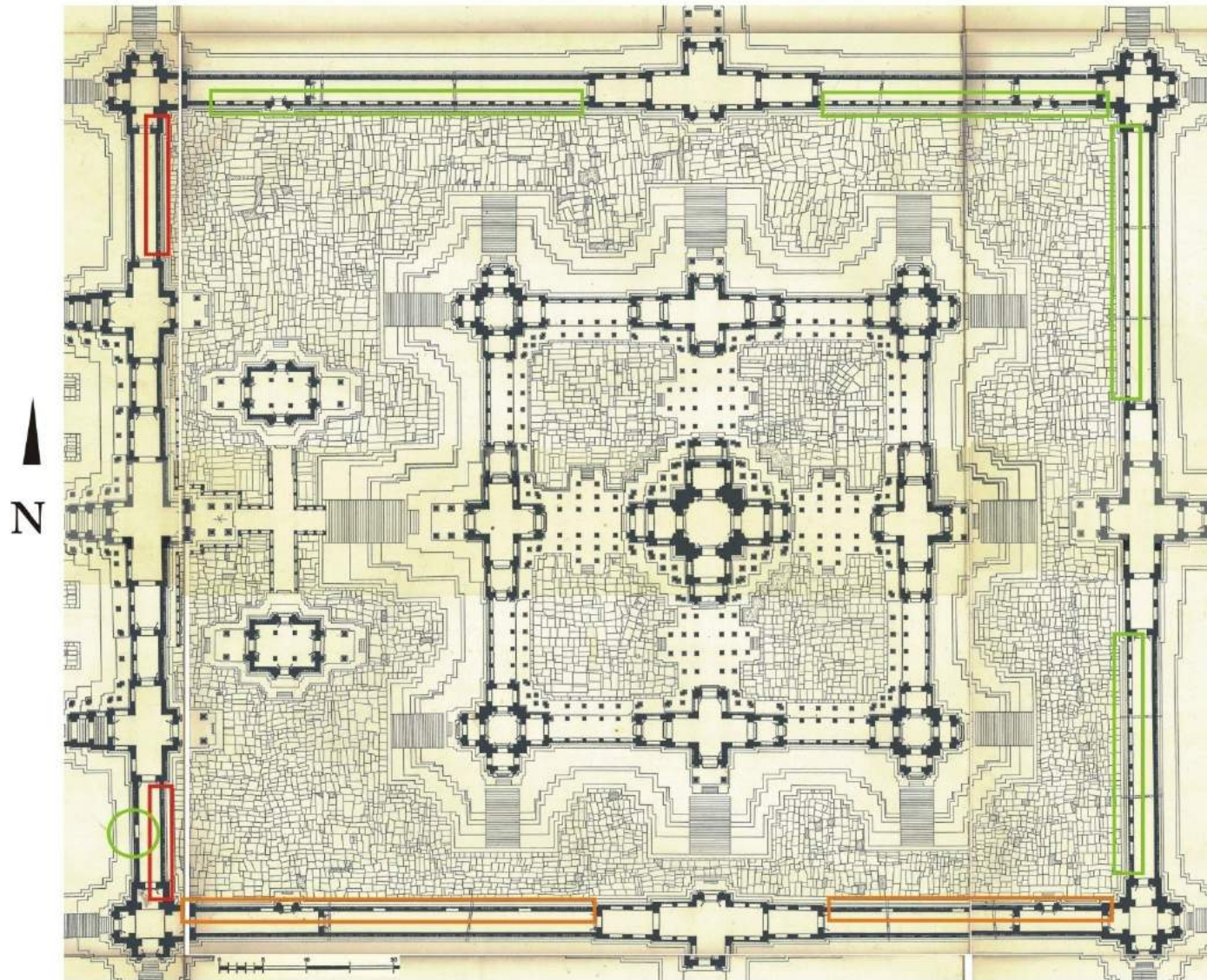


Figure 3.6 – Cross section of the 2nd gallery of Angkor Wat – Note the solid outside wall with false balustered windows on the outside (right) and the inside wall punctuated with real windows (left) (after Pichard 2001)

Figure 3.7 (Next page) - Plan of the second enclosure of Angkor Wat - Note the different configurations of the inside gallery wall: West (false windows - red), North and East (real windows - green), South (alternating one real with three false - orange); also note the one real window in outside gallery wall, Southwest corner (circled – green) (After Nafilyan 1969)



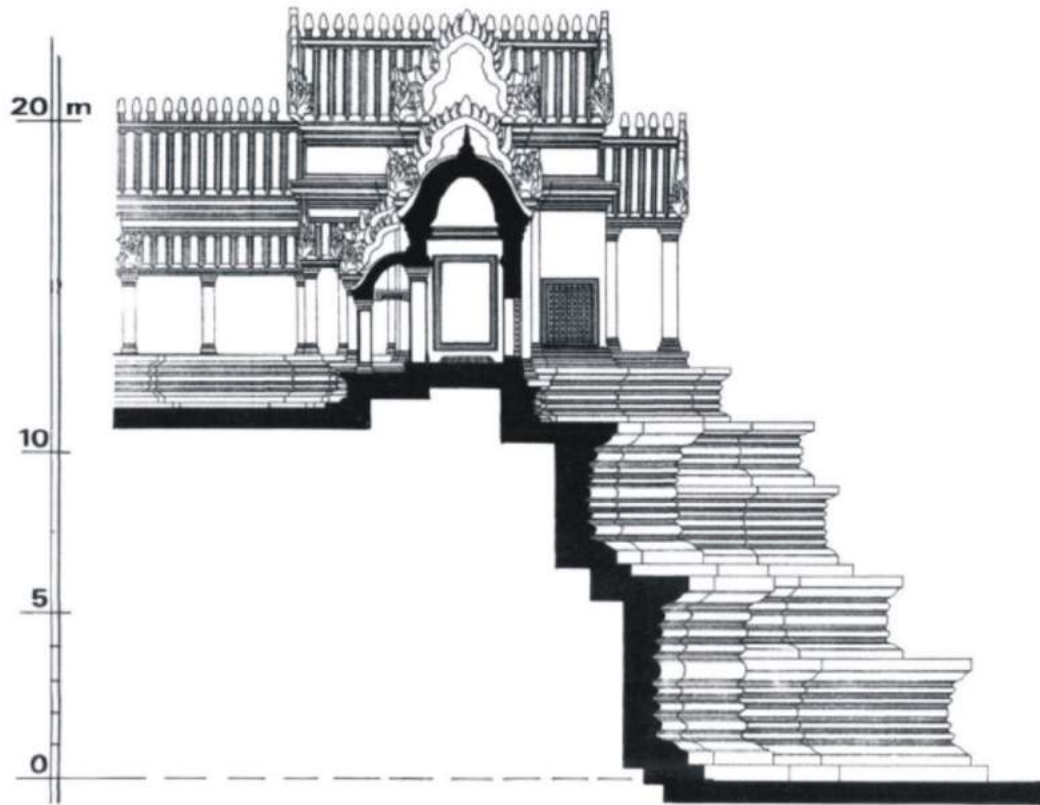


Figure 3.8 - Cross section of the 1st gallery showing the real balustraded windows on the outside (right) and the double colonnaded peristyle on the inside (left) (after Pichard 2001)

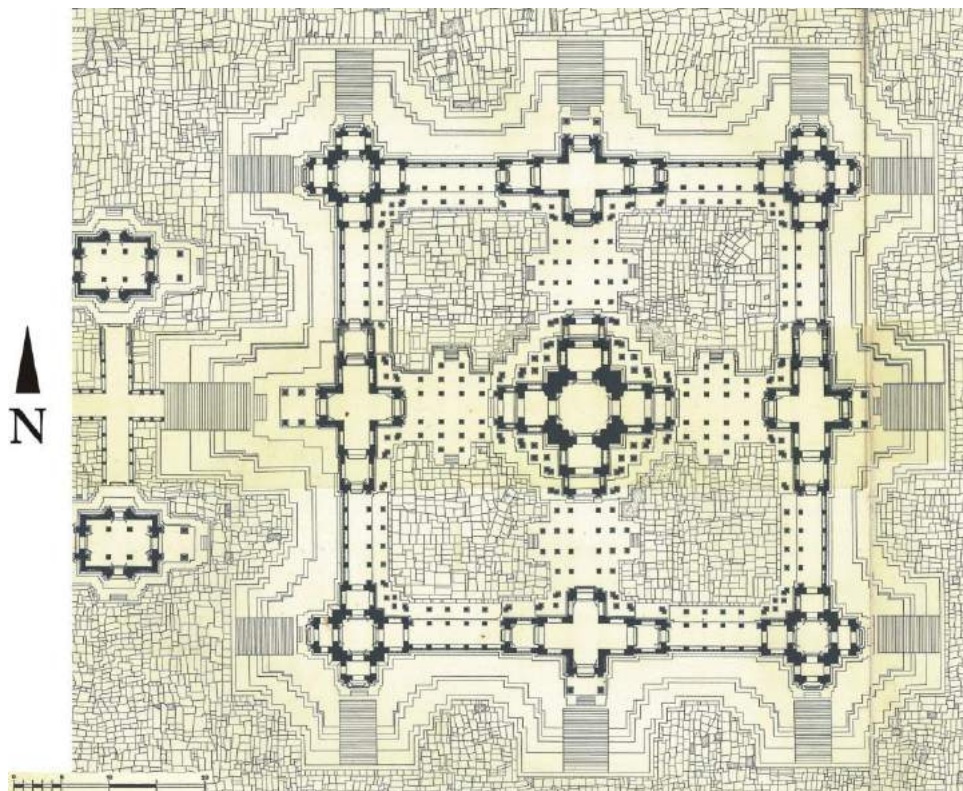


Figure 3.9 - Plan of the 1st enclosure of Angkor Wat - note the real windows on the outside and the open colonnaded walkways on the inside (after Nafilyan 1969)

Late Angkorian Period

The late period of Angkorian architecture presents much the same variations in design as one passes through the temple, although there are innovations. One such innovation is the addition of an extra enclosure wall, which Stern called the “property enclosure” (*enceinte de domaine*). Instituted in the reign of Jayavarman VII for Mahayana Buddhist temples this enclosure provided the peripheral space required to house the scholars and priests of the Mahayana religion (O’Naghten 2000: 60).

The installation of Jayavarman VII which is most appropriate to a discussion about walls and boundaries is Angkor Thom. At a glance Angkor Thom seems an impressive display of serious military fortification. The urban centre is enveloped by an eight metre high embankment wall which has a perimeter of twelve kilometres and is encompassed in turn by a wide moat. In typical fashion the moat is breached by causeways, this time in five places: at each of the cardinal points and an additional point on the North side of the East wall in alignment with the Royal Palace (Figure 3.10).

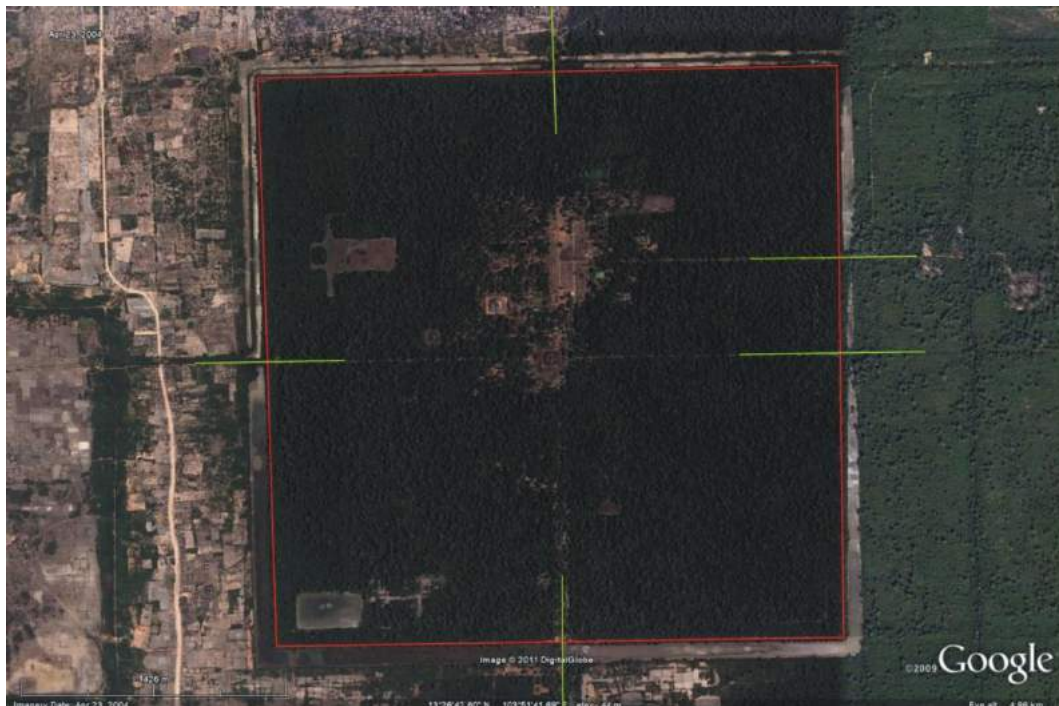


Figure 3.10 Map of Angkor Thom showing the enclosure wall (red) and the alignments of the five *gopura* (green) (GoogleEarth)

Importantly in a discussion about defence, these causeways are not drawbridges but rather solid earth lined with laterite and sandstone. Furthermore, even though each *gopura* features two massive gateways their layout renders them ineffective against a determined

invading force. Defenders along the top of the embankment wall lacked a line of sight to the gateway and would have been unable to fire upon an enemy squad trying to break open the gate (Figure 3.11, left). The only personnel available to defend the gate from within it were effectively trapped in the side rooms as no separate access to the interior of Angkor Thom was provided in the original plan. Consequently, at some stage during the later history of Angkor each *gopura* of Angkor Thom was augmented with two bastions which were built on the outside of the enclosure wall (Figure 3.11, right). Do Couto's account (see Chapter 6, page 110) does mention bastions (Groslier 2006: 53) so they appear to have been built sometime before 1585 AD. At some stage doors were opened for the gateway rooms to the interior of Angkor Thom (see Chapter 6, page 119).

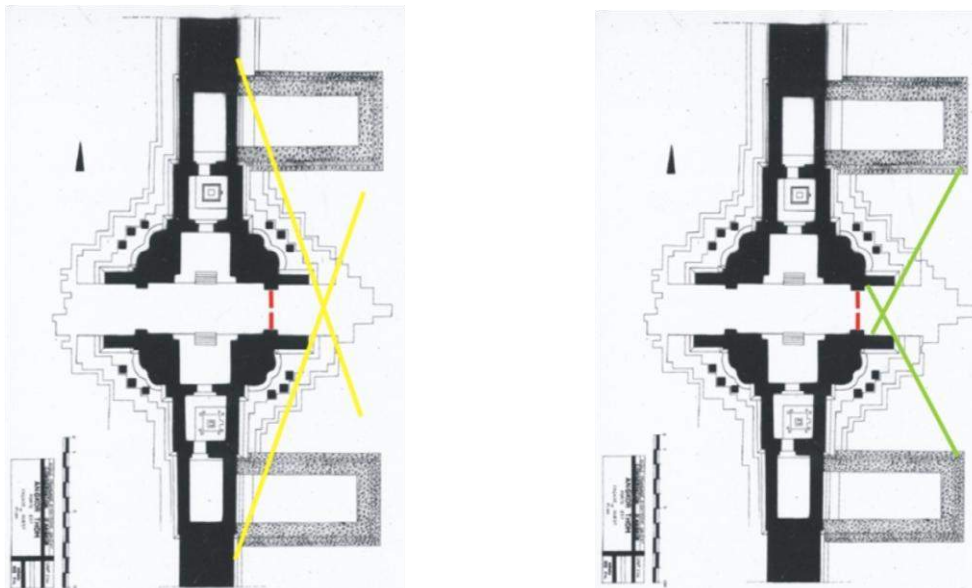


Figure 3.11 – Plans of the East gopura of Angkor Thom showing the gateway (red) and the line of sight of the nearest defenders on top of the wall without the bastions (left, yellow) and with the bastions (right, green) – Note that the rooms on either side of the gateway are only accessible from the middle passage (after Dumarçay 1988)

Another point concerning the lack of comprehensive defence capabilities of Angkor Thom comes from Zhou Daguan who notes specifically that on the walls of the city “there is no crenellation” (Smithies 2001: 19). A better understanding of the function of the walls of Angkor Thom again comes from Zhou Daguan's account. He writes that “...with previous rulers, the imprints of the wheels of their chariots never left the palace threshold; and that

was to prevent untoward incidents” (Smithies 2001: 101). Zhou Dagan’s account suggests a fear of assassination, as does his comment that the present king has “a sliver of sacred iron ... inserted in his body ... so that he is invulnerable to knives and arrows which may strike his body. Assured of this the ... ruler dares leave his palace” (Smithies 2001: 101). His description of the king’s bodyguards during the royal procession is impressive: the inner circle consists of female palace guards bearing lances and shields; outside this numerous elephants surround them, and there are more troops to protect him (Smithies 2001: 101, 102). In addition to this the “there are also guards at the [city] gates” (Smithies 2001: 19). In light of the fact that many successions to the throne were contested between the elite families what the king had in place was a defence mechanism which was designed to thwart potential rivals from the other competing families within the Khmer elite (Figure 3.12). The walls of Angkor Thom were not so much to hold out foreign powers, but rather were installed to impede domestic acts of aggression. Angkor Thom demonstrates that even impressive walls need not be really suited for serious defence.



Figure 3.12 - Diagram visualising the different levels of royal defence - gatekeepers (yellow), elephants and troops (orange), female palatial bodyguard (red) (GoogleEarth)

Boundaries in the Southeast Asian Context

Khmer settlements during the Angkorian period were largely without any serious defensive architecture, a situation which must be related to the security available at the heart of the empire. Southeast Asian settlements in general feature earthworks, canals, walls and moats. Representative sites are described in brief.

Myanmar

During the early first millennium AD numerous walled urban centres emerged in Myanmar along the courses of the Ayeyarwady and the Chindwin rivers. The largest of these, Sriksetra, encloses an area of 1430 hectares and is the largest individual brick walled archaeological site in Southeast Asia (Hudson and Lustig 2008: 271) (Figure 3.13). The conventional dates of occupation at Sriksetra are from the 5th to the 9th centuries AD, yet there is evidence that these dates are very conservative estimates. The Europeans who first cleared the site described the walls as “ancient fortifications” (Hudson and Lustig 2008: 281). However, Moore suggests the walls were more an assertion of power than evidence of a need to retreat behind them (Moore 2007: 175), and Hudson feels that their construction was due more to ideological rather than pragmatic concerns (pers. comm.). The analysis of the sites linear water features carried out by Hudson and Lustig concluded that they were designed to disperse and redirect water rather than contain it: drains as opposed to moats (Hudson and Lustig 2008). In general the sites show no evidence of conflict, although Halin is the exception to this rule. Excavations uncovered defensive weapons such as swords, daggers, spear, axe and arrow heads and missiles (Aung 1970: 61). Furthermore, the stratigraphy of the excavated gates suggests that Halin was destroyed by fire in accordance with the chronicles (Aung 1970: 57). Yet the walls of Halin also do not form a continuous structure (Figure 3.13).

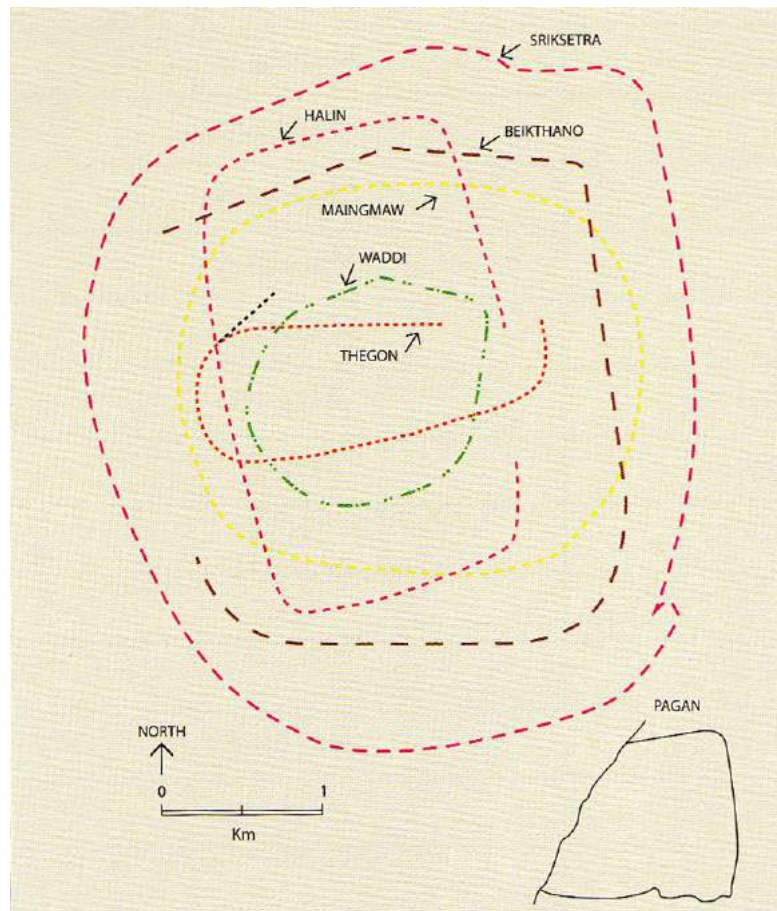


Figure 3.13 Comparison of the areas enclosed by the walled urban centres of Myanmar – Note that Beikthano Halin and Thegon are not closed circuits (from Moore 2007)

Thailand

The Iron Age of Northeast Thailand is rich with around 200 circular earthworks which were identified by aerial photography in the Mun river basin of the Khorat plateau (Higham 1996; Boyd et al. 1999; Hudson 2004: 120). The precise role of these sites, commonly called “moated”, is debated but water-harvesting and territorial/defence functions have been proposed (Hudson 2004: 120). The Dvaravati settlements of the first millennium AD are concentrated on the central plains of Thailand. Many of these sites are located next to rivers and have ditches and ramparts so it is possible to speculate they were for defensive purposes (O'Reilly 2007: 74). However a study utilising aerial photography of 23 such sites in the Mae Nam Mun river valley (Khorat) found that each site was located adjacent to former multiple-channel rivers during a period which was characterised by high runoff (rainfall) conditions. Evidence from the excavation of these “moats” has shown that most of them are no more than former river channels (Boyd et al. 1999: 710-711): hydraulic features that were actually adapted natural phenomena. While the natural origin of these ditches

does not rule out their use in a defensive role, Boyd's study calls this interpretation into question.

Vietnam

The Neolithic sites of Southern Vietnam (see Chapter 2, page 12) feature circular earthworks. In the Bac Bo region of Northern Vietnam Co Loa was one of the largest Iron Age settlements and the capital of the short lived Au Lac kingdom (257 – 207 BC) (Higham 1996: 109). Co Loa has three moated enclosures of which the outermost encompasses an area of 600 hectares (Higham 2002: 172). Co Loa is attributed to the Dong Son culture which is known for its large decorated bronze drums which have been located in a wide variety of contexts across mainland and insular Southeast Asia. One such drum recovered from Co Loa contained around two hundred bronzes including weapons such as socketed spearheads, daggers and arrowheads (Higham 1996: 122). Considered with these finds and its short term success, the ramparts of Co Loa are an unambiguous example of defence measures – or offence stores. While the early first millennium AD site Oc Eo also features earthen embankments, moats and canals, the earthworks of that site do not form a continuous enclosure.

Insular Southeast Asia

Sites located in the Tutuala region of East Timor are argued to be defensive structures which date to the early second millennium AD. The combination of the location of these sites on top of hill tops and/or cliff edges (which affords them long sight-lines) and the presence of built walls suggests they were built to protect against raids from outsiders (Lape 2006: 292). The proposed chronology of these sites correlates with the regional appearance of fortified sites around insular Southeast Asia and the Pacific between 1100 and 1700 AD (Lape 2006: 294).

Conclusions

The primary function of boundaries is to separate and order space and from this follows the mediation of knowledge and the exercise of authority through constraint. The sites discussed vary widely in their character and morphology. However, the lack of defensive boundaries around Khmer settlements during much of the Angkorian period is the one common trait that emerges. The function of boundaries in Southeast Asian contexts is a much debated topic. This overview of the walls, embankments, ditches, canals, moats and drains has shown that the assumption of defence is quite often called into question. The relationship between boundaries and defence is a complicated issue in which many variables must be considered if any correlation is to be accepted between in the outer enclosure wall of Angkor Wat and a defensive function. That is the task of this thesis.

4. Angkor Wat Enclosure Wall: Methodology and Description

Analysing the function of the postholes in the outer enclosure wall required a survey methodology and description of the wall in detail. This includes the wall's dimensions, orientation, constituent materials, the manner in which the parts were assembled, and any anomalies in the form of the wall. These are described in detail in order that their relationships can be interpreted.

Survey Methodology

The survey was conducted using a Leica TPS1200+ Total-Station. The survey procedure was defined by the problem that the interior of the fourth enclosure is overgrown with dense jungle which makes long distance line-of-sight very hard to achieve (Figure 4.1). Although the outside face of the wall is featureless, the excellent visibility which the area outside the enclosure provides made this the ideal location to set up the Total-Station (Figure 4.2). Since the wall features various other sorts of holes and indentations the posthole surveys had selective recording criteria (see page 47).



Figure 4.1 The interior of the fourth enclosure – Note the dense foliage and limited visibility



Figure 4.2 The exterior of the fourth enclosure, between the wall and the moat

Horizontal Posthole Survey

The survey of the horizontal postholes on the inner face of the wall employed the stadia rod to mark the locations of the holes on the inside of the wall. The spotter worked on the inside of the enclosure and used a step ladder to hold the base of the rod in front of the posthole. Another person worked on top of the wall to keep the rod vertical (Figure 4.3), and also to clear any foliage obstructing the line-of-sight as necessary.

Once the location of the feature was recorded, the three dimensions of each hole were recorded with a tape measure. One final aspect was recorded: because the wall is wider at the top than it is in the middle, invariably when held vertically the base of the stadia rod would be situated off the actual face of the posthole. The distance from the vertical rod to the face of the posthole was also recorded (see Figure 4.4).



Figure 4.3 Posthole locating team: method

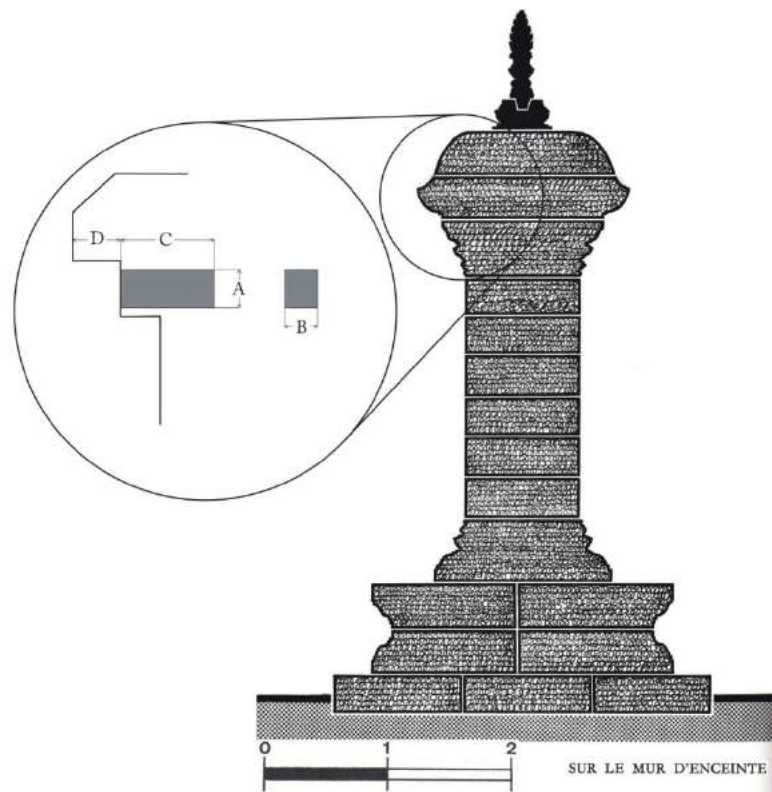


Figure 4.4 Diagram showing the four dimensions of each hole recorded: A (height), B (width), C (depth) and D (overhang) (after Nafilyan 1969)

Horizontal Posthole Selection Criteria

Sections of the wall are covered in postholes of various sizes, so posthole selection criteria had to be developed. The wall is not in a uniform state of completion (see Figure 4.14, page 55). The Western half has had its surface finished with detailed lines and decorative cornices (see Figure 4.10, page 52). It is the finer detailing of the Western half that allows us to designate the Eastern half as a less finished product. In turn, the less finished nature of the Eastern half initially presented problems in terms of feature recognition. Unlike the Western half, in which the postholes were the exclusive aberrations in an otherwise smooth surface, the Eastern half of the wall has numerous other notches and indentations which are of two types: manoeuvring holes and leverage points/finishing guides. These additional, unrelated holes are absent on the Western half because they were chiselled away during the finishing process.

Manoeuvring Holes

Manoeuvring holes are circular, approximately 3cm in diameter and up to 10cm in depth, and are typically found in the centre of the exposed face of a block (see Figure 4.5). They were made as part of the initial block preparation process, facilitating the transport and assembly of the laterite (and sandstone) blocks. These holes are near ubiquitous in Angkorian temples, and presumably are only absent when they have been removed as part of the finishing process. There are examples of manoeuvring holes that are located in an adjoining face between two blocks, which have subsequently been exposed during the surface finishing process (see Figure 4.6). These holes were ignored because they are a constant feature of Angkorian temples and their function is known.



Figure 4.5 - Manoeuvring holes in the exposed face

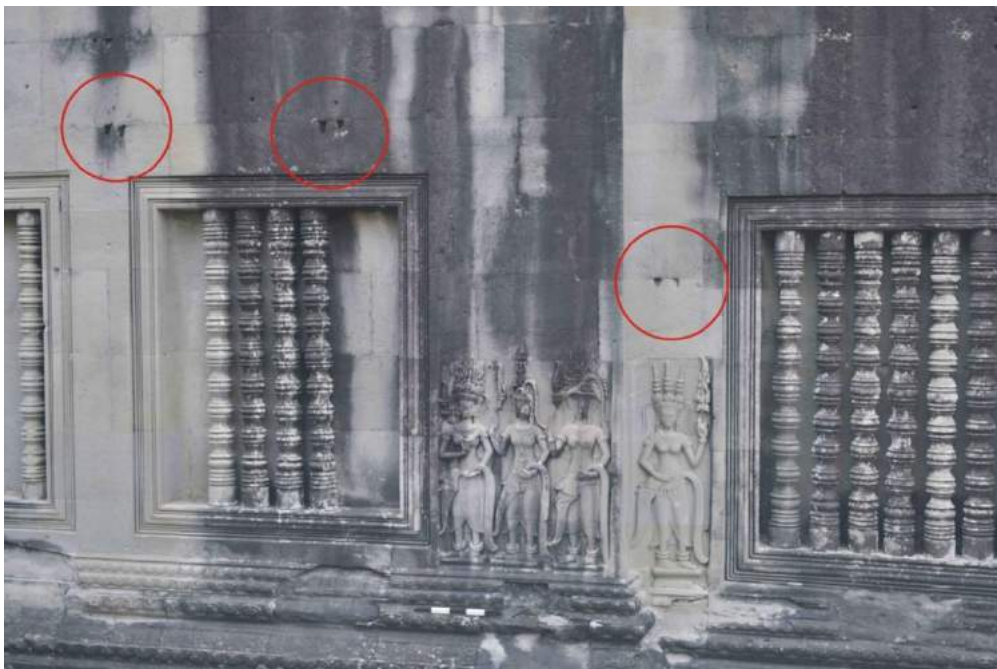


Figure 4.6 - Manoeuvring holes in adjoining faces exposed by surface finishing

Leverage Points/Finishing Guides

Leverage points or finishing guides are shallow (approximately 2-4cm deep) and are always located along the top edge of a masonry block (Figure 4.7). As the name suggests there are two possible explanations for their function. First, they could have functioned as the pivot point at which crow bars were located to lever up the next layer of blocks above. Secondly, these indentations could have functioned as an approximate guide for the level of the

eventual finished surface (Figure 4.8). The Khmer assembled their structures using blocks larger than the finished product. These larger blocks were then carved back to leave a smooth, finished surface.

Unlike the horizontal postholes, these holes:

- are much shallower, offering little anchorage in a mortice/tenon configuration;
- occur on both the interior and exterior faces of the wall;
- are at all heights of these faces.

Regardless of their ultimate function, these holes were also left unrecorded, as they are common along the Eastern sections of the wall which are the least finished.



Figure 4.7 – Indentations, Northeast corner, exterior – Note their presence at all heights of the wall

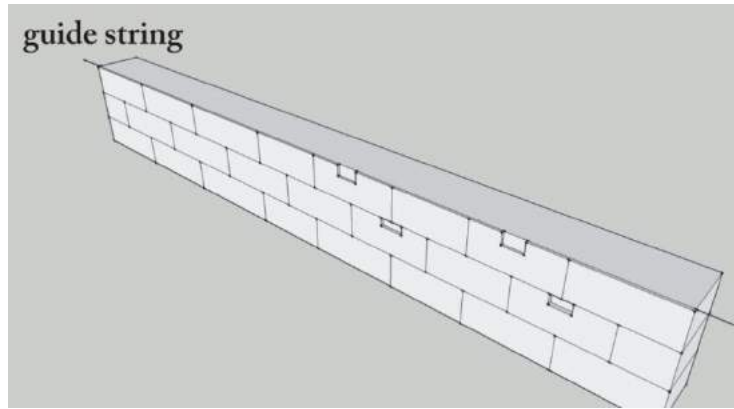


Figure 4.8 - Potential reconstruction of indentation function (Finishing Guides)

Vertical Posthole Survey

The survey of the vertical postholes on the top of the wall was carried out in much the same as the horizontal survey, employing a spotter and the stadia rod. However, time constraints and logistics required a different approach to recording. As they are on top of the wall, the vertical postholes are completely exposed, unlike the horizontal ones which are tucked under the ledge of the top of the wall. Consequently, the vertical postholes are uniformly covered in both detritus and outcrops of organic material which hinders their identification. In addition, these postholes are often filled with hard, compacted dirt which was typically difficult to probe. As a consequence their depths could not be easily recorded. Together, these circumstances led to the adoption of a pragmatic typology (Table 4.1). Depth was not measured as we did not have permission to clear out the holes. For a summary of data correction methods see Appendix A.2.

Table 4.1 - Vertical Posthole Typology

Type	Description	Dimension
1	Large circle	$\varnothing = 20\text{cm}$
2	Medium circle	$\varnothing = 15\text{cm}$
3	Small circle	$\varnothing = 10\text{cm}$
4	Small square	5-7cm square
5	Small rectangle	5-7cm (AR 2:1)
6	Small diamond	5-7cm
7	Large Diamond	10cm
8	Slot – a circular/rectilinear hole which continues to the edge of the block (see Figure 4.9)	$\varnothing = 15\text{-}20\text{cm}$



Figure 4.9 - Slots (Type 8) cut into the South wall

Wall Description

Dimensions and Orientation

Whilst Angkor Wat impresses the observer who walks through it, the temple is by no means perfect in its layout. For example, although not obvious to the casual observer, the outside porch of the West gopura is asymmetrical: the North porch has one post more than the South (Nafilyan et al. 1969: Plate LXVII). Such minor inconsistencies are also evident in the fourth enclosure wall. Though the wall is for all intents and purposes rectilinear it is not perfectly squared: the West and East walls are 814m and 813.5m long respectively, whilst the North and South walls are each 1028.5m and 1030.8m respectively. This is however a very impressive precision in a distance of over one kilometre. Each wall is interrupted near the middle by a *gopura*. The North, East and South gopura are 42m in width, whereas the West gopura is 233m, effectively being five gateways with interconnecting galleries. The height of the wall is consistent around its perimeter at approximately 4.50m above the ground, although the ground level itself varies to a small degree. Where the wall has its surface finished to completion, the cross section, descending from the top, can be described as follows (see Figure 4.10): the upper part of the wall is wider (1.7m) than the main face (0.95m) and a decorative cornice transitions between the two; beneath the main face there are lower decorative mouldings which in turn give way to the base (2.45m in width). However, the above description only applies to the wall on the Western side of the temple

(see page 55). Given these dimensions, the wall is 6.18m² in cross section, and amounts to a volume of nearly 20600m³ of material – not including the *gopura*.

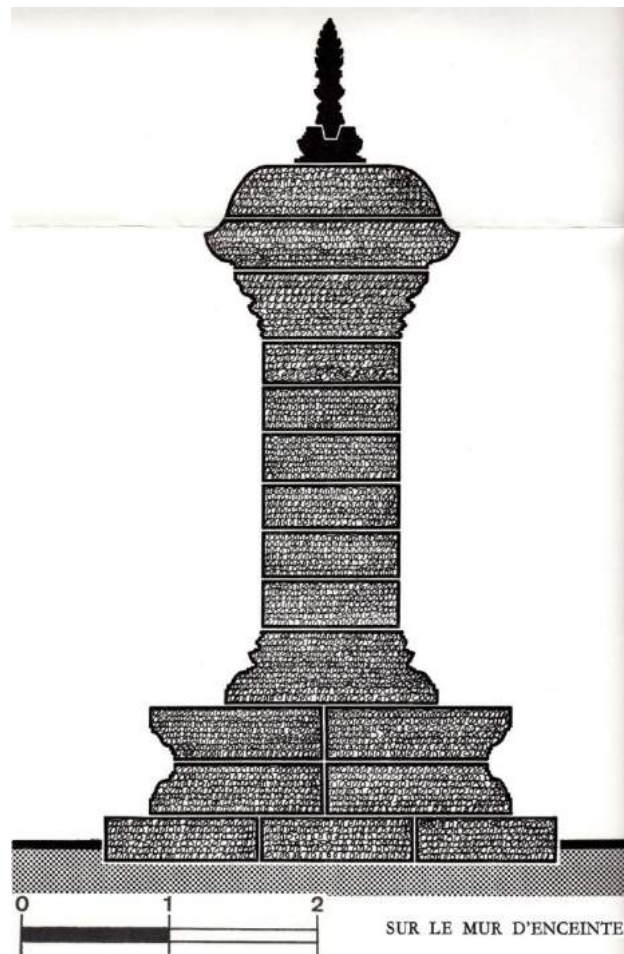


Figure 4.10 - Enclosure wall cross section (after Nafilyan 1969, Plate LXXXIII)

The orientation of the temple is to the West, and yet this too is only an approximation, as the walls are actually skewed slightly to clockwise from the cardinal directions: 1.08° (West wall), 1.49° (North), 0.91° (East) and 1.46° (South).

Materials

The primary material used in the wall is laterite. Laterite is a type of clay deposit with a high iron content, which is abundant in the subsoils of Southeast Asia (Boisselier 1966: 47). When it is moist, it can be easily cut from the ground with a spade and quickly hardens when exposed to air (Tardy 1997: 1). Laterite is readily available throughout the Angkor plain though the best comes from quarries close to the Kulen hills, approximately 30km to

the North. In addition to the laterite some components of the wall are made of sandstone, which was also sourced from the Kulen hills. Along the top of the West wall for example there is a sandstone coping stone in which finials would have been placed (Figure 4.11).



Figure 4.11 - Sandstone coping stone with postholes for finials, West wall facing North.

The *gopura* are made of sandstone, but they also have fittings for large wooden doors in their thresholds. No traces of the wooden doors remain. Finally, sections of the wall with noticeably different block work (see below, page 56) feature both sandstone and laterite masonry.

Method of Assembly

The construction of the wall and the *gopura* make use of the same methods of assemblage. Each masonry block has small circular holes (manoeuvring holes – see page 48) cut into it on two opposite faces which facilitated moving the blocks. Into these holes wooden pegs were

wedged, and these in turn were doused in water so that they expanded in the holes to form a firm anchorage point about which manoeuvring ropes were tied. The blocks could then be manoeuvred from the quarry to the construction site, probably by barge. When the blocks were assembled on site, they were then lifted into position using pulleys and levers. Once a block was in position, it was then ground back and forth using the pegs as anchor points for pull ropes and spars so that a smooth edge was formed between it and the blocks beneath and beside it (Figure 4.12). This task was accomplished with a crew of four men, as depicted in the bas-reliefs of the Bayon (Figure 4.13).

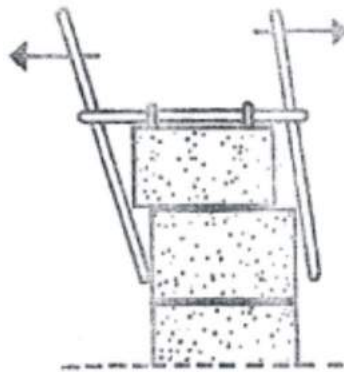


Figure 4.12 Method of grinding blocks (Nafilyan 1967)



Figure 4.13 Bayon bas-relief showing two construction crews – note the horizontal bars and pulleys used to lift the blocks, and the vertical bars used to grind the blocks together (Polkinghorne 2007)

The blocks were assembled in this way prior to their exterior surfaces being finished. The process of surface finishing which occurred at a later stage involved chiselling off the outside face of the assembled blocks, in effect replacing the uneven surfaces with a uniform one. This included a decorative cornice and lower mouldings, as well as a stylised base (see Figure 4.10 above). However, this process was not uniformly completed along the length of the wall. Whereas the Western half of the wall has, by and large, had its surface finished,

the entire Eastern half of the wall was left in an unfinished state (Figure 4.14), with some gradation of finished work from West to East.



Figure 4.14 The difference in surface finish between the West half (above) and the East (below)

Anomalies

There are several anomalies in the fourth enclosure wall which require comment. These include sections of the wall which feature noticeably different block work and materials

compared to the rest of the wall. These sections, although they form part of the enclosure wall continuum, will be referred to as “the gateways”. In addition, there are sections of the wall in which the level of surface detail finish deviates from that described above. Furthermore there is a break in the wall on the East side. Finally the condition of the windows of the South *gopura* is different to that of the other three.

Gateways

The gateway locations are discernable by their obviously different masonry patterns and materials (see Figure 4.15 Figure 4.20).

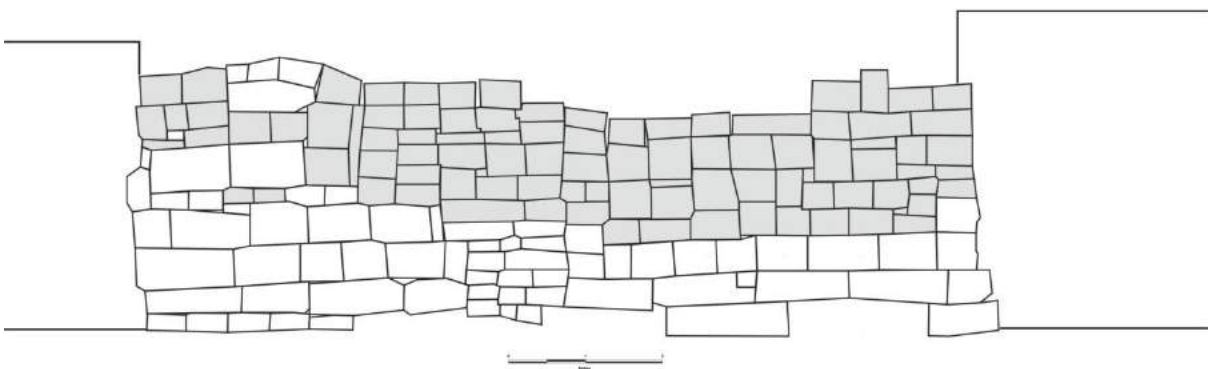


Figure 4.15 - Photo and masonry pattern of the West gateway on the North wall – sandstone (grey), laterite (white)

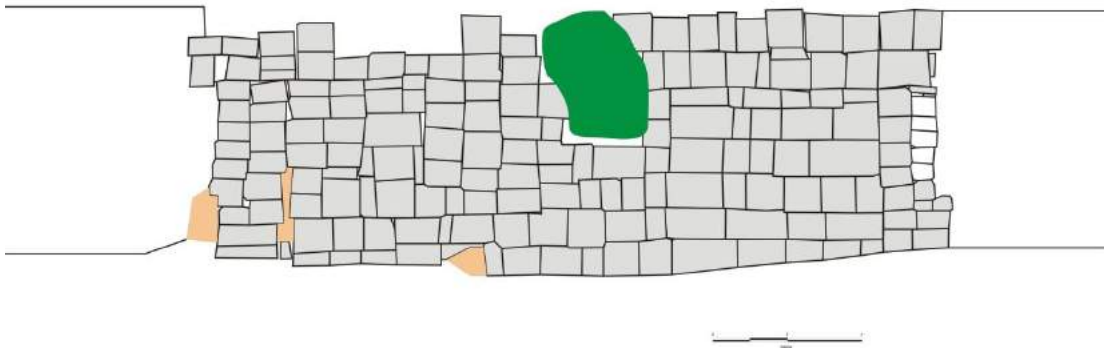


Figure 4.16 - Composite photo and masonry pattern of the East gateway on the North wall – sandstone (grey), laterite (white), foliage (green) and termite mound (beige)

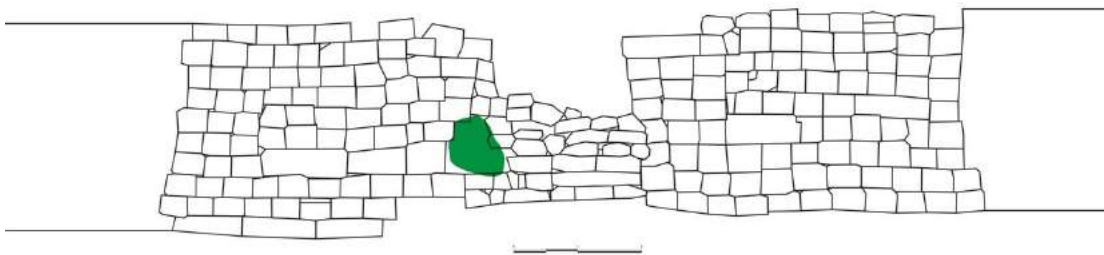


Figure 4.17 - Photo and masonry pattern of the North gateway on the East wall – laterite (white), foliage (green)

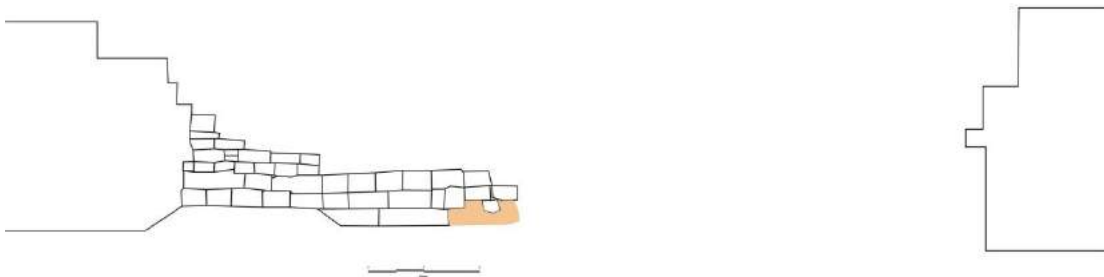


Figure 4.18 - Photo and masonry pattern of the South gateway on the East wall – laterite (white), termite mound (beige)

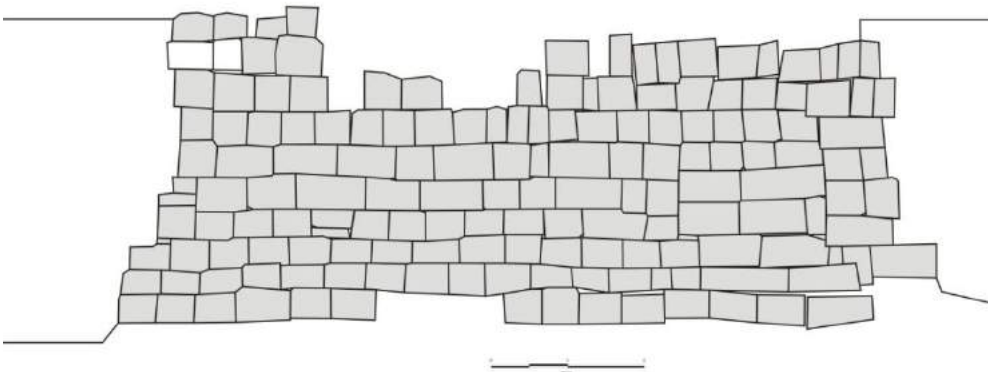


Figure 4.19 - Photo and masonry pattern of the East gateway on the South wall – sandstone (grey), laterite (white)

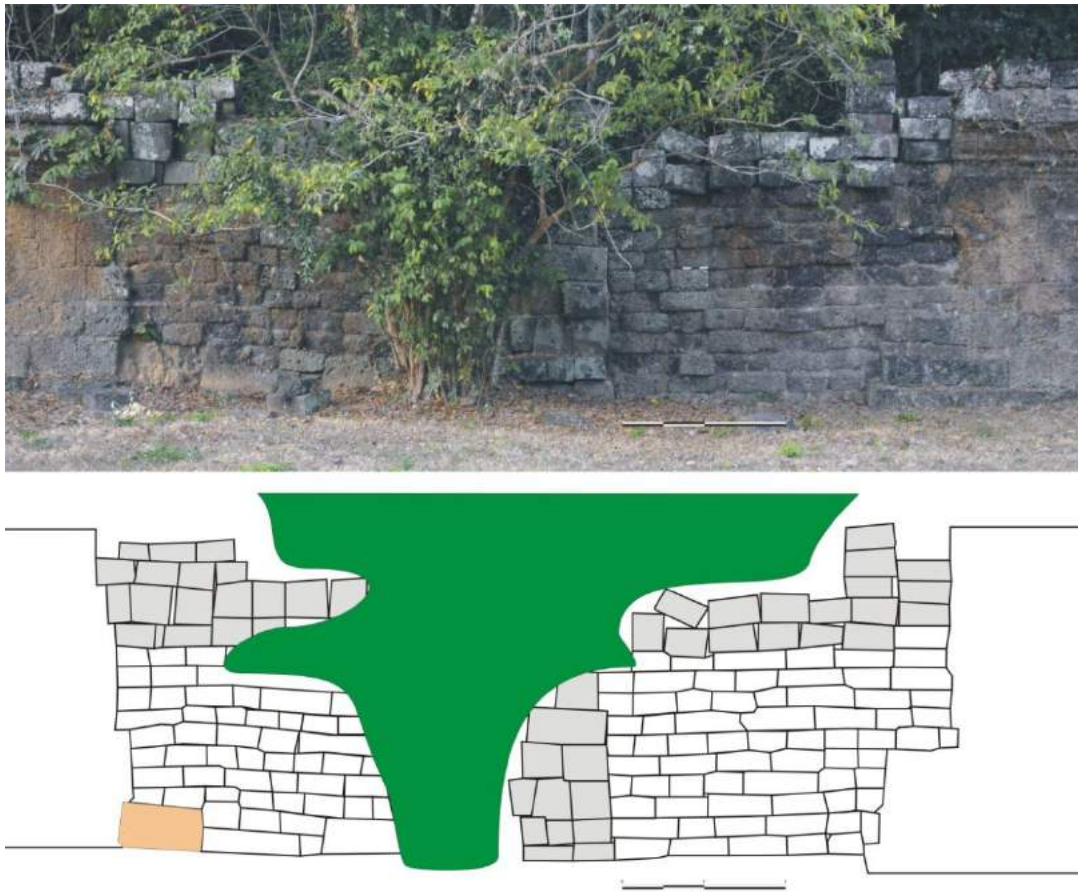


Figure 4.20 - Photo and masonry pattern of the West gateway on the South wall – sandstone (grey), laterite (white), foliage (green) and termite mound (beige)

These gateways are also uniformly spaced along the North, East and South walls and in alignment with staircases around the temple itself. There are twelve staircases located between the third and fourth enclosures which facilitate access to an intermediate level between the ground level⁹ and the third enclosure gallery (Figure 4.21). The staircases are symmetrically distributed around the temple, three on each side (Figure 4.22), and the central staircases are aligned with their respective *gopura* (Figure 4.23). The Western *gopura*, although much larger than the other three, still has its outer doorways aligned with its respective outer staircases. The remaining six staircases are all in alignment with the gateways (Figure 4.24), and effectively compliment the alignment of the *gopura* (Figure 4.25). The alignment of the gateways therefore makes their positioning seem deliberate.

⁹ The central Western staircase is actually located on the causeway, and thus already above ground level.



Figure 4.21 - Central Northern staircase between the ground level (right) and intermediate level (left)



Figure 4.22 - Locations of staircases (red) (GoogleEarth)



Figure 4.23 - The *gopura* (green) and their alignment (blue) with the central staircases; outer doorways of the West *gopura* and their alignment also shown. (Google Earth)



Figure 4.24 – “Gateways” (red) and their alignment (yellow) with the staircases within (GoogleEarth)



Figure 4.25 - Alignment of “gateways”, *gopura* and staircases, superimposed (Google Earth)

One final feature of the gateway sections is that some of them contain decorated sandstone blocks (Figure 4.26). These carvings resemble the decorative style of monuments from the Bayon era of construction (late 12th to mid 13th century) (Pottier pers. comm.)



Figure 4.26 - Decorated blocks in the North wall, East gateway - left: exterior; right: interior

Changes in Surface Finishing

There are sections of the Western parts of the wall which require comment. As described above, the Western half of the wall differs to the Eastern in that it has had its surface finished with uniform lines and decorative cornices and base. However, certain sections of the West parts of the North and South walls do not feature this uniform surface finish (Figure 4.27, Figure 4.28).



Figure 4.27 - Changes in surface finish detail in the South wall, West sector, exterior, near the West gateway –West of the gateway (left) and East of the gateway (right)



Figure 4.28 - Changes in surface finishing detail in the North wall, West sector, interior, near the West gateway (to the right of frame)

Modern Vehicle Gap

A brief note is required concerning one of the gaps in the enclosure wall. On the East wall between the North gateway and the *gopura*, there is a section of the wall which has collapsed and, like the gateways, has some noticeably different block work. This gap is now the access route for vehicles into the enclosure (Figure 4.29).

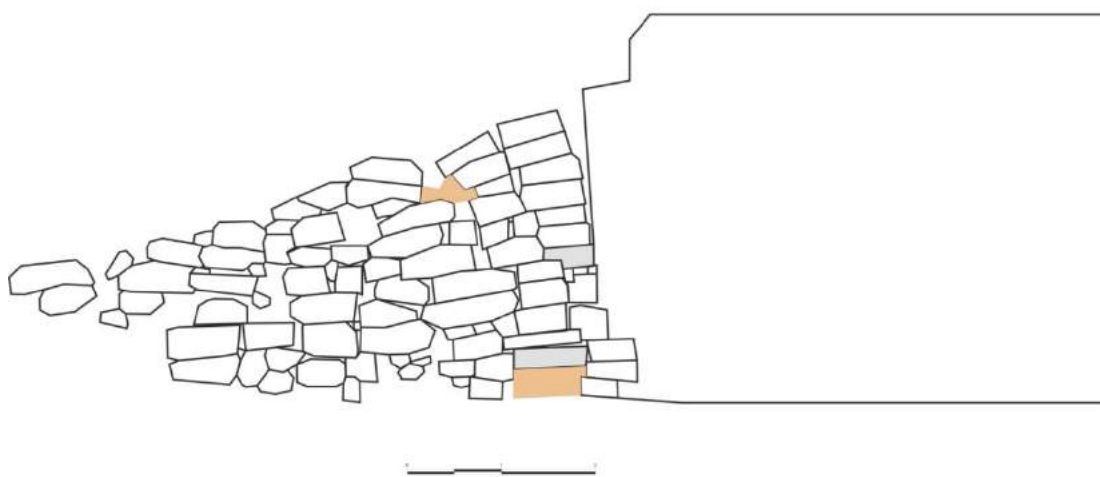


Figure 4.29 - Photo and masonry pattern of the gap in the East wall, interior – sandstone (grey), laterite (white), termite mound (beige)

South Gopura

The South gopura of the fourth enclosure also requires comment due to some anomalous features. As mentioned previously the South *gopura* has the same dimensions as both the North and East gopura as shown in Nafilyan's plan (Figure 4.30).

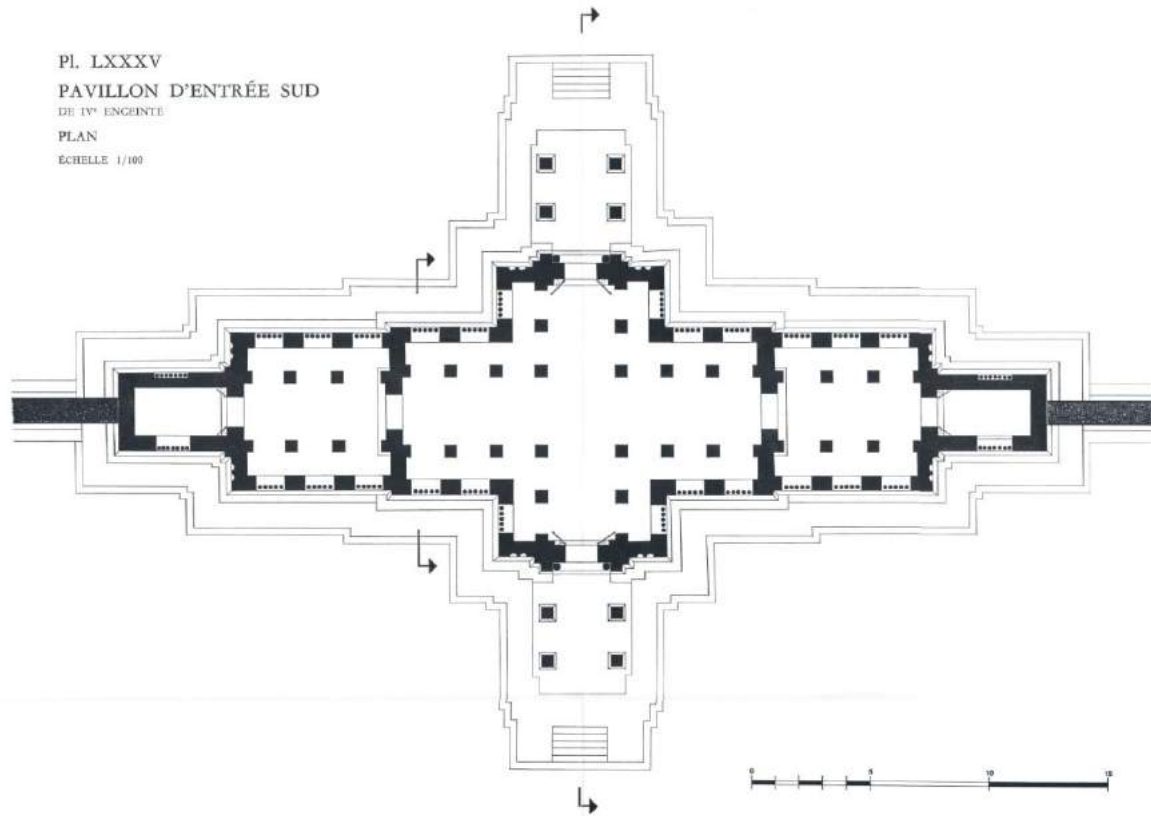


Figure 4.30 - Floor plan of the South gopura of the fourth enclosure (Nafilyan 1969: Plate LXXXV)

However, Nafilyan's description of the South gopura as being *identical* to the North and the East (1969: 27, emphasis added) is inaccurate¹⁰, as nearly all of the real windows of the South gopura have been blocked in (Figure 4.31). The materials used in this blocking fill are roughly hewn sandstone. Furthermore, like certain gateways in the enclosure wall some of the sandstone blocks have decorative carvings (Figure 4.32).

¹⁰ This is no doubt due, like so much of the research into Angkor Wat, to his focus on the original phase of construction and use.



Figure 4.31 - The difference in block work between a false window (above) and real window with blocked up infill (below); South gopura, interior.



Figure 4.32 - Sandstone blocks with decorative carvings – South gopura, exterior

Conclusions

A survey method suited to the prevalent conditions was devised to record the postholes. Marks and indentations which are known to relate to the masonry blocks transportation and assembly were not recorded to ensure the consistency of the recorded posthole dataset. These other marks, which are unrelated to the postholes, are apparent because the wall is not finished uniformly and their presence enables an understanding of the construction process. The comprehensive scope of the survey – all but the top of parts of the West wall – permits a detailed analysis of the standardisation and distribution of the postholes. A detailed study of the characteristics of the wall can be used as an index for chronology.

5. Survey Results

To identify the function and dating of the postholes required analyses of their size, distribution and inter-relationship. Three key aspects were examined: 1) the horizontal and vertical postholes by themselves to assess if there is any standardisation in their characteristics; 2) the relationship between the horizontal and vertical postholes; and 3) the relationship between the postholes, the wall and the chronology of Angkor Wat. Finally, other aspects relating to the wall's chronology are analysed.

Horizontal Postholes

Dimensions

The horizontal holes on the inside face of the wall, of which there are 1071, are highly regular in their dimensions. Over 80 percent of the postholes are 11-20cm high, over 95 percent are 11-15cm wide, 80 percent are 16-30cm deep, and 85 percent have a cross sectional area 151-300cm² (Figure 5.1 and Figure 5.2). The Western half is most regular in its dimensions because the form of the wall is highly uniform - in the Eastern half the depths of the postholes are impacted by the uneven nature of the blockwork (Figure 5.3); this is also evident in the comparison of dimension D values between the Eastern and Western halves of the wall (Figure 5.4).

Distribution

The horizontal holes also demonstrate regularities in their spacing and distribution, particularly along the West and South walls, and along the West portion of the North wall. Along these sections of the wall the holes are generally spaced in a very regular pattern, which consists of a set of 7 holes spaced at 2.5 - 3m, followed by a larger gap of 9m (Figure 5.5 and 5.6). The other sectors of the wall also exhibit this pattern to a degree, but it is broken up by longer sets of postholes without a large gap. The postholes are also at a uniform height above the ground, between 3.2 and 3.6m (Figure 5.7).

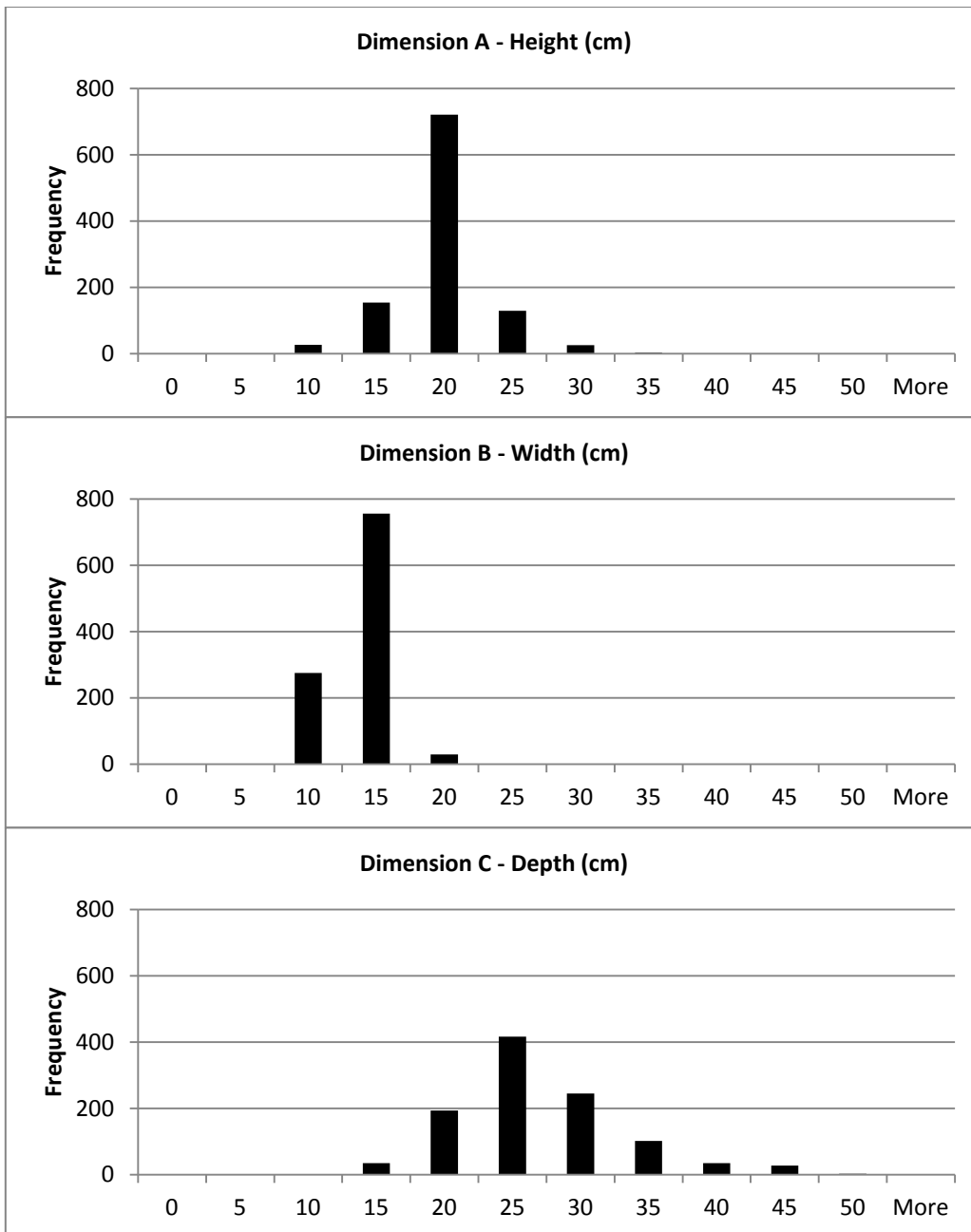


Figure 5.1 - Dimensions of the horizontal postholes (cm) – Entire wall

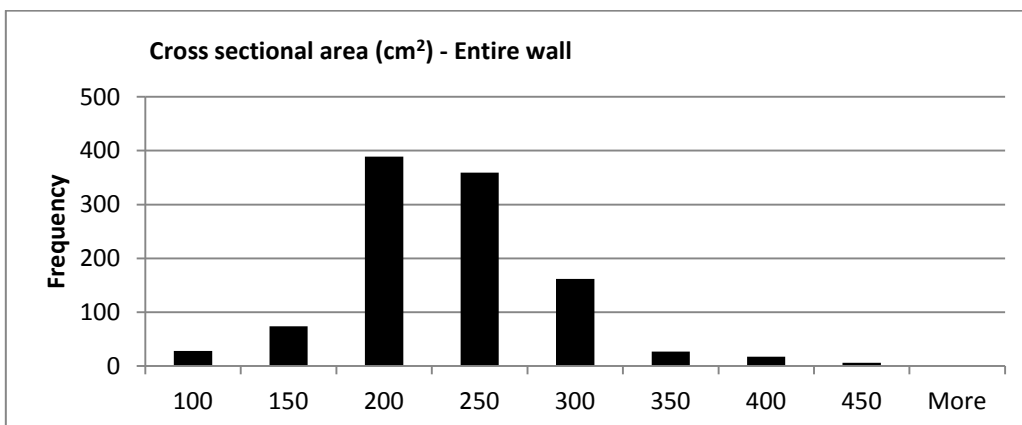


Figure 5.2 - Cross sectional area of the horizontal postholes (cm²) - Entire wall

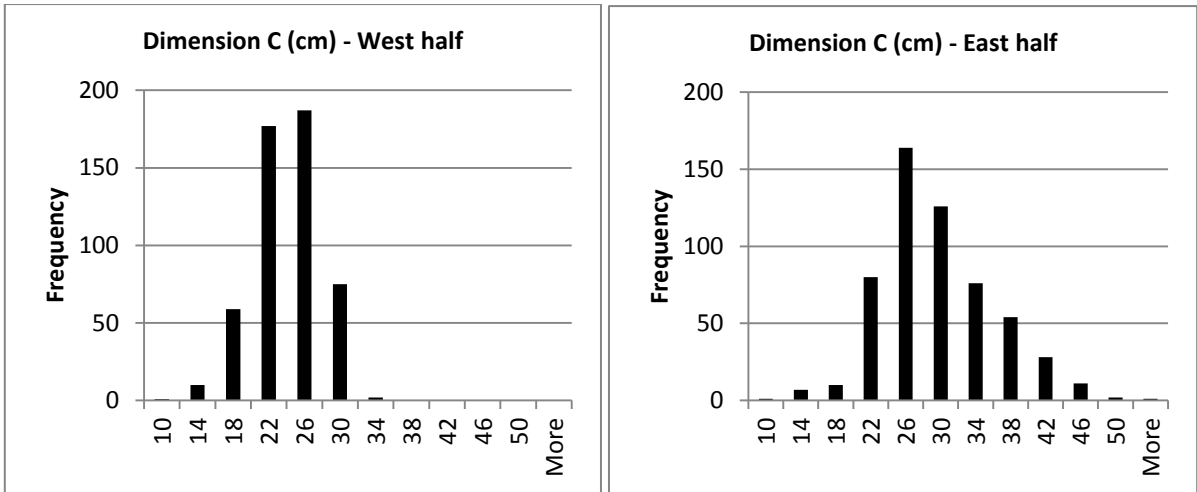


Figure 5.3 - Dimension C (depth) values, West (left) and East (right) halves - Note the tighter clustering of the West half.

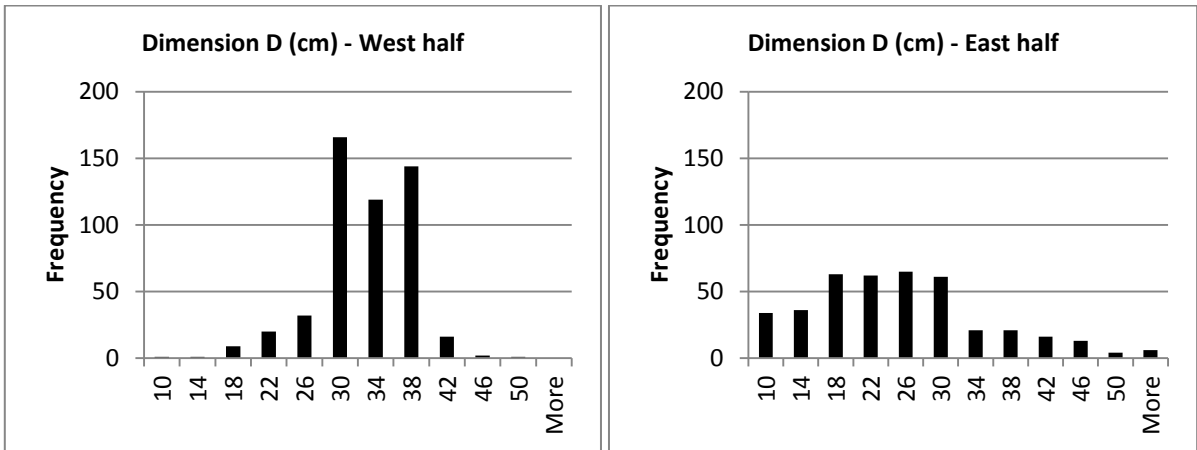


Figure 5.4 - Dimension D (overhang) values, West (right) and East (right) halves - Note the tighter clustering of the West half.

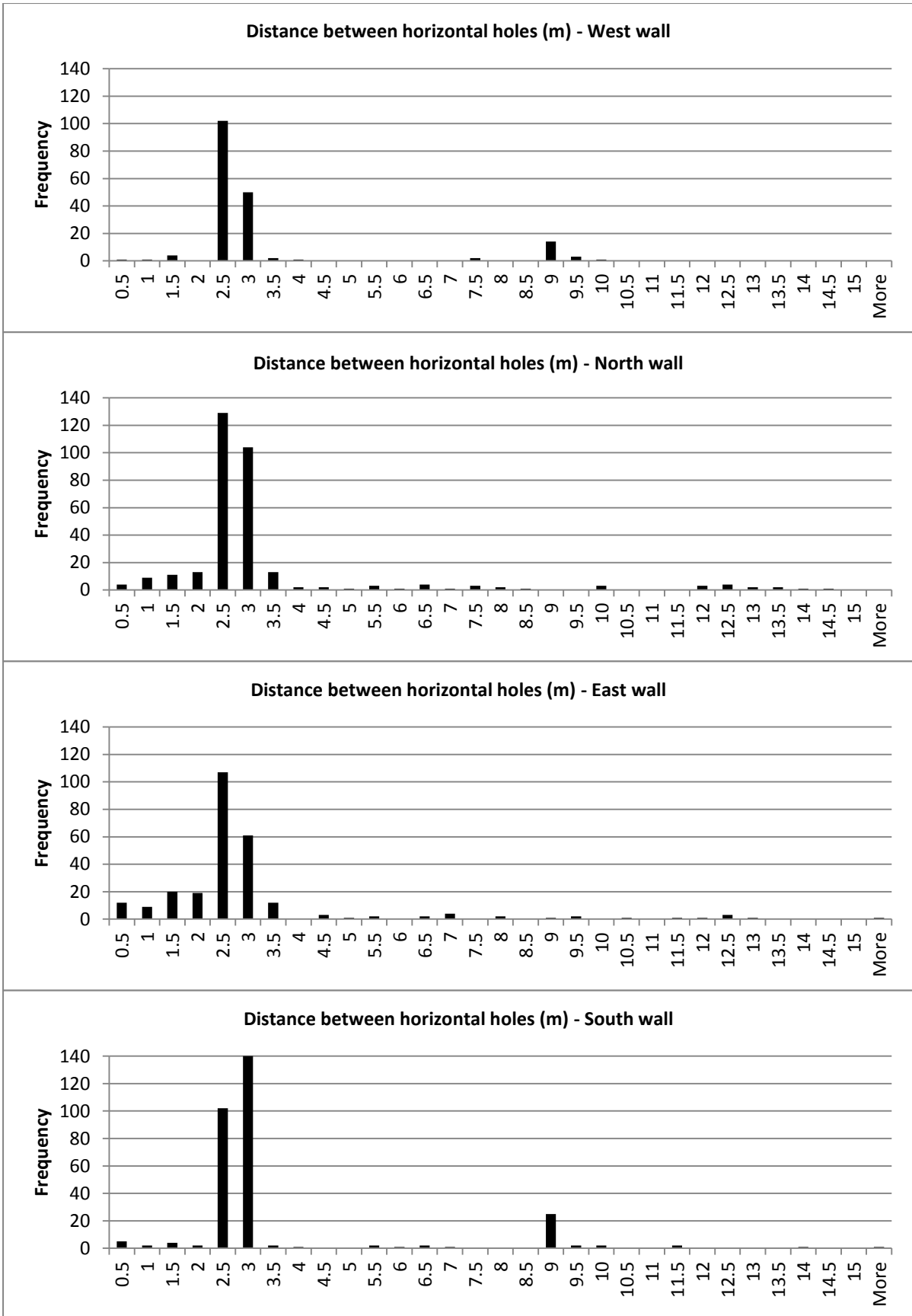


Figure 5.5 - Distance between horizontal postholes – Note the clustering at 2.5-3.0m and 9.0m on the West and South walls.

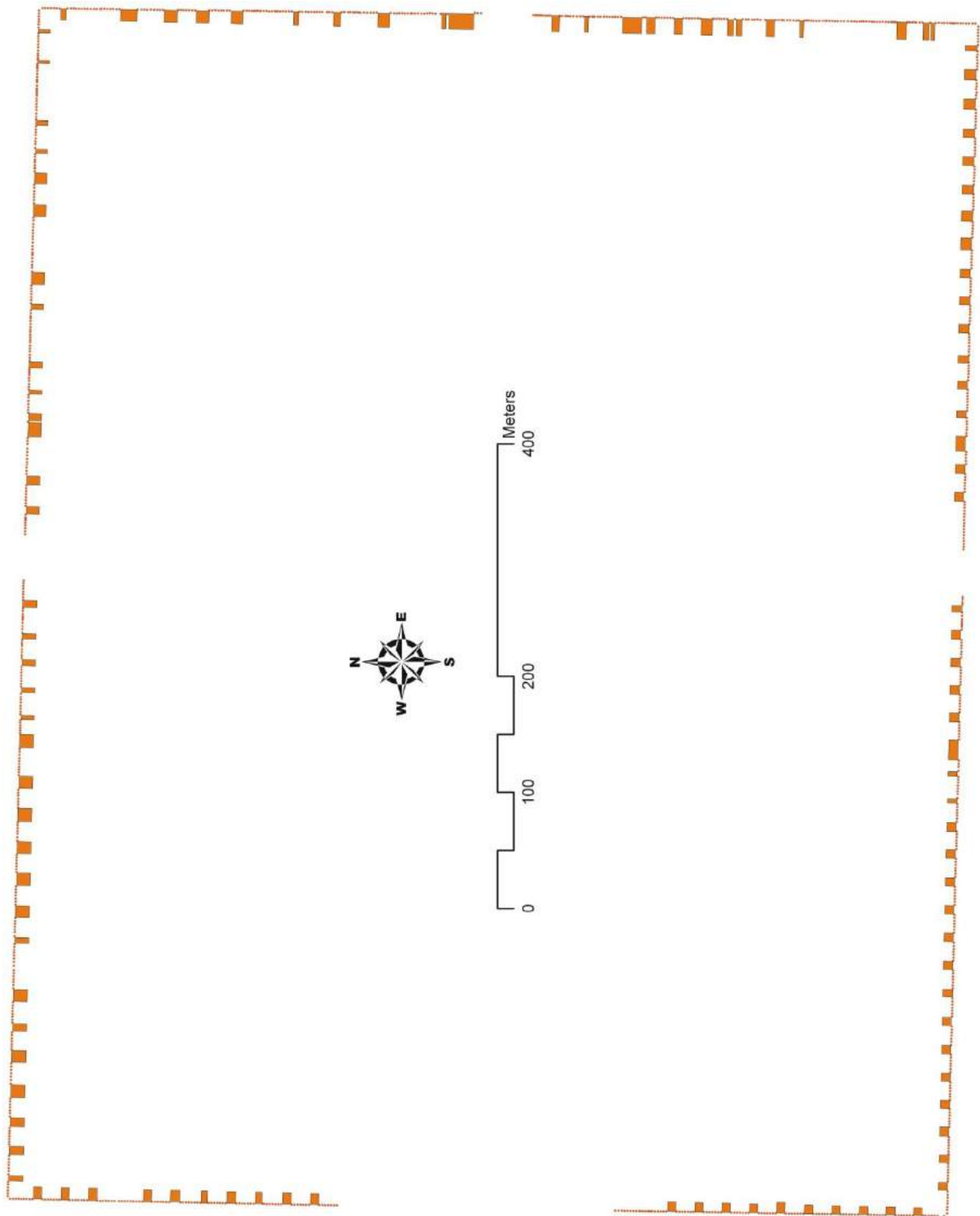


Figure 5.6 - Horizontal postholes (points) with the gaps between sets highlighted (rectangles) - Note the regular spacing along the South and West walls, and the West side of the North wall.

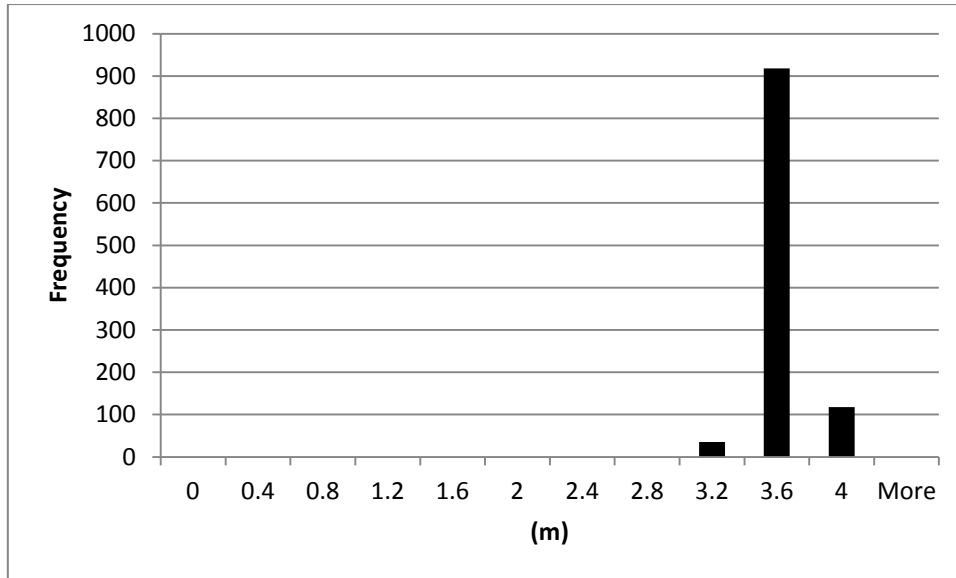


Figure 5.7 – Horizontal postholes height above ground level (m) – Note the clustering around 3.6m

Anomalies

There are several instances around the wall where the postholes are clustered or form parallel lines (Figure 5.8, Figure 5.9).



Figure 5.8 - Postholes forming parallel lines: East wall, South side, near the East gopura.



Figure 5.9 - A cluster of postholes: South wall, West side, near the South gopura.

Vertical Postholes

The vertical holes on the top of the wall display a complex distribution of holes of various shapes and sizes (see Appendix A.5).

Dimensions

As mentioned previously, the dimensions of the vertical postholes were not individually measured. Rather, a pragmatic typology was used to describe them (see Table 4.1, page 50). There were 2367 postholes on top of the walls which were surveyed completely¹¹. The most abundant postholes were the Type 3 (65%), Type 4 (14%) and Type 2 (8%) (Figure 5.10).

¹¹ Due to the presence of the coping stone which obscures the centre of the wall, the survey of the West wall was left incomplete. The survey was only carried out to the extent that postholes consistent with the rest of the wall were located.

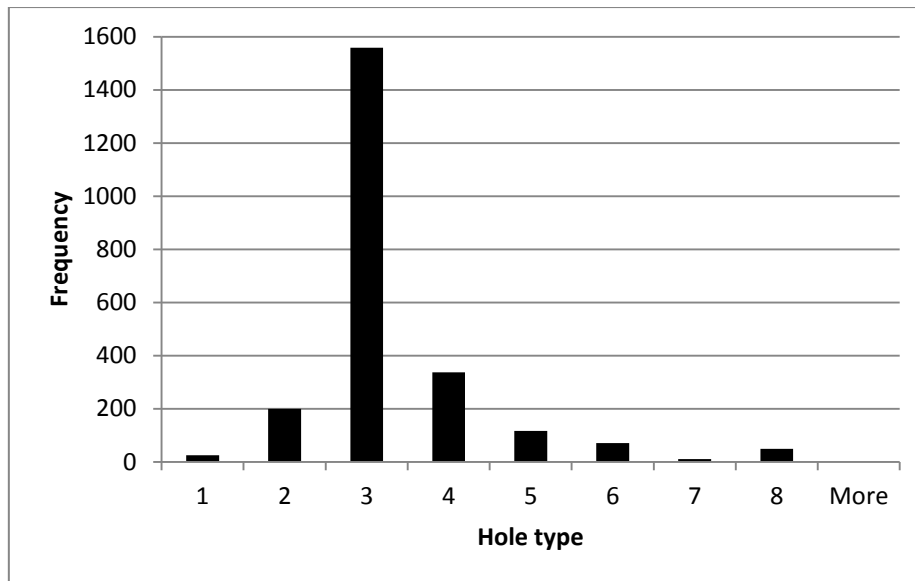


Figure 5.10 - Frequency of vertical posthole types; North, East and South walls – Note the dominance of Type 3 holes.

Distribution

Assessing the patterns amongst these different types of holes was no simple task. With eight different types of postholes, analysing each of the types on its own produced little information of value. However, even though the eight different types have their own unique traits, there are other ways in which the types can be grouped together. One such way in which the classification of the posthole types can be simplified is by grouping them by overall size: that is, the smaller holes and the larger holes. Although it is an arbitrary number, if the holes are separated on the condition of whether they are greater or smaller than 15cm across, noticeable patterns arise. This condition results in two new groups: Types 1, 2 and 8; and Types 3, 4, 5, 6 and 7. As the histograms and diagram demonstrate (Figure 5.11 and Figure 5.12), the spacing of Types 1, 2 and 8 along the North and South walls is regular and similar in respects to the horizontal holes on the inside face. Like the horizontal postholes, these large vertical postholes are distributed in sets. While the sets feature fewer postholes, typically three, they too are spaced between 2.5 to 3m. The gaps between the sets are much larger, at between 10 and 20m. The East wall does not display this regularity. As to the West wall, due to time constraints, only a small section of this wall was surveyed.

The other group of holes, Types 3, 4, 5, 6 and 7 also demonstrate regularities. These types are often aligned with each other, in groups of two or three, across the wall (Figure 5.13).

The spacing of these grouped postholes is also very regular, with 85 percent of them spaced between 0.31m and 0.6m across the wall¹² (Figure 5.14).

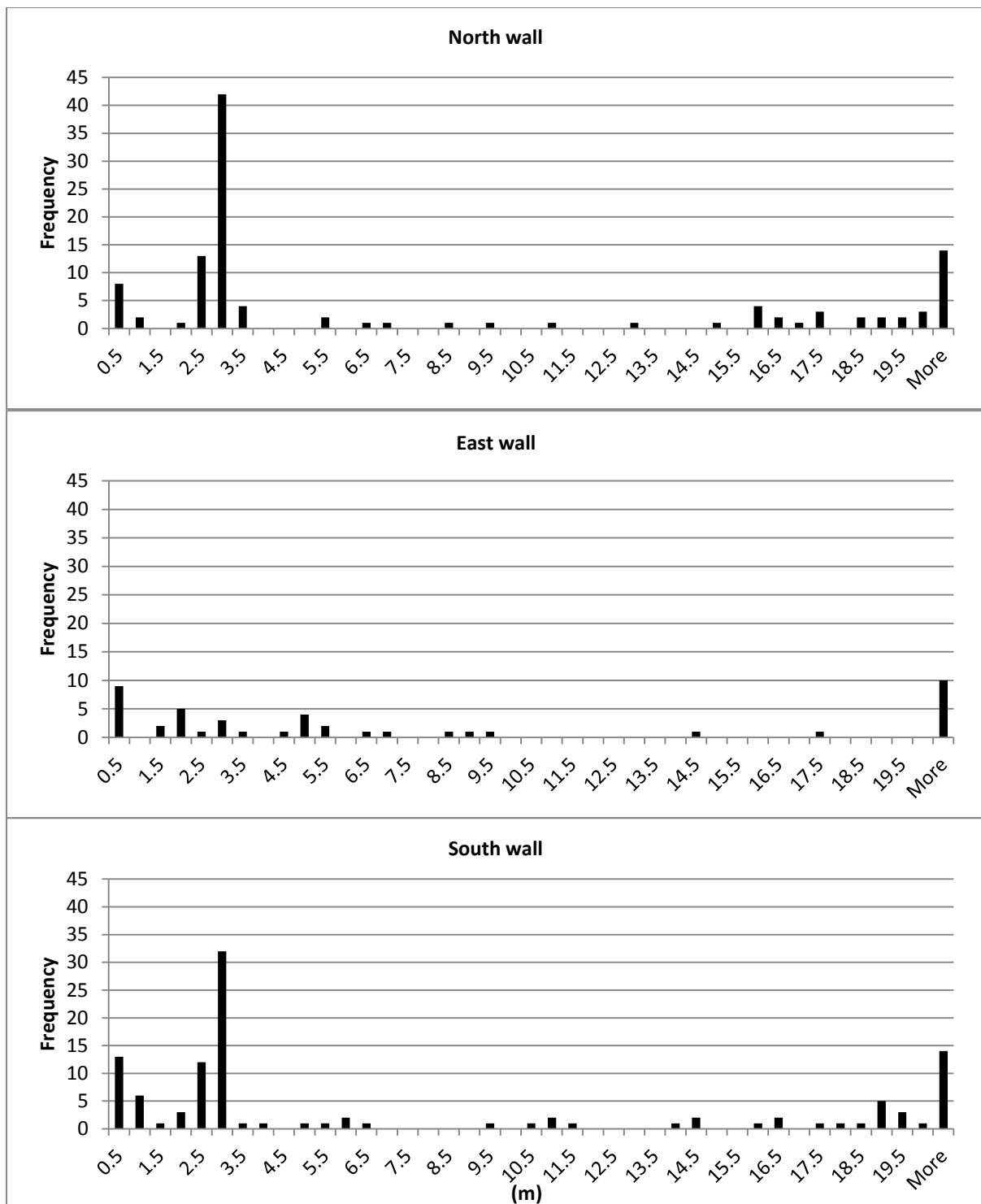


Figure 5.11 - Frequency histograms of the spacing (m) between postholes (Types 1,2 and 8): North wall (above), East wall (middle) and South wall (below) – Note the clustering around 3m on the North and South walls

¹² This limit in spacing is of course restricted by the width of the wall.

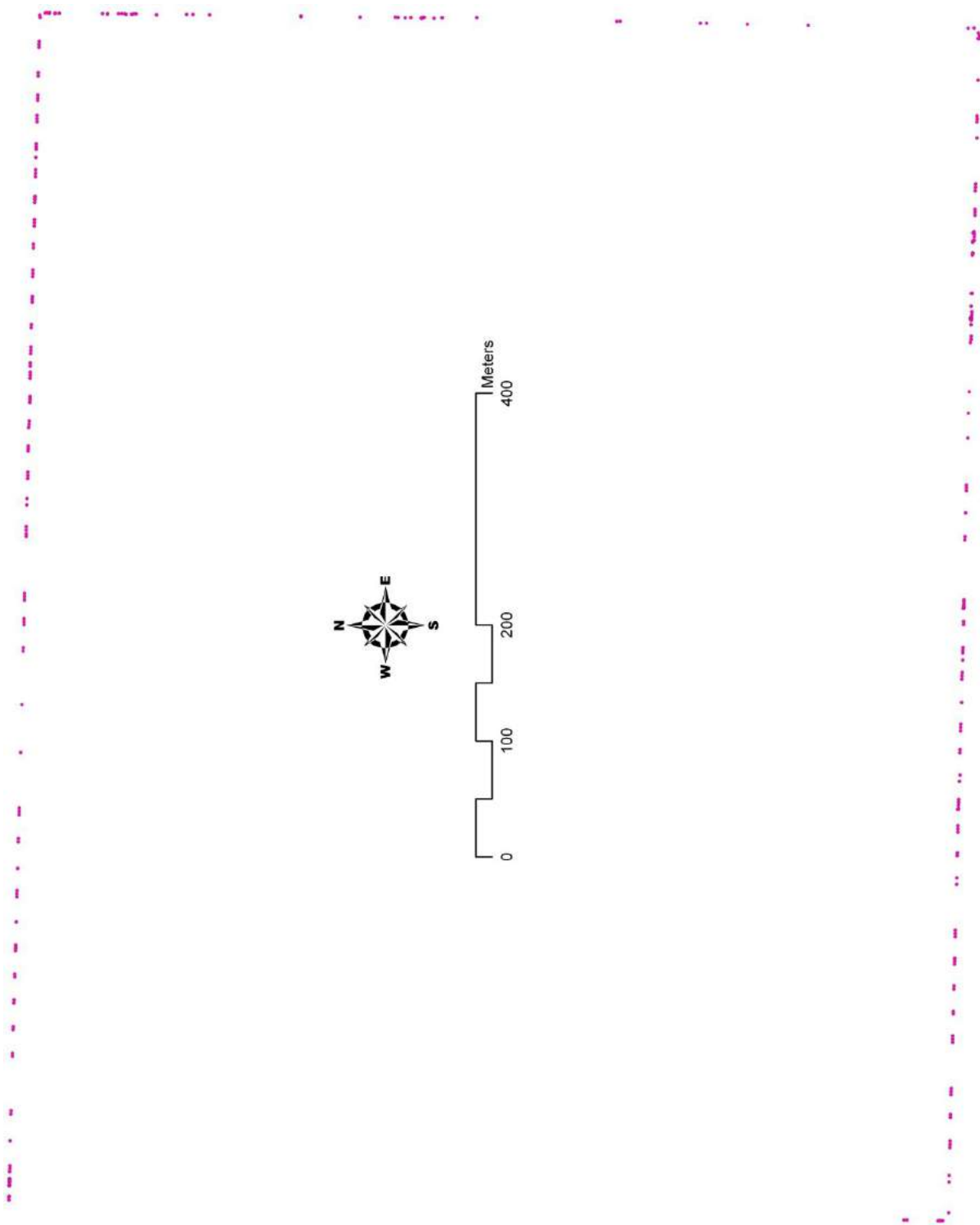


Figure 5.12 – Vertical postholes (Types 1, 2 and 8) – Note the regular patterns along the North and South walls, as well as the irregularities along the East wall.



Figure 5.13 Groups of postholes aligned across the wall: three Type 3s (above), two Type 4s (below) – East wall, North side, near the East gopura

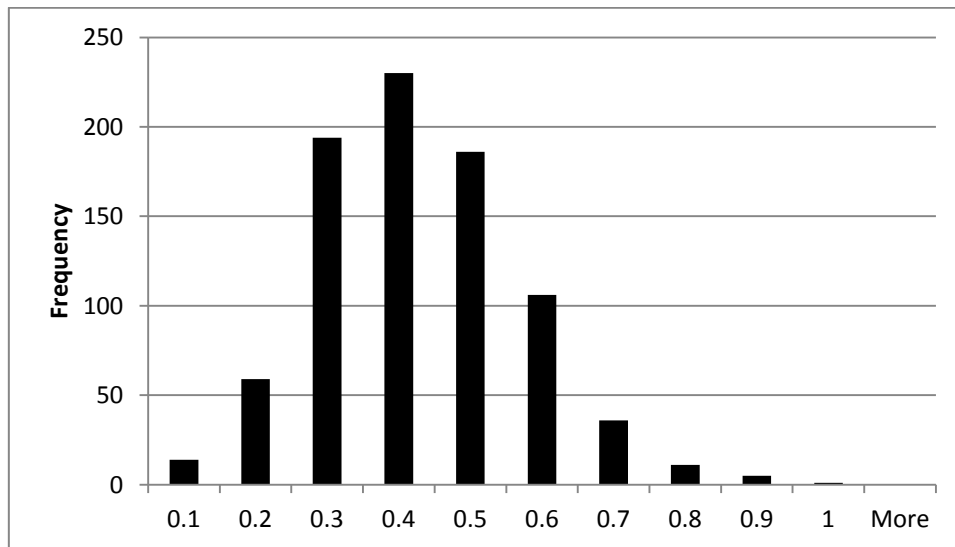


Figure 5.14 Distance (m) between grouped holes (all types) ACROSS the wall - Entire wall

An interesting relationship also exists between the larger and smaller postholes: the smaller postholes are very rarely located within a set of larger postholes. Rather, the smaller postholes are located in the gaps between the sets of large postholes. Again, this relationship is mostly contained to the North and South walls (Figures 5.15 - 5.17)

Anomalies

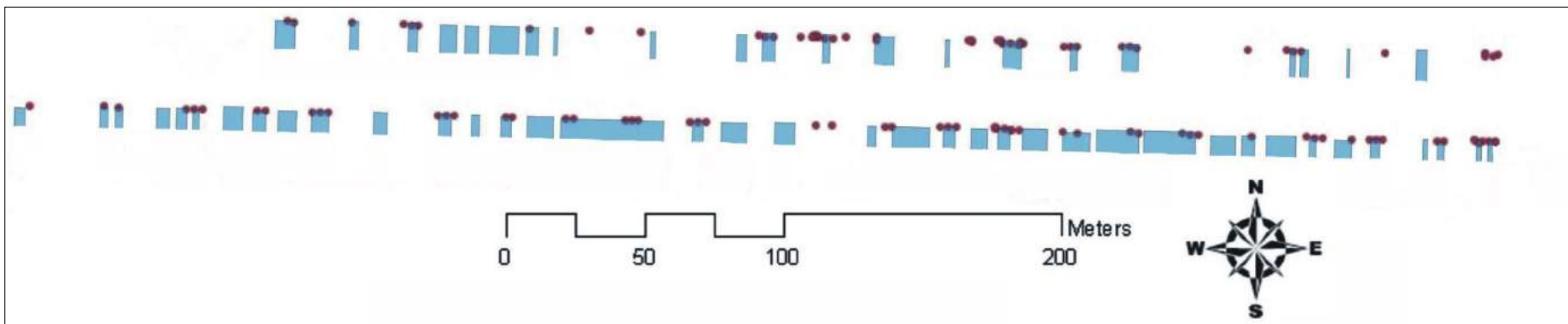
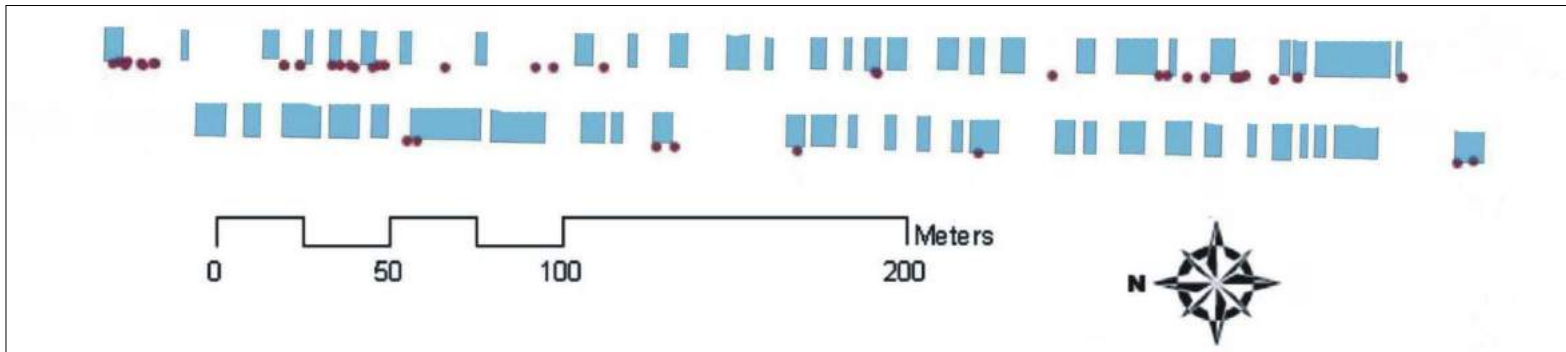
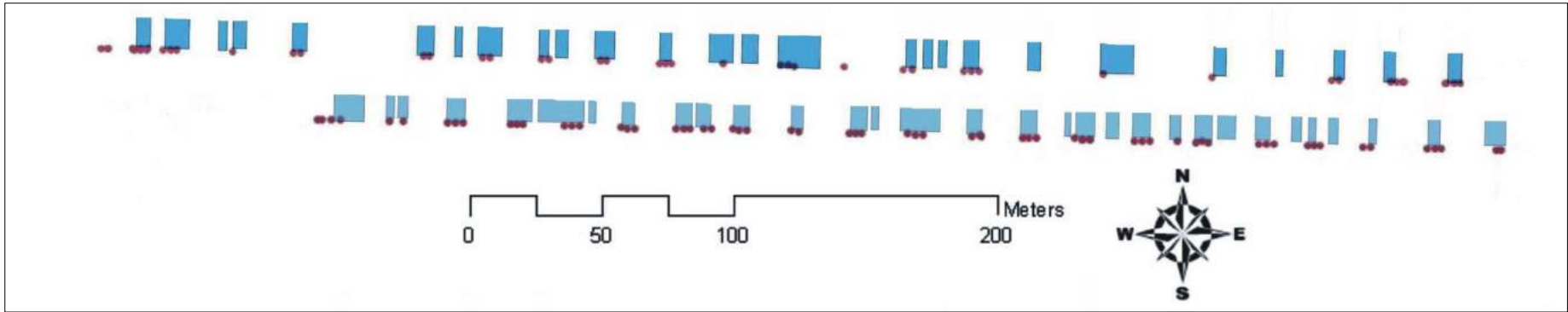
As has been mentioned, the East wall is markedly different to the North and South walls in that it lacks the regular sets of larger Type 1, 2 and 8 holes. Furthermore, the North side of the East wall has significantly more of these holes than the South side (see above Figure 5.12, and below Table 5.1). With respect to the smaller holes, the East side of the South wall has a much higher number of these holes than the other sections of the wall (Figure 5.18).

(Next page)

Figure 5.15 (top) – Vertical postholes (Types 1, 2 and 8 - purple) superimposed with the larger gaps between the small postholes (types 3, 4, 5, 6 and 7 – light blue), North wall, West side (above) and East side (below) – Note the correlation between light-blue bars and purple dots.

Figure 5.16 (middle) – Vertical postholes (Types 1, 2 and 8 - purple) superimposed with the larger gaps between the small postholes (types 3, 4, 5, 6 and 7 – light blue) – East wall, North side (above) and South side (below)

Figure 5.17 (bottom) – Vertical postholes (Types 1, 2 and 8 - purple) superimposed with the larger gaps between the small postholes (types 3, 4, 5, 6 and 7 – light blue), South wall, East side (above) and West side (below) – Note the correlation between light-blue bars and purple dots.



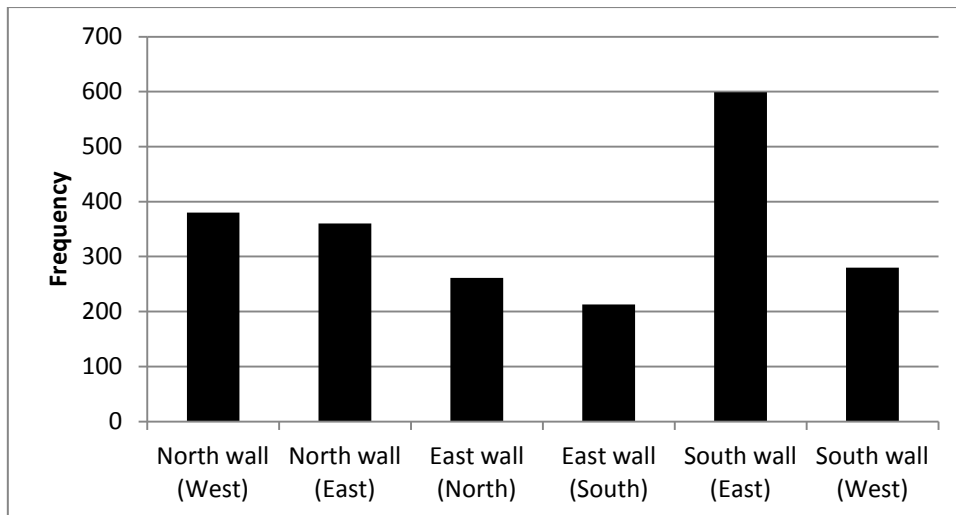


Figure 5.18 – Frequency of postholes (Types 3,4,5,6 and 7) by wall section. Note the peak on the Southeast section.

The Distribution of the Postholes Relative to Each Other

When the distribution of large vertical postholes (Types 1, 2 and 8) is superimposed on the distribution of the horizontal holes on the inside face, an interesting relationship appears. As Table 5.1 and these plots demonstrate, along the North and South wall a clear pattern is evident: when there is a larger gap between the horizontal holes, more often than not there is also a larger gap between vertical holes (Figure 5.19 to Figure 5.22).

Table 5.1 - Number of vertical postholes (types 1, 2 and 8) and the number of which are located in between sets of horizontal postholes - by wall sector

Section		Type 1,2, and 8 holes – Total (T)	Type 1,2 and 8 holes -in a Horizontal gap (H)	Percentage (%) (H/T)*100
North wall	West side	49	11	22
	East side	65	6	9
East wall	North side	39	6	15
	South side	8	1	13
South wall	East side	51	8	16
	West side	62	6	10
Entire wall		274	38	14

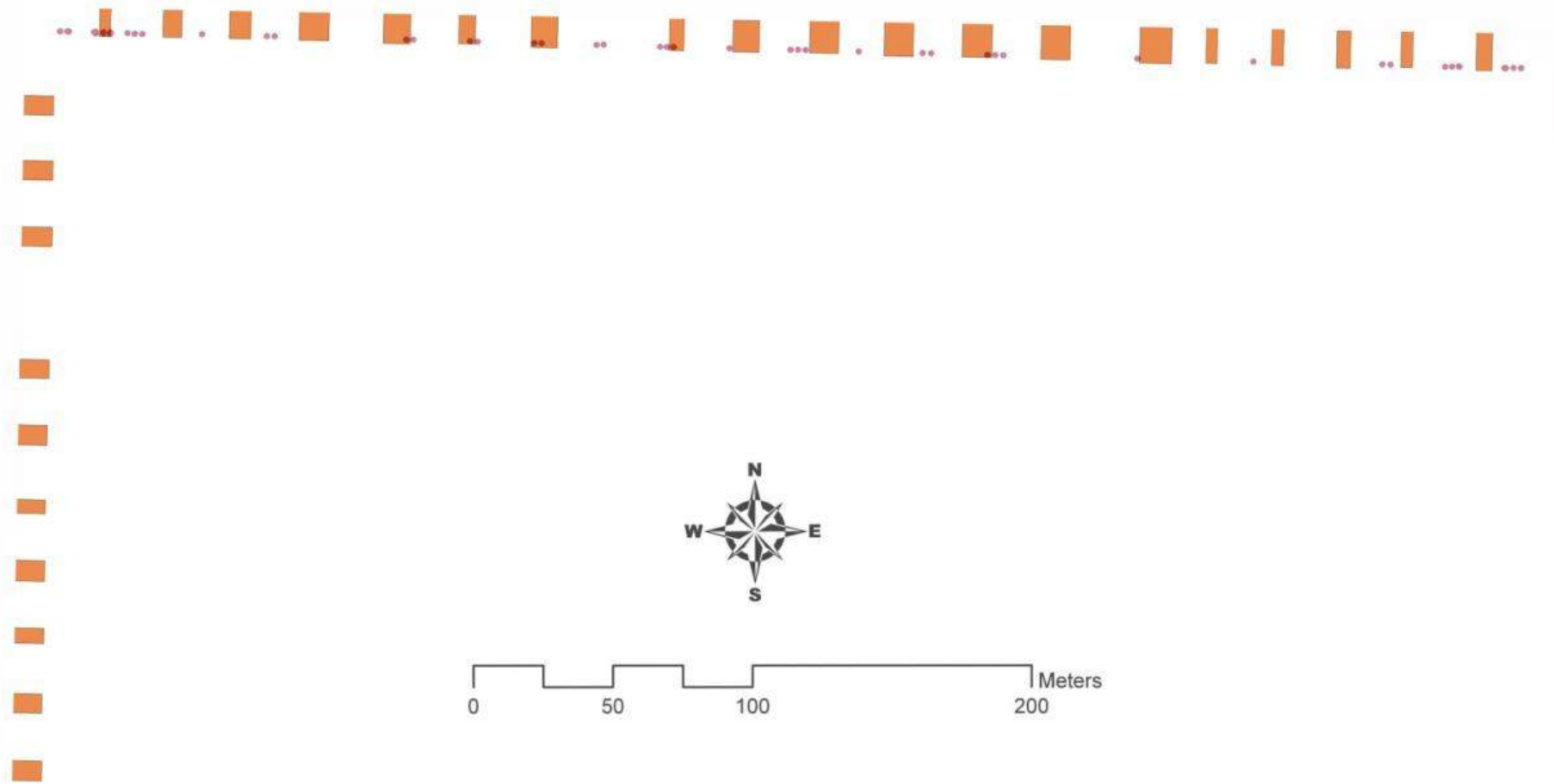


Figure 5.19 - Large vertical postholes - Types 1, 2 and 8 (purple) - superimposed with the gaps between the sets of horizontal postholes (orange), Northwest section – Note the correlation between the orange bars and the gaps between the purple dots along the North wall.

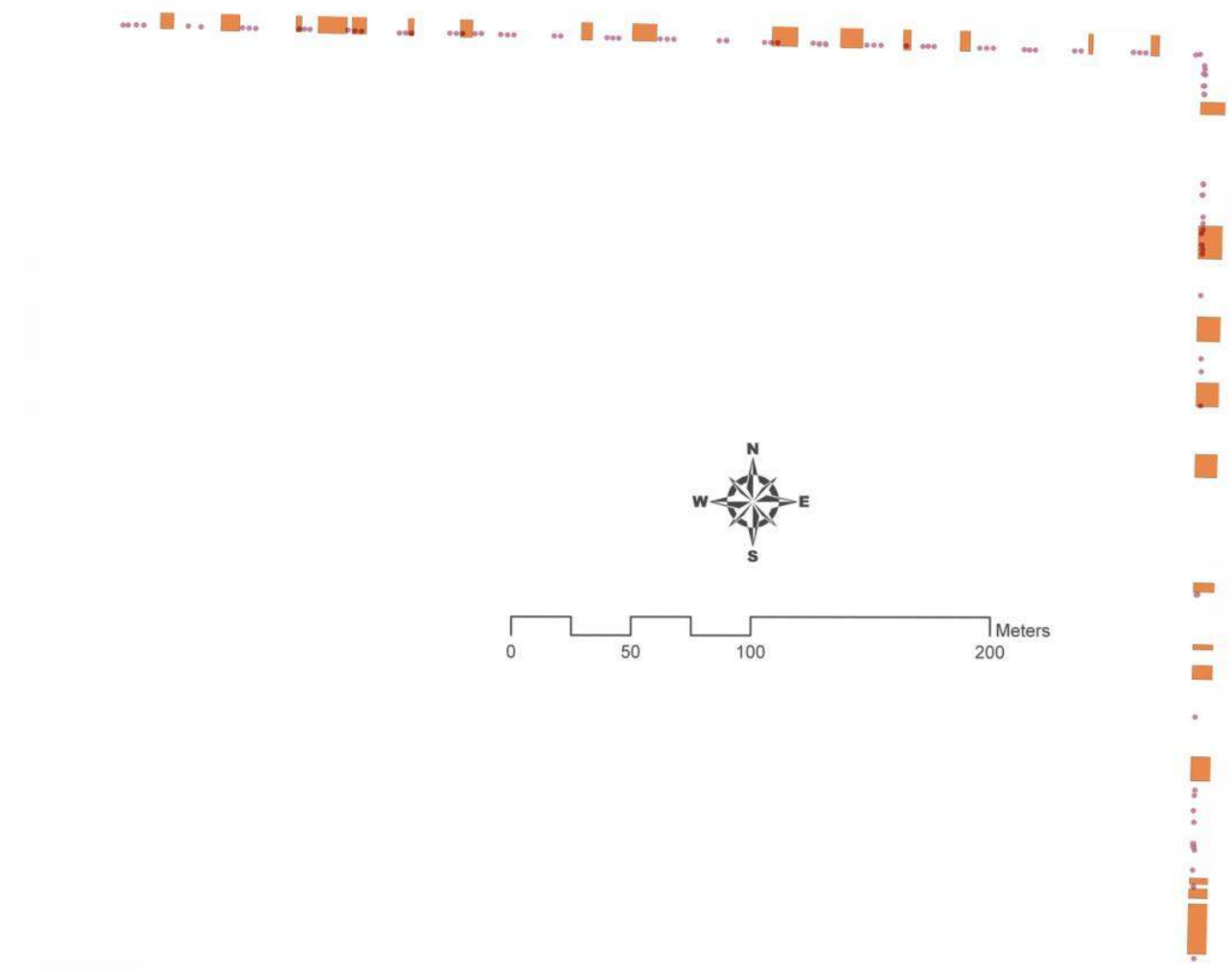


Figure 5.20 - Large vertical postholes - Types 1, 2 and 8 (purple) - superimposed with the gaps between the sets of horizontal postholes (orange), Northeast section - Note the correlation between the orange bars and the gaps between the purple dots along the North wall.

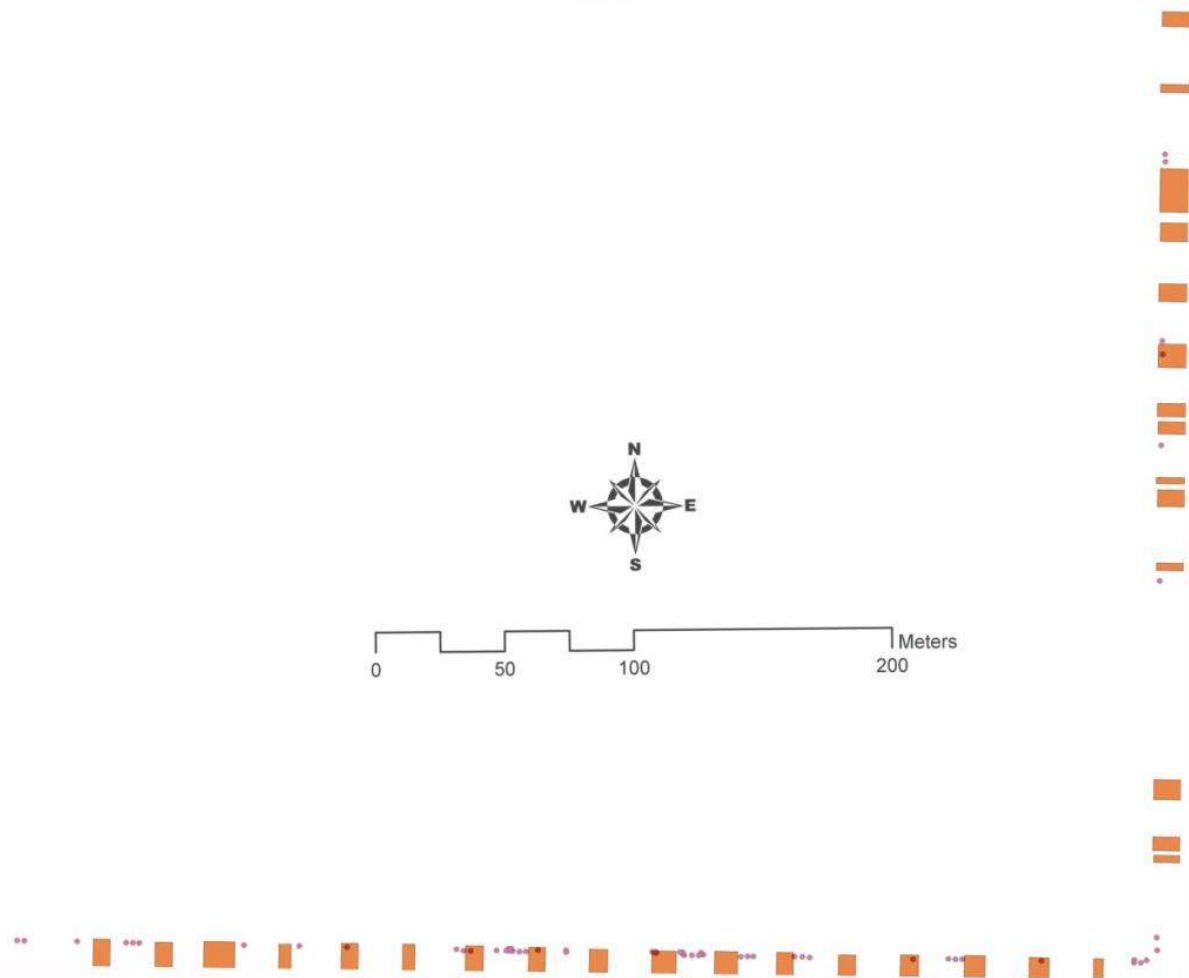


Figure 5.21 – Large vertical postholes - Types 1, 2 and 8 (purple) - superimposed with the gaps between the sets of horizontal postholes (orange), Southeast section - Note the correlation between the orange bars and the gaps between the purple dots along the South wall.

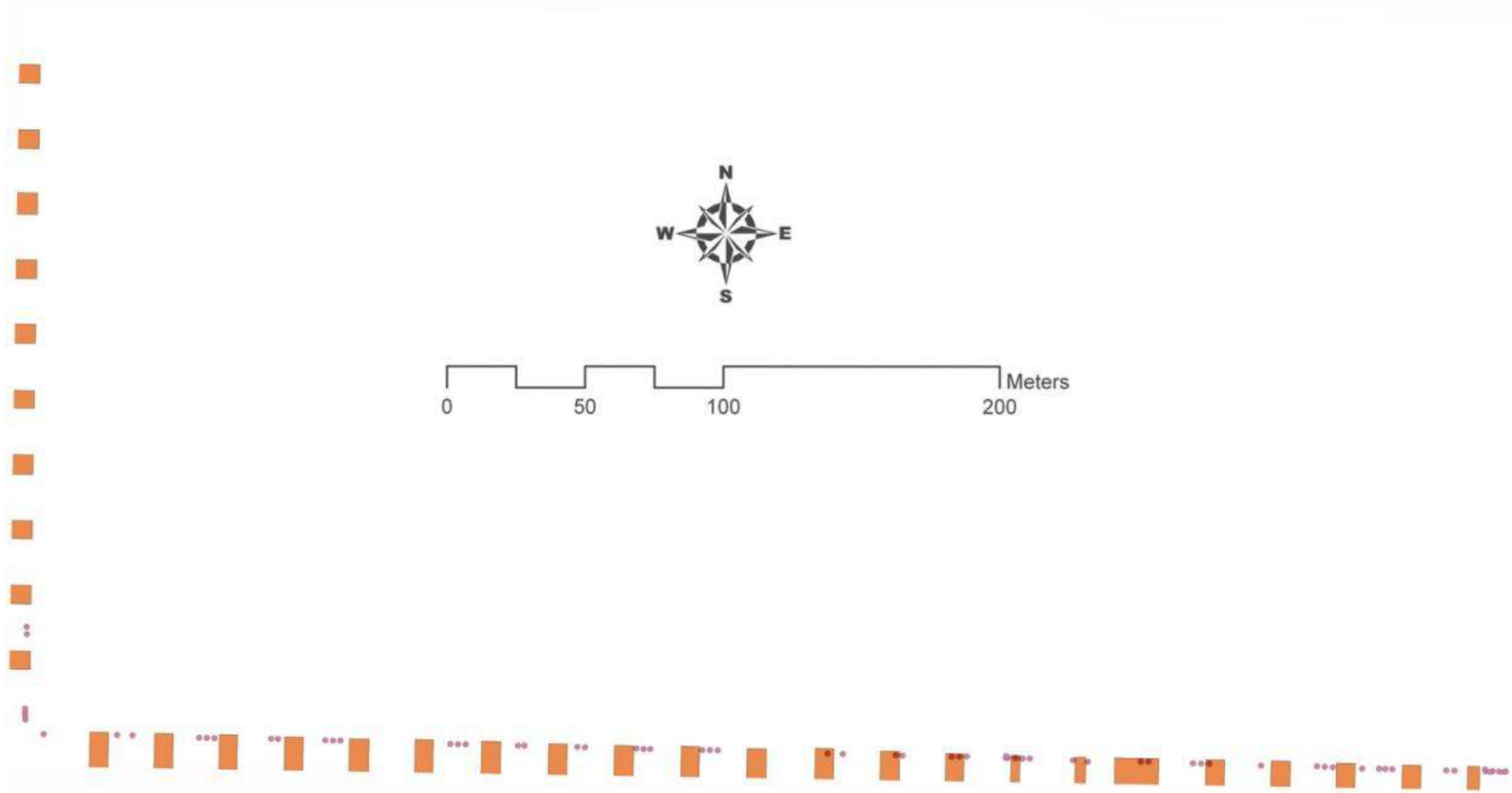


Figure 5.22 – Large vertical postholes - Types 1, 2 and 8 (purple) - superimposed with the gaps between the sets of horizontal postholes (orange), Southwest section
 - - Note the correlation between the orange bars and the gaps between the purple dots along the South wall.

In total, only 14 percent of the large vertical postholes are situated within the gaps between the sets of horizontal postholes. That is, the distribution of the larger vertical postholes is highly correlated to the distribution of the horizontal postholes. This kind of related distribution is highly unlikely to have occurred by chance: this suggests that the two different datasets are related, and furthermore, contemporary.

The Postholes and the Chronology of the Wall

The enclosure wall is the product of several construction phases to which the postholes can be dated relatively.

Wall Chronology

The gateways are critical to an understanding of the relative chronology of the construction phases of the wall. The material evidence indicates these sections of the wall were never actually built in the original construction phase and consequently that the masonry which now fills them was assembled subsequent to the initial phase of construction.

As was mentioned, the gateways have obviously different masonry patterns and materials (see Chapter 4, page 56). The evidence that indicates the wall was not built in these sections initially is the presence of incomplete surface finishing in the vicinity of the Western gateways on the North and South walls. As the rest of the Western half of the enclosure has had its surface finished, one would expect to see this occurring all along that section of the wall. Crucially however, the portions of the West halves of the walls which exhibit varying levels of surface finish are located around – that is, on either side – of the gateways (Figure 5.23, Figure 5.24). That is, as you approach the Western gateway locations, from either side along the wall, the detail in the surface finish decreases. This leads to the conclusion that the wall was never actually built in the gateway sections in the first place¹³. Rather, the infill portions represent a later phase of construction and are actually modifications to the original structure in which there were open gaps – the gateways – in the outer enclosure

¹³ Based on the assumption that the degree of surface detail decreased as one approached the gap in the wall.

wall. It should be noted here that since the Eastern half of the wall has not had its surface finished in any places, this phenomenon is not evident around the other four gateways.

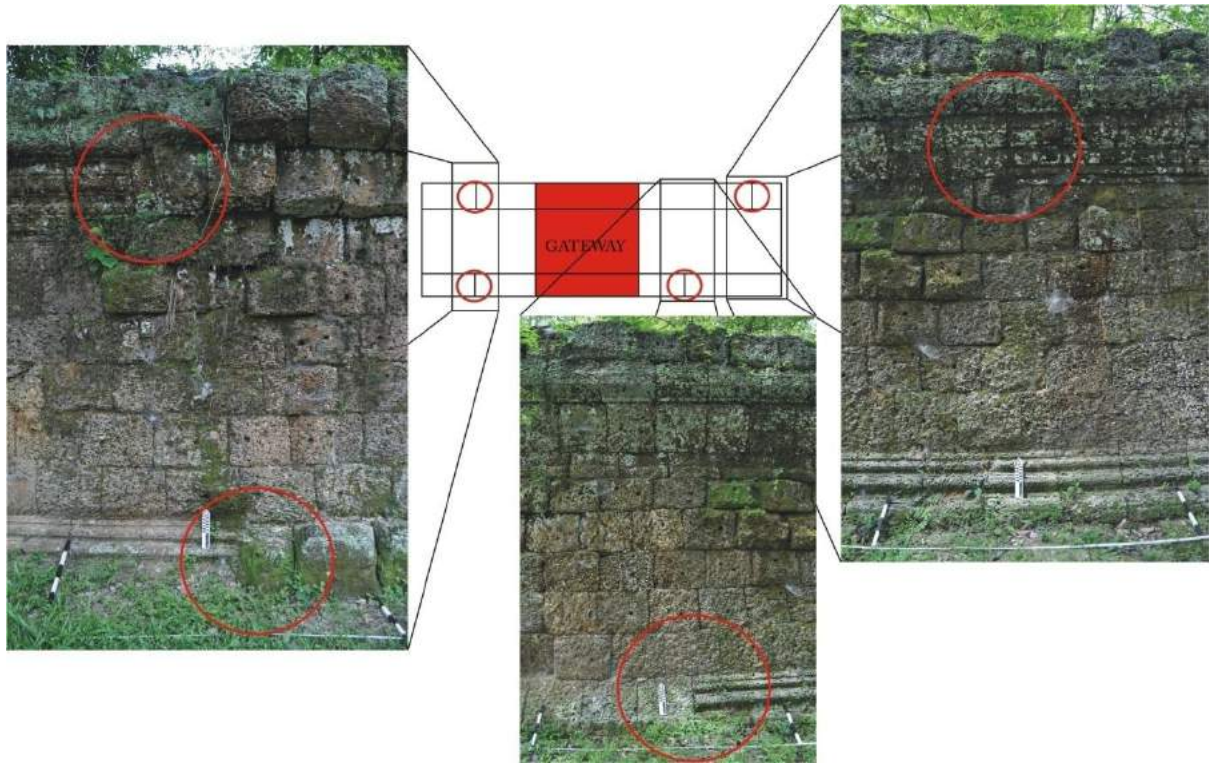


Figure 5.23 - Diagram (not to scale) and photographs showing the relative distribution of changes in surface finish about the West gateway in the North wall.

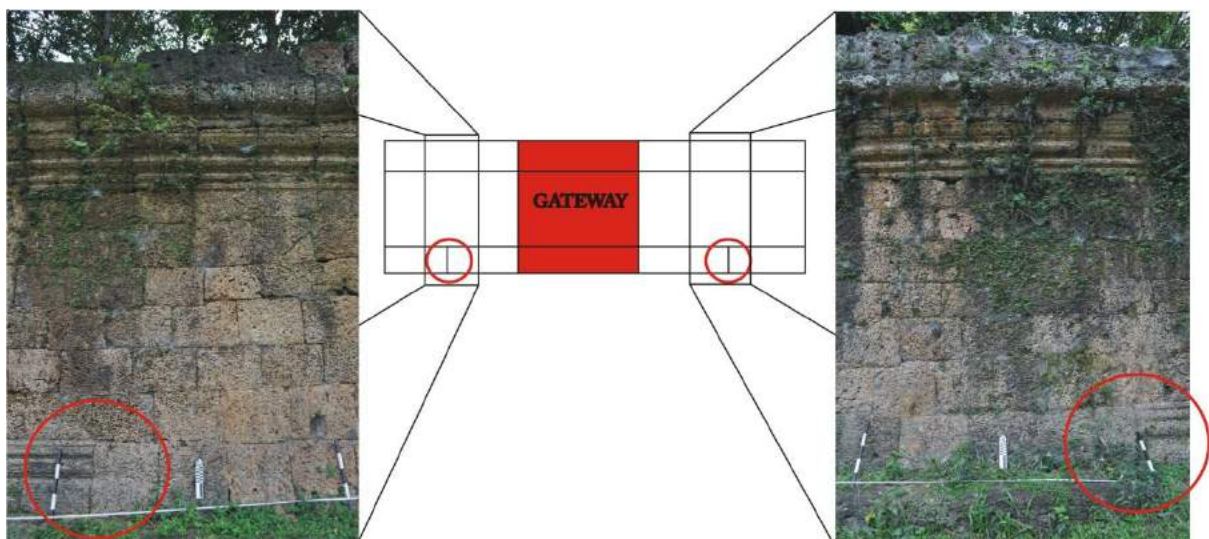


Figure 5.24 - Diagram (not to scale) and photographs showing the relative distribution of changes in surface finish about the West gateway in the South wall.

The changes in masonry patterning and materials in the gateways, and the changes in surface finishing associated with them lead to the conclusion that they represent an additional phase of construction. However, some of the gateways themselves exhibit evidence of multiple construction phases: the Western gateways in the North and South walls, and the Northern gateway in the East wall. In fact, due to the change in materials and block patterns, the two Western examples appear to have been first modified from a wide gateway to a smaller doorway, which was then filled in completely to form a continuous wall (Figure 5.25).

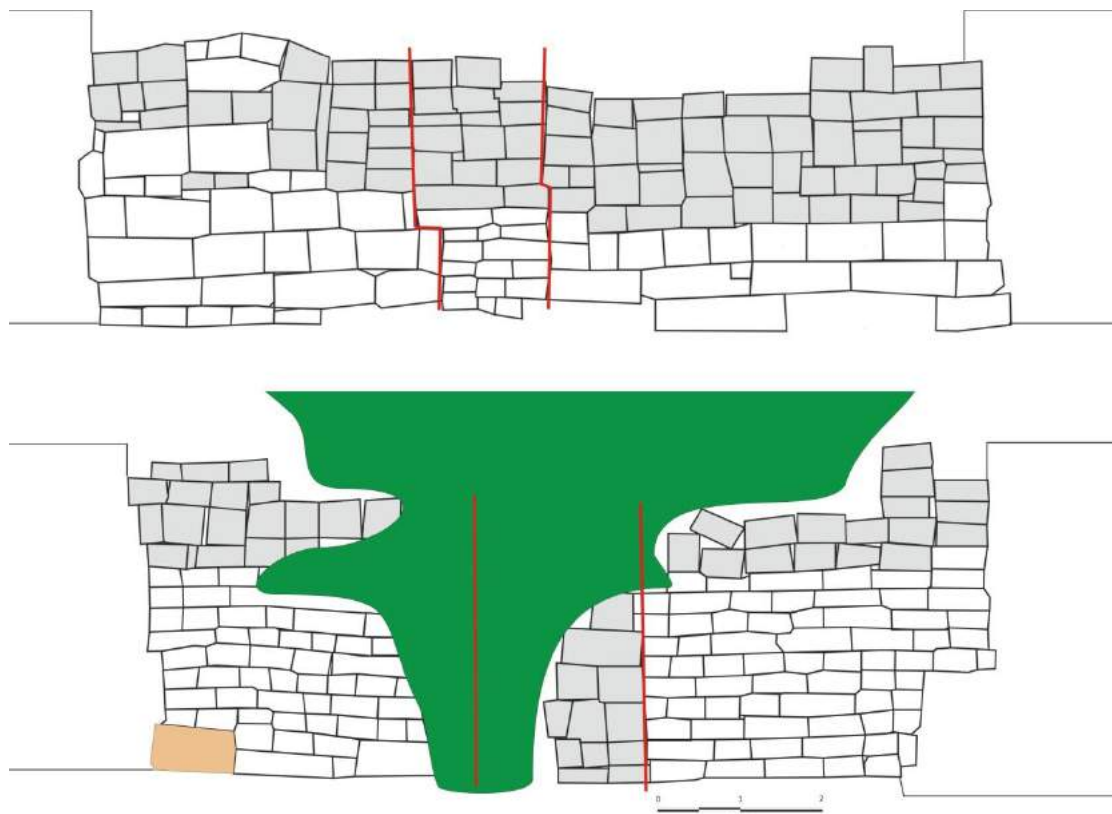


Figure 5.25 – Masonry pattern of the Western gateways in the North wall (above) and the South wall (below) showing sandstone (grey) and laterite (white); foliage (green) and termite mound (beige)

The South wall modifications were noticed in August 1931 by the EFEO team working on the stabilisation and restoration of Angkor Wat (Marchal: August 1931). Due to the present-day presence of a tree which partially obscures this feature, the two phases of construction are more clearly visible in the EFEO’s archival photos (Figure 5.26). The North modifications to

the East wall also feature a central section with different block work to the rest of the fill (Figure 5.27).



Figure 5.26 – South wall, West gateway, showing the pattern of laterite and sandstone components (EFEO archives)

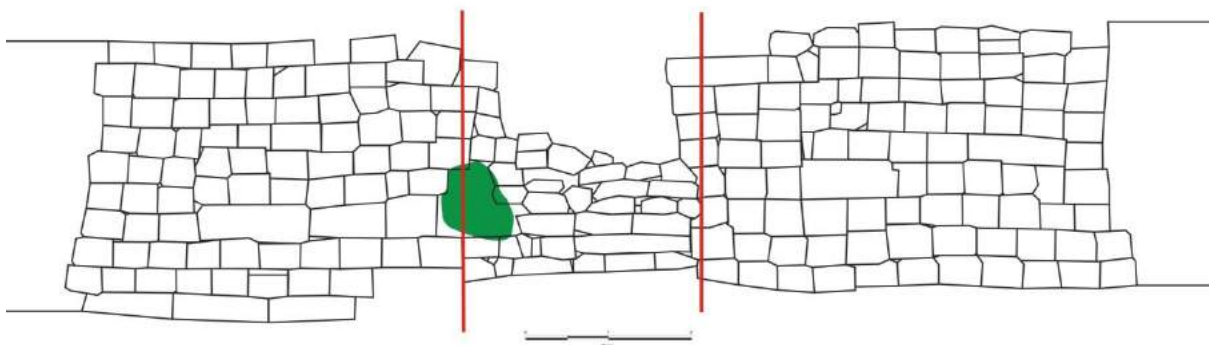


Figure 5.27 – Masonry pattern of the East wall, North gateway; laterite (white) and foliage (green)

Another feature of the wall which relates to its chronology requires attention. As it was noted, some of the sandstone blocks in the gateway modifications are decorated with carvings (see Figure 5.28). Without delving into the complexities of art history and stylistic dating, the carvings on these blocks are characteristic of artworks featured on monuments from the Bayon era of construction (late 12th to late 13th centuries AD) (Pottier pers.

comm.): that is, they significantly post-date the initial construction phase of Angkor Wat (mid 12th century AD). Since the decoration of temples takes place after the assembly of the masonry (see Chapter 4, page 53) it is surmised that these blocks represent the recycling of materials and the partial dismantling of another temple.



Figure 5.28 – Decorated blocks recycled in the North wall, East gateway: left – pillar cornice blocks (exterior), and right – dancing apsara (interior)

Similarly, the blocked up windows of the South gopura also feature carvings consistent with those just described. The use of the same types of recycled stone suggests that the infill of the South gopura and the gateways are associated and possibly contemporary.

One final note is required about the gap immediately to the North of the East gopura in the East side of the wall (see Chapter 4, page 64). The symmetrical layout of the six gateways with the temple itself is the basis of their association and conversely, since this gap does not fit into this symmetry, it is argued that this partial modification is also from a construction phase which is different to those mentioned above.

The Postholes and the Wall

There is crucial relationship between the postholes and the different phases of construction. Both sets of postholes are found in the gateway infill masonry. The horizontal postholes are found in the masonry fill of the North wall, East gateway and the East wall, North gateway (Figure 5.29), and both the East and West gateways of the South wall (Figure 5.30). Vertical postholes are known in the North gateway of the East wall (Figure 5.31).



Figure 5.29 - Horizontal postholes in the original wall (green) and the later modifications (red) –North wall, East gateway (above), East wall, North gateway (below)



Figure 5.30 – Horizontal postholes in the original wall (green) and the later modifications (red) – South wall, East gateway (above), South wall, West gateway (below)

There may in fact have been more postholes in the gateway modifications, but since many of the blocks of the upper courses of each gateway infill have collapsed to some extent their presence is hard to identify elsewhere and may be under-represented. That is, the blocks are very heavy and tumbled in heaps along both sides of the wall and are often either

partially buried or overgrown¹⁴. Regardless of the number of instances, due to the association between both the sets of postholes and the modifications to the gateways (exemplified by the North gateway on the East wall which bears both), both the postholes and the gateway infill postdate the original construction phase of the wall, and the postholes postdate the gateway infill, whether it be by minutes or years.



Figure 5.31 – Vertical postholes (red) in the later modifications to the North gateway in the East wall – Two Type 4s (above left), two Type 3s (above right), one Type 3 (below) – (Roland Fletcher’s feet as scale...)

¹⁴ Nor did we have permission to excavate.

Conclusions

The two sets of postholes demonstrate a high degree of standardisation in their shape, size and distribution and in addition the consistent relationship between the horizontal and vertical holes suggests their installation was collaborated and contemporary. The postholes are present in, and therefore postdate, the masonry assembled in the blocked gateways which themselves postdate the construction of the wall. Furthermore the masonry of the gateways is known to postdate the 13th century due to the presence of decorated sandstone blocks recycled from Bayon-style monuments. The holes therefore relate to events in Angkor probably from the 14th to 17th centuries when the urban centre is known to have been abandoned.

6. Discussion

To assess the function of the postholes and their dating the various strands of evidence regarding the form and chronology of the enclosure wall are brought together and discussed. The interpretation which the author finds most convincing for the function of the postholes is that of defence, however other hypotheses can be envisaged and these too will be discussed. The chronological possibilities for the installation of defensive works are numerous and governed by the circumstances in which they were installed. The potential reasons why Angkor Wat was fortified must be considered in relation to the often problematic inscriptional and historical evidence though not necessarily in concurrence with them.

The Function of the Postholes?

Defensive Structure

The postholes in the fourth enclosure wall are consistent with the material traces of a defensive platform and palisade, inside and on top of the wall respectively. The horizontal postholes were the lodgements for large beams which protruded several metres from the wall where they were then, we presume, attached to vertical posts. In such a manner these horizontal beams functioned as double cantilever beams. The gaps in this platform left room for access stairways. The vertical postholes on top of the wall which supported the palisade were lodgements for posts of two main types. Larger, circular posts formed a superstructural framework with smaller posts in a variety of cross sections filling in the body of this superstructure in a more ad hoc fashion. The case for this interpretation is as follows.

Supporting Evidence

The first feature of the posthole distribution which is consistent with this hypothesis is that the horizontal postholes are only located on the inside face of the wall. That is, whatever was constructed was only within the perimeter of a substantial boundary. The defence hypothesis holds that the horizontal postholes supported an elevated platform which gave defenders the “higher ground” over would-be attackers outside the wall.

Secondly, the horizontal holes are indeed that – horizontal. Beams of wood anchored in these postholes would thus also be horizontal, as would be the platform they supported. Had they been inclined they would have been unsuitable for a platform on which people had to stand and would be interpreted as the roof beams of sheds or galleries.

The third point in this argument is that both the postholes on top of and on the inside face of the wall are associated with the modifications to the gateways. Whatever was in these gateway sections, presumably wooden gates, was more susceptible to forcible entry than a solid wall. The blocking up of the gateways to form a continuous wall therefore helped secure these sectors against potential attackers. The association of the postholes with the gateway modifications – they run across the masonry – suggests that the structure they supported also took advantage of the additional security.

Another important point in this argument is that, due to the correlations in the patterning between the two sets of postholes, it is reasonable to suppose that they are at least associated with each other and more than likely contemporaneous. The relationship between the large vertical holes and the gaps between the horizontal sets is regular along the North and South walls. Likewise, the relationship between the large vertical holes and the small vertical holes is regular along all the surveyed walls. The implication is that such regularities are intentional as they are consistent over a considerable distance and that all the surveyed postholes are related in some way.

Problems

There are some problems with the defensive structure theory which must be addressed. These problems exist primarily because the perimeter of this proposed defensive arrangement was not uniformly sealed in its entirety.

First of all, it must be acknowledged that while the windows in the South gopura are blocked those of the North and East gopura are not¹⁵. So, while this phenomenon in the South gopura and the gateways sections of the wall can be interpreted as sealing the perimeter, the two other *gopura* contradict this proposition. The issue of the *gopura* has

¹⁵ The West gopura does not enter the discussion about blocked up windows as it does not feature any real windows on its inside wall, only gateways.

further implications for the defence theory. The fact that the doorways in each *gopura* were left unaltered is not detrimental to this theory as they are much narrower (1.35m) and presumably easier to defend than the gateways in the wall (10m or more). This then leads to the conundrum of why the windows, some of which still feature all there balusters, were blocked up with stone whilst wood sufficed for the doorways?

A potential solution to this problem lies in the current state of the West *gopura* of which almost all the original pieces of stone are missing from the outside verandah. This verandah was effectively identical to the one which goes around the third enclosure gallery (Figure 6.1 and Figure 6.2). In fact each *gopura* of the fourth enclosure is damaged to some degree. Typically the architrave and porch immediately adjacent to the outer gateway are missing with pieces of fallen stone situated in front of the *gopura* (Figure 6.3). It should be noted that this phenomenon is common amongst Angkorian temples: the porches and verandahs are the first components of the structure to collapse. However, this fact merely reinforces the fact that whilst the verandahs and porches may be unstable, they can be safely removed without compromising the overall integrity of the structure. Numerous pieces of masonry are currently situated on the ground alongside the West *gopura* (Figure 6.4) but these do not constitute sufficient stone to rebuild the entire porch. So while speculative, it is possible that the missing pieces of sandstone were used to block up the gateways in the *gopura*, and later were simply removed.

The second problem with the sealed perimeter interpretation is that the proposed palisade along the top of the wall has some significant gaps in it. While the relationship between the large and small vertical postholes varies, implying that the manner in which the palisade was constructed was not uniform, some sections of the wall – for example parts of the South wall, West side and parts of the East wall, South side (see Appendix A.5) – have neither type of posthole.

Another potential problem with the palisade is that some of the small postholes on top of the West wall are partially covered by the sandstone coping stone. The coping stones are elongated blocks of bevelled sandstone, several metres in length, which are positioned on top of the wall (Figure 6.5).



Figure 6.1 - West gopura of the fourth enclosure (above) and the verandah (red) around the third enclosure gallery (below) – Note the similarities in the design of the roof and the absence of the verandah extending beyond the roof of the West gopura (http://www.devilmaycare.us/img_3753-20110112231949.jpg)



Figure 6.2 - West gopura, exterior, facing South – Note the postholes for the verandah columns (foreground), the sheared cross beams of the verandah (right), the missing stones of the porch roof (background, left) and the original verandah column and corbel vaulted roof *in situ* (background, centre)



Figure 6.3 - North gopura, facing East - Note the missing stone pieces from the porch roofs and the architraves.



Figure 6.4 – West gopura, interior – Note the dislodged pieces of sandstone

They too have postholes along their upper face, into which decorative finials were fitted, and are undoubtedly a part of the original construction phase. The presence of coping stones on top of some of the surveyed postholes upsets the established relative chronology which stipulates that the postholes postdate the original construction phase of the wall (Figure 6.6).

However, while bulky these pieces of coping stone could be moved, so it is possible that they were removed and later replaced. Indeed this is actually the likeliest scenario. Additional pieces of coping stone are located on the ground around the exterior of the South gopura. These pieces are only around fifty centimetres long and appear to be fragments of original larger single blocks (Figure 6.7). Their proximity to the South gopura suggests that they were originally associated with it: that is, situated on top of the wall adjacent to and on both sides of the *gopura*. In addition, a close inspection of the pieces on top of the West wall shows that these pieces, while longer, are also broken and have had their ends and sides badly chipped (Figure 6.8). Such damage would not have occurred if they had been left *in situ* since the original construction phase. Finally, no finials are present in their designed locations.



Figure 6.5 - Coping stones along the top of the West wall – Note the elongated shape.



Figure 6.6 - Two type 3 postholes partially covered by the coping stone, West wall

It is therefore proposed that the coping stones were not only removed from their original position, but more than likely simply pushed off the top of the wall in the process. The four metre fall damaged some blocks and broke apart others, and the finials were dislodged. At some later stage the blocks along the West wall were partially replaced.



Figure 6.7 – Coping stone fragments located adjacent to the South gopura – Note the short lengths.



Figure 6.8 – Coping stones on the West wall - Note the breaks and broken ends.

Construction Process

One alternative to the defence theory is that the postholes were made as part of the construction process of the wall.

Supporting Evidence

This possibility arises as other parts of the temple exhibit signs of the construction process. For example, within the first and second enclosures of Angkor Wat large postholes are situated in the sandstone flooring (Figure 6.9 - Figure 6.11). Their precise function is

unknown, but one possibility is that they were involved in the erection of the central towers. Large ramps could have been installed which allowed the sandstone blocks to be assembled for the upper stages of the central towers. These ramps were supported by large diameter posts in the ground, and the posts were in turn stabilised by sandstone blocks. When the ramps were dismantled and the posts removed the postholes were filled in with circular pieces of sandstone. Perhaps then the postholes in the fourth enclosure wall also relate to the construction process. For instance, the horizontal holes on the inside face may have been the lodgings for beams designed to support the wall itself.

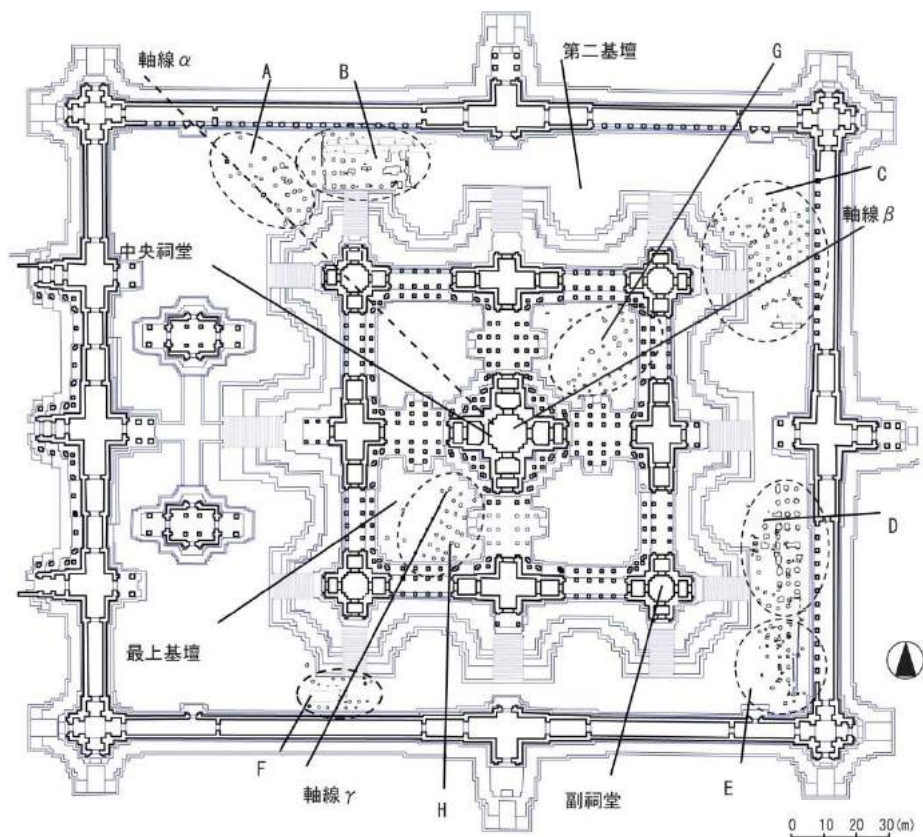


Figure 6.9 – Plan of the first and second enclosures showing the locations of the large postholes in the floor (Sawada 2008).

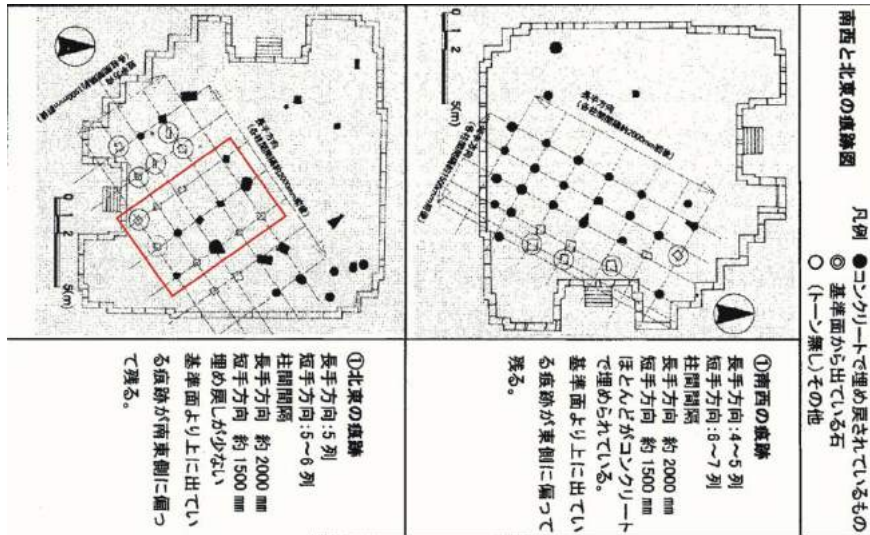


Figure 6.10 – Diagram of postholes in the floor of the Northeast (left) and Southwest (right) sections of the first enclosure, red outline showing the corresponding postholes in Figure 6.11 (after Sawada 2008)



Figure 6.11 – Postholes in the floor of the Northeast section of the first enclosure

Problems

The first problem with the construction hypothesis is that, to my knowledge, no other walls in an Angkorian context have postholes like those of Angkor Wat. If they were part of the construction process then it must have been a stand-alone experiment as neither the temples built before or after Angkor Wat exhibit the same phenomena, nor do they occur in the wall around Angkor Thom¹⁶. If the horizontal holes were employed to help support the wall by propping it up, then it was a superfluous measure as the wall has stood without

¹⁶ It should be reiterated that the postholes in Angkor Wat's enclosure wall are significantly different to those in the Royal Palace's and that these too are believed to postdate the original construction phase.

them for at least 150 years. Another problem with the construction hypothesis is that other types of holes were removed. Although manoeuvring holes are frequently visible in certain types of finished surface, traces such as these (i.e. large indentations) are typically removed in the finishing process. Finally, I can think of no way in which the postholes on top of the wall facilitated its construction.

Habitation or Religious Practice

The postholes on the inside face of the wall were the supports for beams which held up a shed which provided shelter for habitation or those engaged in religious practices.

Supporting Evidence

The case for the shelter shed is rudimentary. Khmer architects have a tradition of anchoring the wooden elements of roof sections and annexed porches into the stone components of temples (Cunin 2002). In a similar fashion the enclosure wall of Angkor Wat could have been used as the basis of a shelter which ran around the inside perimeter of the enclosure. Theravada Buddhist monks are known to have inhabited Angkor Wat continuously during the Middle Period and a common Buddhist practice is circumambulation (Fogelin 2006). In a modern context according to Ang Choulean, villagers who came for Buddhist ordination ceremonies from afar first did a circumambulation of Angkor Wat before going to the Buddhist wat (Kasiannan 2011: 226). Angkor Wat is known to have been a sacred place of pilgrimage for many of the peoples of Southeast Asia (Thompson 2004): a shelter shed could have served as either domestic space for the monks and pilgrims, or functioned as another circumambulatory path in addition to the inner three galleries.

Problems

The case for the shelter shed is problematic. First, numerous *vihara* and places of residence were situated within the enclosure of Angkor Wat. However, these were free standing structures that were located along the main causeway and in front of the temple on the West side¹⁷. Why then go to the effort of chiselling out the necessary fittings in the wall when there is ample space within the enclosure? Another issue with this hypothesis is that the beams were horizontal and the level roof they would have supported would not be suitable in the monsoon climate of Cambodia. Finally, the excavation carried out by GAP in 2010 recovered only tenuous evidence of occupation debris (GAP 2010: 6).

¹⁷ Some still exist today, but further to the North and South of the central axis.

The Dating of the Postholes?

Each interpretation of the postholes function has its respective chronological implications. However it has been demonstrated that the additional hypotheses do not stand up to a rigorous assessment. The assessment of chronology will therefore focus on the defensive model.

When was the Defensive Structure made?

Pertinent to the discussion of *when* Angkor Wat had defensive works installed is *why* they were installed. The two most likely scenarios are that 1) Angkor Wat was fortified as a sort of outpost of the Khmer state once the capital had shifted to the Southeast, or that 2) it was fortified by one of the families of the Khmer elite against the other families. The second scenario itself has two possibilities, that it was the royal family holding off a *coup d'état*, or that it was the *coup* leaders holding off the deposed royals.

The *terminus post quem* for the defensive works is the Bayon period of art and architecture (late 12th to mid 13th century). The *terminus ante quem* for these scenarios is governed by the introduction of the new weapon technology of gunpowder and cannons. There are two lines of reasoning involved. First, cannons would have rendered the proposed fortification system obsolete. Secondly and crucially, there is no evidence that anyone ever attacked any place in Angkor with cannons indicating that if these defensive works were used as part of a conflict they were effectively abandoned before the mid 17th century AD when cannons were present in Cambodia.

Between the two chronological limits there are several possible times at which the Angkor Wat defensive works were installed. The various scenarios envisage the fortification of Angkor Wat in different contexts. The viability of each scenario is invariably linked to the occupation status of Angkor Thom just one and a half kilometres to the North. If the defensive works at Angkor Wat were installed when Angkor Thom was still being used by the royal court the implications of such a situation are confusing – the additional stronghold at Angkor Wat only strengthened the defence of Angkor Thom along the Southern entrance, and this addition could quite simply be circumvented by approaching the urban centre from

one of the other four gateways (Figure 6.12). So why do it? Also in the instance of a squabble between the elite Khmer families, due to its proximity to Angkor Thom, the work required to successfully fortify Angkor Wat could not have been carried out if Angkor Thom was held by the opposing party. These scenarios are unlikely and are discarded from this discussion. What follows are the key points in time which are known from the inscriptions and the more reliable historical records.



Figure 6.12 - Hypothetical situation of Angkor Wat and Angkor Thom simultaneously occupied and fortified (red) and approach vectors (yellow) to the royal centre (green)

13th century AD

The first possibility which presents itself is based on the account of the Chinese ambassador Zhou Daguan in the late 13th century. During his visit to Angkor in 1296/7 AD he wrote that the country had recently been ravaged by war (Smithies 2001: 89). This scenario takes place when Greater Angkor was still the resplendent capital of the Khmer Empire, although past its peak. At this time Angkor Thom is most definitely the urban centre and the royal palace and temples within it are described by Zhou Daguan as rich and noble (Smithies 2001: 20). Furthermore, Zhou Daguan is specific about the lack of battlements on the wall around Angkor Thom (Pelliot 1993: 2), nor does he mention the bastion by the gates. This raises the

question of why would so much of value be left exposed within Angkor Thom if substantial efforts had just been made to create a fortified space one and a half kilometres south of its South gate? Also why would defences be installed at Angkor Wat when Angkor Thom lacked even battlements on its walls and its gates could not be effectively defended? Evidently, this scenario is not without its problems and therefore an unlikely candidate for the installation of the defensive works.

14th - 15th century AD

The climate crisis which began in the mid 14th century (Buckley et al. 2010) is another factor which requires comment. Although there were no instances of an Ayutthayan attack on Angkor before 1431 AD (Briggs 1948), the weakening of Angkor's potential resource base may have led to such drastic measures of security reinforcement and downsizing. While unlikely this scenario is possible.

The next possibilities would be just before or just after Ayutthaya attacked Angkor in 1431 AD. What the chronicles mention is that the king of Ayutthaya took Angkor and returned to Ayutthaya with a few valuable items (for two shrines) and left his son to rule over Angkor (Vickery 2004: 27). The cultural connections between Ayutthaya and the Khmer are well known, as the lands which Ayutthaya controlled were once part of the Khmer Empire, and all the royal inscriptions from Ayutthaya are written in Khmer script until the late 16th century (Vickery pers. comm.). However, whatever the potential for cooperation between the two states, the outcome was continued hostilities. Given this situation, might the Ayutthayan governor of Angkor have sought to strengthen his hold on the city? Although the work involved in modifying Angkor Wat would have been quite substantial (see Appendix A.3), such an exertion of effort may have proved more effective than manning the much larger enclosure of Angkor Thom. The presence of outsiders as previous rulers of Angkor is known so his degree of acceptance by the local population (or lack thereof) is highly speculative – such a ruler could well have been regarded by the populace as just another king, irrespective of his origin. The history of the Angkorian monarchy includes numerous examples of contests for and usurpation of the throne, as well as monarchs who were from the periphery of the empire. Suryavarman I and Jayavarman VII were from North of the Dangrek mountains (Vickery 2004: 4). Furthermore, Jayavarman VII lived in Vijaya (central Champa) before he became king, used his Cham allies in his battle for the throne,

and finally raised Cham princes in the arts of government and war in his royal court (Vickery 2004: 5; Schweyer 2007). So it is possible that the Ayutthayan ruler could have fortified Angkor Wat but there is – I believe – a more likely scenario (see below).

16th century AD

The next options date to the 16th century, a period in which the historical record recommences at Angkor Wat in the form of inscriptions and sculpture although, as it has been noted, the temple itself was never abandoned. The bas-reliefs of the third enclosure in the Northeast sectors of the gallery were not finished in the 12th century though they had clearly been drawn in. The scenes they depict are from Hindu mythology, namely the victory of Vishnu over the Demons and the victory of Krishna (Vishnu) over the Demon Bana (Thompson 2004: 204). The difference in workmanship between these panels and the originals is noticeable, strongly suggesting a different team of carvers. Two inscriptions, K296 and K297, allow us to date the commencement and completion of these carvings to 1546 and 1564 AD respectively (Pakdeekham 2008: 40) and that they were done “in accordance with the (spirit of the) past” (Thompson 2004: 204). The question that arises here is that if there was a perceived need to fortify Angkor Wat, would it be reasonable for resources then to be expended on the decoration of the temple’s bas-reliefs, even if they were evocative of former greatness? I would argue for the negative. If Angkor Wat was fortified in the 16th century it was surely not during this period.

Another possibility arises courtesy of inscription IMA3 which tells how in 1579 AD the king “... restored the enclosure walls of Brah Visnulok stone by stone, and rebuilt the roof with its nine spires which he adorned by covering them in gold ...” (Lewitz 1970: 112)

This reference raises the question of which repairs to the enclosure wall, and furthermore which enclosure? As has been mentioned the fourth enclosure wall demonstrates at least two and possibly three phases of construction after the initial phase, and it is possible that reference is being made to the other inner enclosures. While no mention is made of fortifying the temple, the inscriptions from this period rarely make mention of anything with a negative connotation. The vast majority of the Middle Period inscriptions found at Angkor Wat are accounts of pious acts and devotion to the Buddha, focusing on the virtuous character and deeds of those who commissioned them (Thompson 2004). Similarly to the

bas-reliefs scenario, would the gilding of the temple's towers really be a priority if Angkor Wat was to become a defensive compound? Again I would argue for the negative.

Additional evidence comes from the accounts of Portuguese merchants who visited Angkor towards the end of the 16th century. Diogo do Couto the Portuguese chronicler in the East Indies recorded the account of the Franciscan brother Antonio da Magdalena who had visited Angkor around 1585/6 (Groslier 2006: 50). Do Couto's account specifically describes the "city" with an embankment wall and five gates – Angkor Thom – which had a superb bastion (Groslier 2006: 53, 67-68). It is unlikely that they would describe Angkor Thom as the city if it was not occupied, although Groslier speculates that the 16th century town was outside the city (2006: 70). Furthermore, do Couto describes the temple called Angkor (Angkor Wat) with its towers "entirely gilded at their summits" (Groslier 2006: 54). Although no mention is made of defensive works, it is possible that they were overlooked by the monk but unlikely given his attention to Angkor Thom and his presumed familiarity with European fortified monasteries.

The next potential scenario is in the lead up to an important event in Khmer history: the capture of Lovek. After several unsuccessful attempts in 1549, 1566 and 1587 King Naresor of Ayutthaya¹⁸ captured Lovek in 1594 AD (Ewington 2008: 97). Lovek had been established as a royal city in 1528 by Param Reachea II who was presumably the king responsible for the completion of the bas-relief carvings of the third gallery (see above). As with the events 150 years earlier at Angkor the Ayutthayan king left an occupying force in Lovek and again took revered items back to Ayutthaya: the *Brah Ko* and *Brah Kaev* (the sacred bull and jewel). This event was considered by the Khmer to have had a terrible effect, as these statues contained texts upon which the country's prosperity depended, and their loss is considered a turning point in Khmer history: unlike the loss of Angkor which is not considered to be of a dire consequence (Ewington 2008: 98). The armies of Ayutthaya attacked Lovek on several fronts invading Cambodia via Battambang, Pursat and Angkor (Figure 6.13).

¹⁸ Who had recently gained independence from the Toungoo dynasty of Burma in 1590 AD.

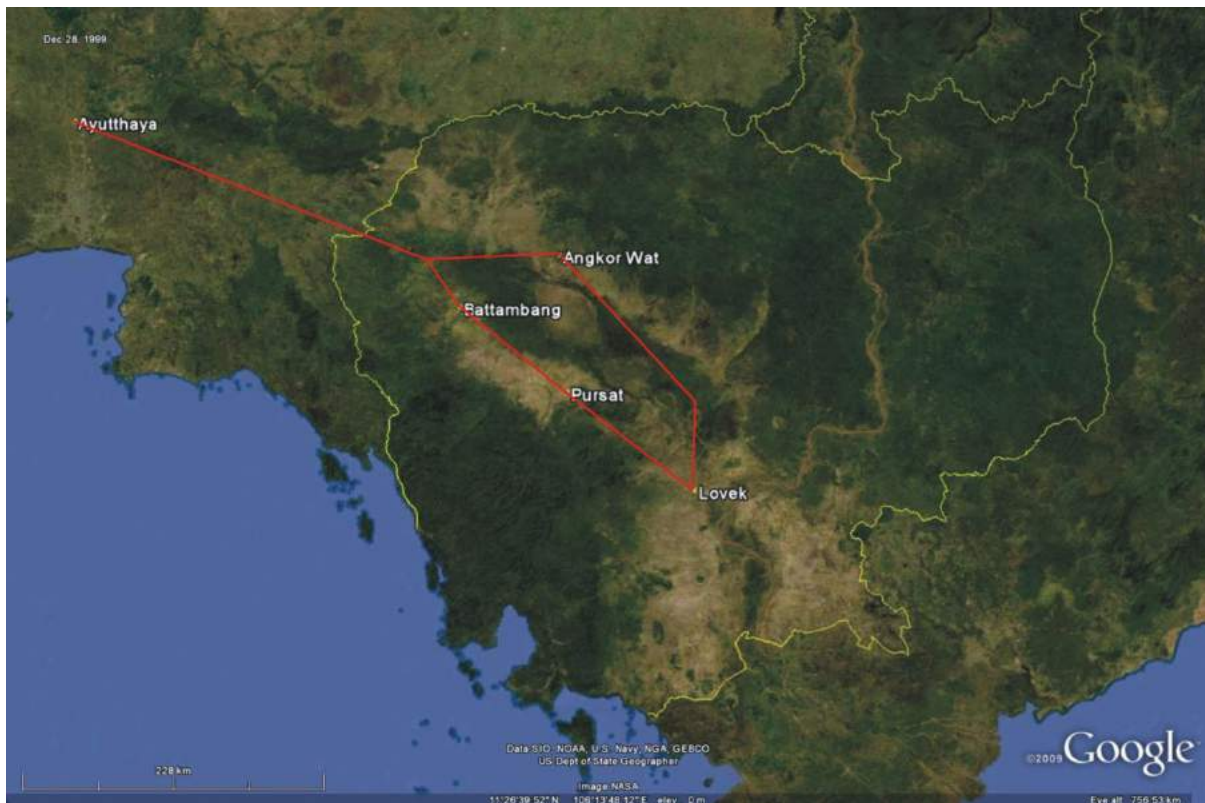


Figure 6.13 - Proposed routes from Ayutthaya to Lovek via the North and South of the Tonle Sap. (GoogleEarth)

It is therefore possible that during the lead up of the unsuccessful attempts on the Khmer capital it was decided to strengthen defence along the way to Lovek. In such a scenario Angkor Wat offered a suitable location and pre-existing infrastructure to establish an advance fort. But if this is the actual case then circumstances had changed drastically between 1579 and 1594 because the fortification of Angkor Wat strongly implies the abandonment of any attempt to defend Angkor Thom. It suggests further that Angkor Thom was abandoned between 1585 and the early 1590s. Though this is a strong case the do Couto report of 1585/6 makes it somewhat problematic.

17th century AD

Another strand of evidence which must be brought into this discussion is a Japanese map which dates to the first half of the 17th century (Figure 6.14). This map can be dated with reasonable accuracy to between 1623 and 1636 AD (Péri 1923: 122). On inspection the map is recognisable as Angkor Wat on account of the central enclosures and the cruciform terrace. Beyond this, however, inaccuracies take the form of false symmetry and duplication of features that do not exist. The map is deemed to be a copy, at least once

removed, from the original sketch and description (Péri 1923). This map too makes no mention of any defensive works along the fourth enclosure wall, although curiously there is a fence around the outside of the moat. A very odd note accompanies this feature which states it is a “border for the tying up of horses, [there is] a balustrade, decorative carvings”: a balustrade exists on the outer edge of the moat immediately adjacent to the West causeway but nowhere else. The map also describes other recognisable features such as the bas-reliefs depicting the Churning of the Sea of Milk and the Battle of Kuruksetra, but has them in the wrong place (Péri 1923: 126). Although speculative it is therefore still possible that the presence of a wooden fence – the proposed palisade – was noted but its exact location was mistaken in the transcription process. Otherwise the map and its commentary make no mention of defensive works. Also of key importance is that this is all that the pilgrim reported: there is no indication of Angkor Thom at this time.

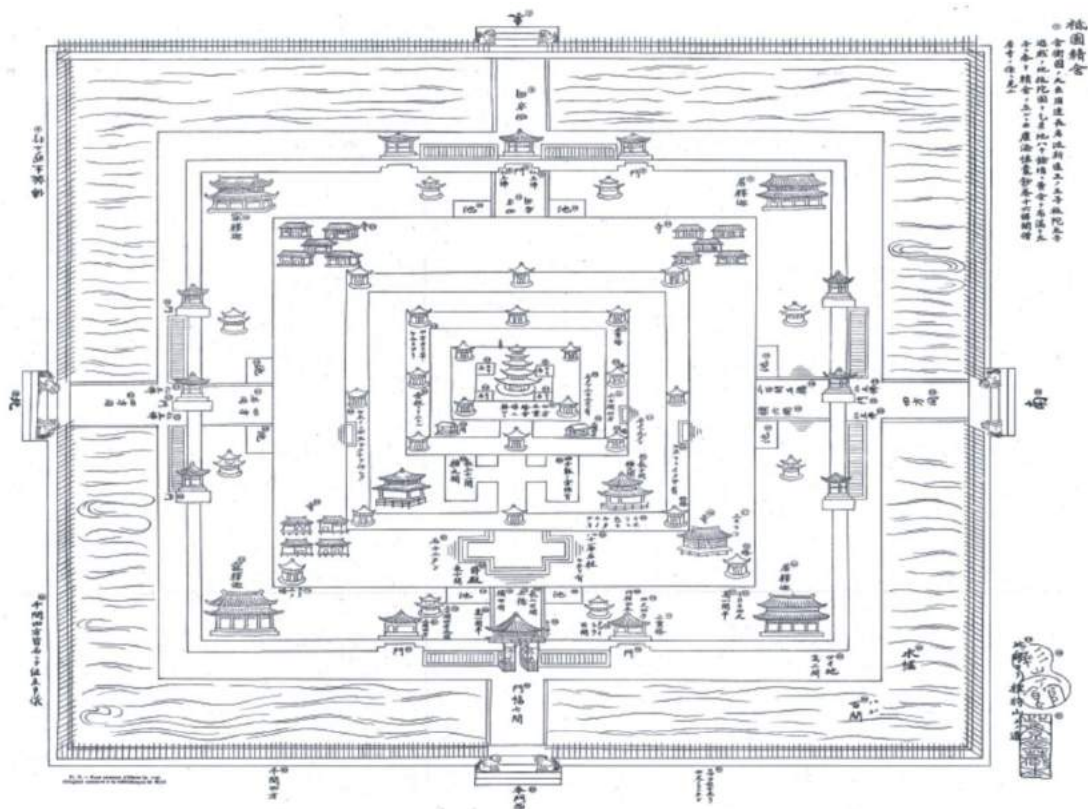


Figure 6.14 – Japanese of Angkor Wat (1623 – 1636 AD) (after Péri 1923)

In the author’s opinion the fact that Angkor Thom is absent from the pilgrim’s description of the city suggests that the likely circumstances are in place for the installation of the

defensive works. However, the confused information this map presents does little to strengthen the argument for this period.

Cannon Warfare

As mentioned the upper chronological limit for this scenario is the advent of cannon warfare. If Angkor Wat was fortified to repel a besieging force it would not have withstood artillery and Angkor Wat was never attacked by cannon as it shows no signs of such damage¹⁹. Cannons had made their way into Southeast Asia from Europe, India and China before the arrival of Europeans. Originating in China around 1280 AD the Mongols were pivotal in the cannon's dissemination into Western Europe where the first incontestable evidence of firearms is 1326 AD (Allsen 2002: 273-275). Venetians brought them to Egypt and from there they were passed on by Arab traders (Reid 1982: 3). The Portuguese described, perhaps with exaggeration, the 3000 guns they encountered at Melaka in 1511 AD (Reid 1993: 12).

The introduction of artillery into European warfare had a profound effect on the design of fortifications and siege tactics. The traditional design of medieval castles consisted of sheer vertical walls in a square or rectangular configuration, a design which was effective until the use of gunpowder propelled projectiles. The refinement and gradual improvement of cannon technology led to changes in defensive architecture and produced fortifications such as the *trace italienne* (Tallett and Trim 2010: 23). The *trace italienne*, or star fort, is typified by much wider and lower walls which radiate from its centre like the points on a star. As they were wider and more solid, and did not present a face perpendicular to the incoming projectile, they were far more suited to resisting artillery fire. Furthermore, the protruding bastions provided overlapping fields of vision so that each bastion could cover the adjacent ones and fire upon an enemy who had reached the base of the wall.

In a similar manner, the introduction of European artillery into Southeast Asia by the Portuguese had wide-ranging consequences. As mentioned, cannon were already in use in parts of Southeast Asia but the technology employed by the Portuguese was superior in range and accuracy to what previous weapons encountered in Southeast Asia (Padfield 1973: 27). The surprise advantage held by the Europeans equipped with superior

¹⁹ There are bullet holes along the outside of the West gopura but these date to the civil war of the 1970s.

technology was short-lived, as Southeast Asian states quickly set about acquiring Portuguese style firearms and the means to manufacture them (Reid 1982: 4; Reid 1993: 13). While the Dutch VOC took a firm line against selling effective weaponry to potential Asian enemies, the English and the Portuguese had no such caution, being more often the allies of such states against the Dutch (Reid 1982: 3). Portuguese mercenaries were even employed to train the Ayutthayan king's soldiers in musketry in 1538 AD (Ishii 1993: 184). The new technology helped shape the formation of new states: in the mid 16th century in present-day Myanmar king Bayin-naung introduced Portuguese cannon into his wars of conquest. At the end of the 16th century Nguyen Hoang of present-day Vietnam used Portuguese cannon to demolish his enemies' fortifications (Taylor 1993: 42).

More specific to Cambodian affairs and this discussion were the Dutch traders who established a trading station in Lovek, near Phnom Penh, in 1620 AD (Volker 1971: 11). Dutch interests in Cambodia were mainly driven by the need to secure a reliable supply of grain for their colonies in Batavia (Ewington 2008: 117). Relations between the royal court and the VOC deteriorated during 1643 AD and this climaxed later that year with the massacre of thirty five VOC officials in Phnom Penh. A punitive expedition sent by the VOC in 1644 AD consisting of five ships ended in disaster when they were ambushed near Phnom Penh – they were attacked by one of their own captured ships which was manned by Japanese, Malays and Portuguese (Kersten 2006: 18, 19). Crucial to this discussion is that cannon had undoubtedly proliferated throughout Southeast Asia by this time and that any conflict at Angkor Wat which involved cannons would surely have left some kind of material signature. Even a 16th century cannon could fire in excess of three hundred metres so it could easily clear the moat which is only two hundred metres wide (Padfield 1973: 38). It is therefore proposed that the defensive works at Angkor Wat did not face an opposition armed with cannon and therefore predates the mid 17th century.

Summary

The different proposed reasons why Angkor Wat had defensive works installed – Khmer versus foreigners or Khmer versus Khmer – are likely to have occurred in different contexts: see Appendix A.6 Chronology of Events for a summary of historical events. The proximity of Ayutthaya makes it the more likely foreign force although Champa (and the later Dai Viet)

are potential candidates. Although the Champa and Dai Viet polities were frequently at war with each other, the Cham were never unified and displayed a total absence of a “national consciousness” (Vickery 2005: 78, 80). Similarly the Dai Viet were preoccupied with lengthy civil wars during the 16th and 17th centuries (Buttinger 1972). Although Ayutthaya was subjugated for a period by the Toungoo dynasty of Burma (Reid 1993: 7), contesting with Ayutthaya still seems the most likely candidate. If Angkor Wat was fortified against a foreign force the period just before the capture of Lovek in 1594 AD seems the most likely time or between the 1590s and the 1630s when Angkor Wat would have been the only major fortifiable location in Angkor as the rulers began shifting permanently to the Phnom Penh region. If however the defensive works were installed due to infighting amongst the Khmer elite there are a whole range of time periods in which this could have taken place.

For further research potential refer to Appendix A.4.

Conclusions

The defence hypothesis integrates the material evidence with greater consistency than the other hypotheses. There are numerous possible dates for the installation of the defensive works as Angkor shifted contextually from the core to the periphery of the Khmer world. However, the most likely scenarios were during the lead up to the capture of Lovek in 1594 AD in which Angkor Wat may have been fortified as an advance outpost of the Khmer military to defend the Northern access route, or between the 1590s and 1630s when Angkor Wat would have been the only major fortifiable location in use in Angkor.

7. Implications

The possibility that Angkor Wat had defensive works installed during the aftermath of the empire marks a new chapter in this monument's history. The material traces of this episode and numerous others around Greater Angkor are consistent with other alterations and downgrading of facilities in Greater Angkor from the 13th century onwards.

Greater Angkor in Decline

The defensive works at Angkor Wat were an outcome of the changing relationship between the inert material and the dynamic socio-political setting. Likewise, features of the hydraulic network (canals, spillways) are known to have been either modified or changed function as the inertia of the overall network led it to be counterproductive to the needs of the time (Fletcher et al. 2008: 663). Dynamic changes such as accumulative siltation and riverbed erosion, a lowering of the water table and the severe fluctuations in the climate during the 14th and 15th centuries caused the network to cease functioning effectively. The outcome for the hydraulic network involved drastic changes to the way its components could be used.

Krol Romeas

For example, the structure known as Krol Romeas which is located in the middle of the East bank of the East Baray originally functioned as a spillway and may have acted as a monitor to prevent flooding of the East Mebon temple. The inlet channel for the *baray* is located at the Northeast corner of the reservoir (Figure 7.1). Krol Romeas was later modified with the addition of a masonry wall which completely blocked off the exit channel. Later still part of the North wall of the channel and the spillway was breached to allow water to enter the *baray* (Figure 7.2) (Buckley et al. 2010: 6749).

The function of Krol Romeas as an outlet channel, then part of the *baray* embankment and later to an inlet channel suggests that the management of water within the East Baray was an ongoing problem. An initial surplus of water (spillway/outlet phase 1) was followed by an apparent shortage (blockage phase 2). Later still the original inlets at the Northeast corner had become ineffective so the blockage was breached (inlet phase 3) to allow water into the *baray* 900m further to the South. The conundrum here is that both Krol Romeas and the original inlet source their water from the same canal. Bringing water in at Krol



Figure 7.1 - Location (inset) and detail of the East Baray (blue), Krol Romeas (yellow) and the original inlet channels (green) (GoogleEarth)

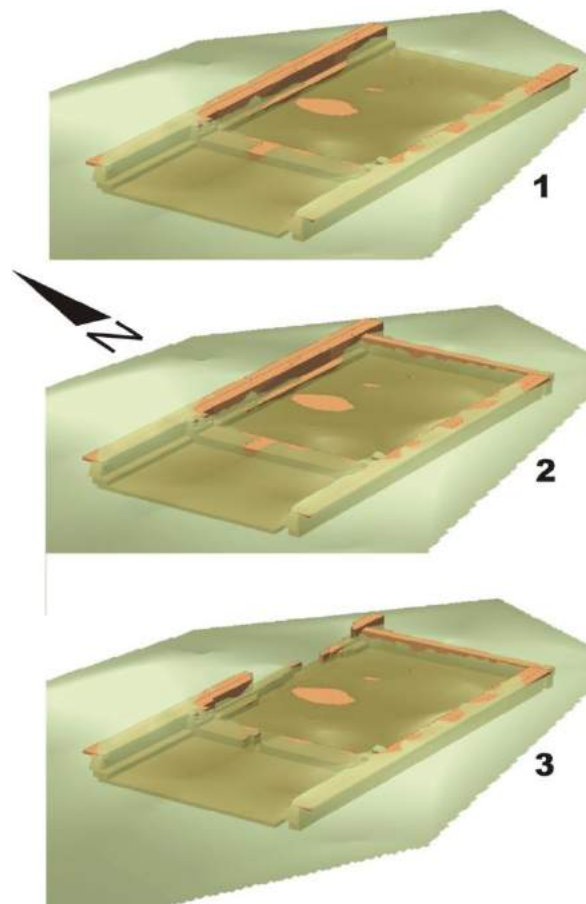


Figure 7.2 – Krol Romeas, phases of construction – (1) Original channel crossed by spillway to allow excess water out of the baray, (2) East wall built to block the channel, (3) North channel wall and spillway breached to allow water into the baray (after GAP/Wilson 2006)

Romeas implies that there was only enough water to fill half or less of the *baray*²⁰, and that the water supply had been drastically reduced. If the reduced supply of water were to enter via the Northeast corner it would have soaked into the ground and been lost. The inertia of the material (the hydraulic features) was unable to keep up with the dynamic changes in the environmental context (erosion and siltation) and thus the outcome of this situation was the repeated and effectively irreversible downgrading of the material structure. A new system could not be developed *in situ*, instead the Khmer had to do what they could with the intractable material that filled the landscape around them and constricted their options (Fletcher 2004; Fletcher 2010).

Angkor Thom

In a similar fashion many of the walled enclosures of Greater Angkor became of little use in a changing socio-political setting after the 13th century. By the late Angkorian and the Middle Period the location of Angkor changed from being at the heart of the Khmer Empire to lying at the periphery of the Khmer state. The walls of Angkor Thom, which seem to have effectively served the cautious late-Angkorian monarchs who were apprehensive about their position and the possibility of usurpation or assassination, were apparently perceived as inadequate for halting a determined opposing force. The outcome was the construction of bastions which flanked the city gates on the outside of the enclosure wall (see Figure 3.11, page 38).

Even though Angkor Thom boasts walls almost eight metres high around its perimeter, essentially the enclosure was not defensible. Although those on top of the city walls had the advantage of the higher ground, there was no crenellation to protect them and the design of the *gopura* left the gateway exposed to prospective sappers because it was recessed inside the *gopura* and thus hidden from the view of those along the top of the wall. Once an intruding force had reached the shelter of the inner *gopura*, the defenders could do really little to stop the gate being breached. Again, the outcome of this situation was that an additional but awkward line of defence was installed. Doorways were cut into the outer rooms of the *gopura* through the inside wall which would have allowed a steady

²⁰ Recall that the gradient of the land slopes from Northeast to Southwest.

stream of defenders (as opposed to however many could fit in the rooms) to attack intruders between the outer and the inner gateways (Figure 7.3, Figure 7.4). The cutting of the doorways represents a serious effort to defend the Angkor Thom enclosure gates from intruders. The bastions flank both sides of the roadway that passes through the gateway and they allowed the defending forces another vantage point from which to hold off intruding forces. However, it is difficult to assess exactly how the bastions were accessed by the defending forces.

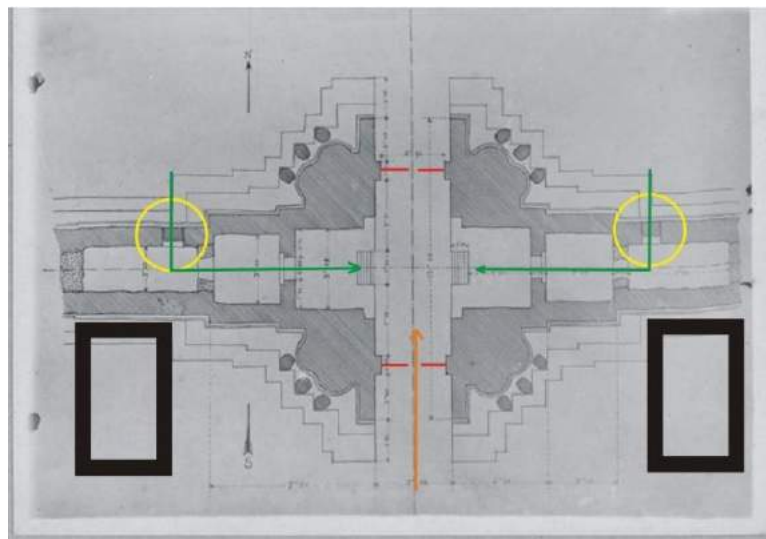


Figure 7.3 - South gopura showing: gateways (red) and intruders' approach (orange); doorway modifications (yellow), additional defence vectors (green) and bastions (black) (after Dumarcay 1988)



Figure 7.4 - West wing of the North gopura, interior. Blocked up doorway highlighted.

No access was provided from within the rooms on each side of the *gopura* to the bastions on the outside of the wall. In addition the tops of the bastions are located significantly lower than the top of the embankment wall (see Figure 7.5) and there was no direct way to access them other than to climb onto the roof of the end of the gate and then down from the roof, or across from the wall by ropes or ladders. Nevertheless, regardless of the way the bastions were accessed they did provide another layer of defence.

Angkor Wat

The defensive works at Angkor Wat seem to be an even more extreme outcome of the changing social and political context of Angkor. When a formerly secure settlement enters into decline this typically results in a reduction in security in which the remnant population seeks to downsize its defensive space in an effort to avoid the overextension of the available manpower. There are numerous examples of this phenomenon in the global context - Arles (Garrett 2006: 50) (Figure 7.6), Ephesos (Foss 1979: 103), Dos Pilas and Aguateca (Coe 2005: 162) and Athens (Thompson 1972) to name but a few. Like the enclosure wall of Angkor Wat the post-Herulian wall of Athens uses materials recycled from other monuments (Figure 7.7).

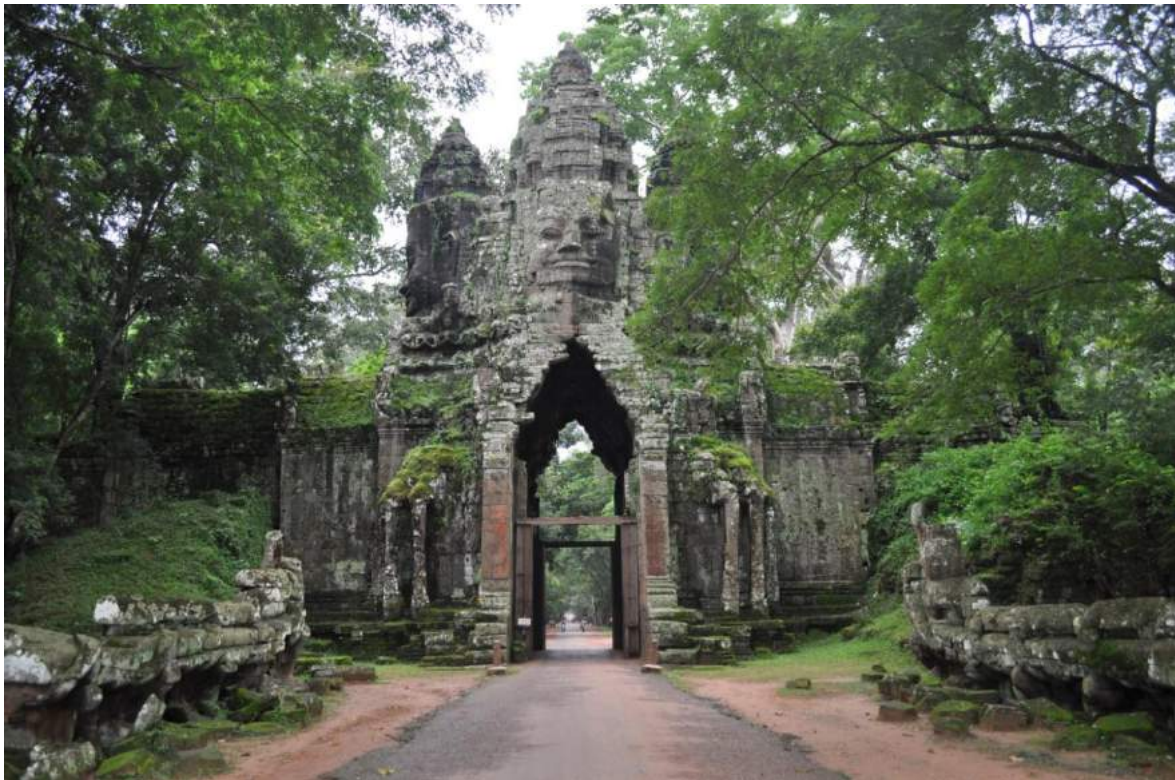


Figure 7.5 - North gopura, facing South, showing the mounds of bastion rubble on either side of the gateway - Note their positioning relative to the *gopura* roofs and their difference in height.



Figure 7.6 – The amphitheatre of Arles during the Middle Ages
(<http://frysingerreunion.org/1/france/arles06.jpg>)



Figure 7.7 - Recycled column drums and entablature in the post-Herulian wall, Athens
(<http://www.mesogeia.net/athens/places/agora/imageagora/latefortification001.jpg>)

The enclosure of Angkor Wat while still extensive is less than one tenth the size of Angkor Thom in area (0.8km² as opposed to 9km²). The distance within Angkor Wat from one *gopura* to the opposite side was less than one third of the distance within Angkor Thom (1km as opposed to 3km). Angkor Wat could therefore be effectively defended by a much smaller force than Angkor Thom. The outcome of this scenario is one of maximising the defensive efficiency of the inert landscape of the walled enclosures. The reduced scale of the defence strategy employed by fortifying Angkor Wat in preference to manning Angkor Thom suggests that the population of Angkor was in serious decline. The implication is that the defensive works of Angkor Wat were probably installed at the very end of the Khmer state's occupation of Greater Angkor.

Conclusion

The abandonment of Angkor Thom and the evidence of what we might call desperate measures at Angkor Wat – the dismantling of parts of the *gopura* of the fourth enclosure as well as other temples to acquire materials, the hasty method of assembly, the coping stones pushed off the wall – to fortify a small portion of the former city suggests that the grip of the Khmer rulers on their former capital was either in its final days or had passed. The defensive works of Angkor Wat seem to represent an eleventh-hour attempt to maintain control of the cultural icon, with which they were driven to associate themselves as a symbol of former greatness, regardless of the cost. Ultimately this attempt failed, as by the late 16th to mid 17th century the Greater Angkor region was finally forsaken by the Khmer political elite. This thesis therefore proposes a reappraisal not just of history but also, as a consequence, of terminology. As opposed to 1431 AD, it is more appropriate to consider this event – arguably the Khmer rulers' last reinforcement of security at Angkor sometime between 1590 and 1630 – as the end of the Angkorian period.

8. Appendix

A.1 Environmental Background

Angkor is located in the central Northwest of present day Cambodia. Angkor Wat is positioned just South of the centre of the urban complex (Figure 8.1). Geographically, central Cambodia offers little in the way of topographical variation, being made up largely of the Tonle Sap plain which is interrupted in places by small hills. This plain is bordered by several mountain ranges (Figure 8.2): the Dang Raek mountains to the North, the Truong Song Cordillera to the East and the Cardamom ranges to the Southwest (Higham 2002: 10). The plains of Cambodia are drained by many small rivers which feed into three main hydraulic features: the Tonle Sap lake and river, and the Mekong river along with its levee bank channels. To the South, the intersection of the Mekong and Tonle Sap rivers is known as the *Quatre Bras* (Four Arms), and is the location of the modern capital Phnom Penh.

Greater Angkor itself is located on the plain just to the North of the Tonle Sap lake (Figure 8.3), and is traversed by three rivers, the Puok, the Siem Reap, and the Roluos, all of which have their source in the Kulen and Khror hills to the north. The present-day courses of these waterways have been substantially influenced by human action as they were all redirected during the Angkorian period. Again, the topography of the land is flat, the ground level rising by only 13m over a distance of 12km, a gradient of around 0.1 percent (Acker 1998: 7). Angkor is situated on an ancient alluvial fan, and although the soil around much of the Tonle Sap is highly fertile, that around Angkor is relatively infertile (Lustig 2001: 14).

The climate of Angkor is sharply seasonal, alternating between the monsoon and the dry period (Figure 8.4). Temperatures peak at over 35°C during April and May, and fall to around 19°C in December (Lustig 2001: 13). On average, 1440mm of rain falls annually, but this figure is subject to extreme variances at times (Acker 1998: 7). Rain is expected on more than half the days between May and October in which eighty percent of the annual rain falls (Parry 1996: 16). This peak in the annual rainfall pattern causes flooding and the rivers to surge. Between June and October the increased flow of the Mekong is so severe that at the *Quatre Bras* intersection it actually forces the Tonle Sap river to flow back upstream, with dramatic consequences: the Tonle Sap lake floods and effectively increases in size from 2700 km² to 10000 km² (Delvert 1961: 80). However, recent damming of the

Mekong and its tributaries is beginning to have a noticeable impact on this phenomenon (Lu 2006: 194).

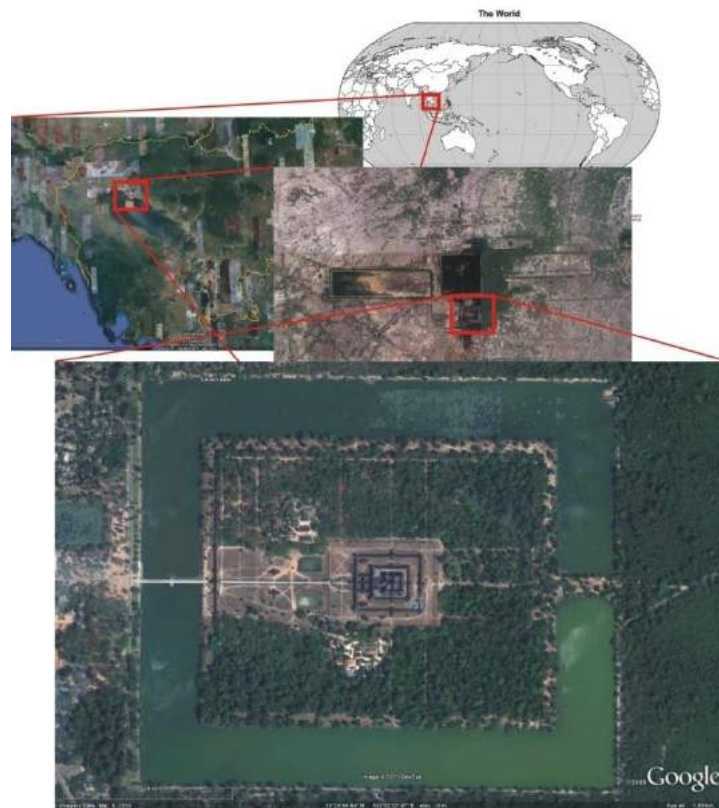


Figure 8.1 - Location of Angkor Wat (<http://whale.wheelock.edu/SAS/images/wrldpac.jpg>, GoogleEarth)

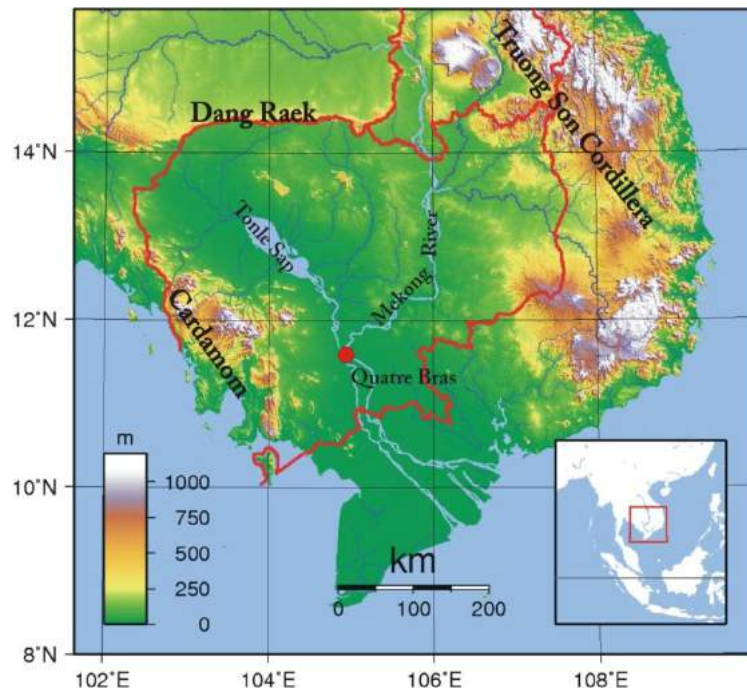


Figure 8.2 Topographical map of Cambodia (adapted from http://upload.wikimedia.org/wikipedia/commons/3/3c/Cambodia_Topography.png)

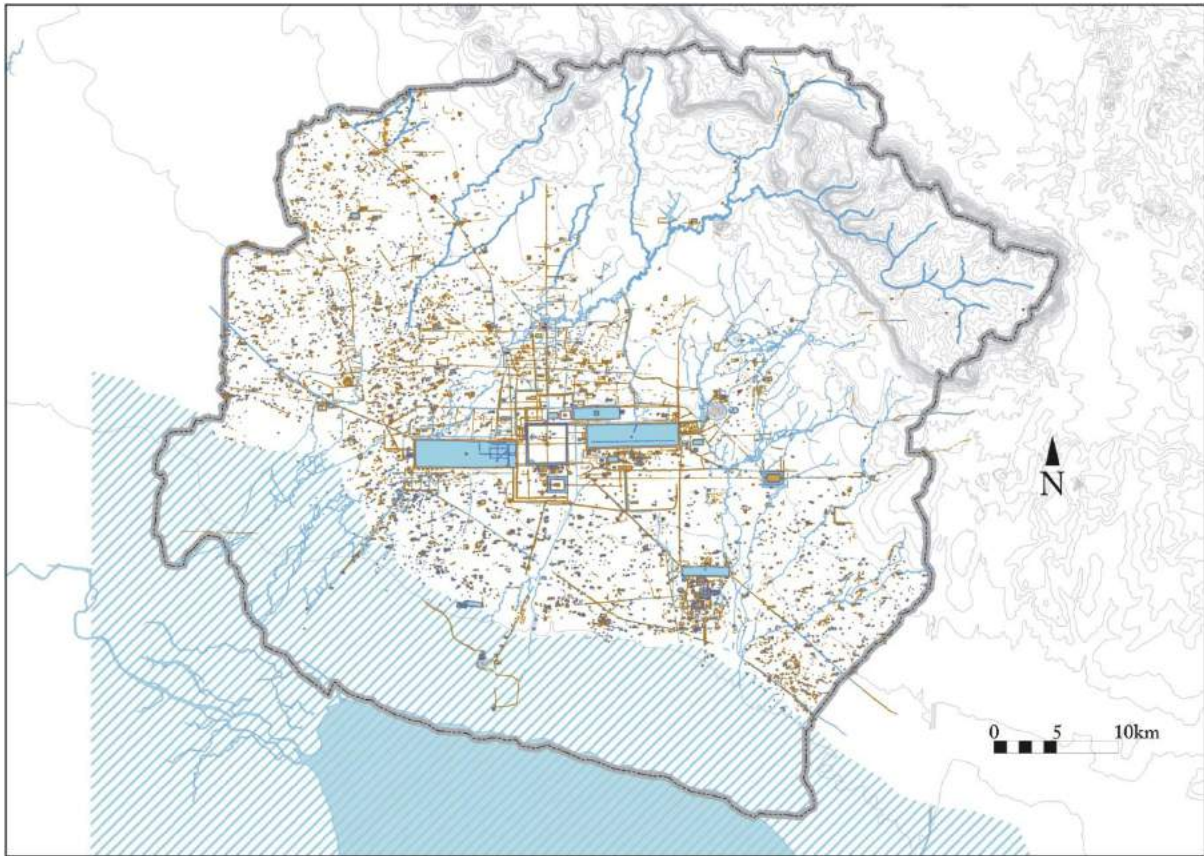


Figure 8.3 - Greater Angkor (GAP/Evans 2007)

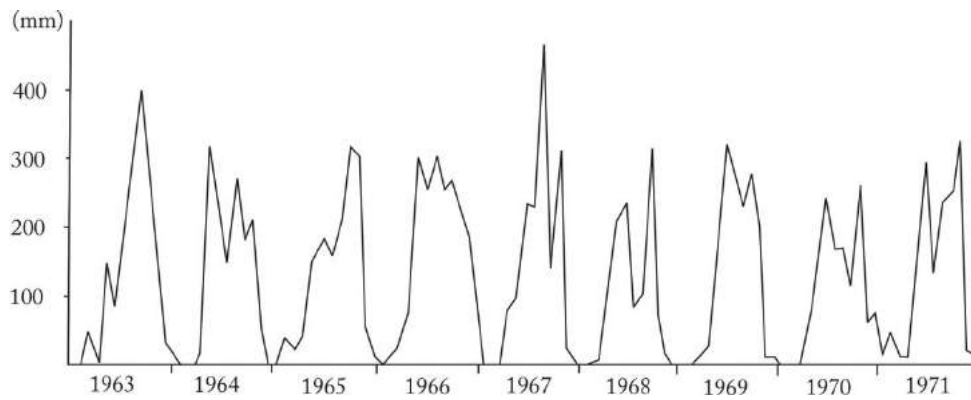


Figure 8.4 Rainfall at Siem Reap, 1963-1971 (reproduced from Parry 1996)

A.2 Data Correction Method

Although the Total Station provides a high degree of accuracy with respect to recording angles and distances the compiled data set was still in need of some corrections. The survey began at the East gopura, and proceeded anticlockwise. Upon closing the circuit, the initial postholes were resurveyed, and a variance of approximately one metre was noted. When compared to a perimeter of almost 3700m this error is understandable; however, it is hardly acceptable. Fortunately, accuracy could be improved. Even with the relative clear visibility afforded by the enclosure's exterior, the recurring presence of trees and foliage required more than fifty benchmarks to complete the survey and this increased the chance of accumulative errors. It is argued that the potential error between two adjacent benchmarks is negligible and that it is only after the total combined error that it became a problem. It was therefore decided to resurvey key points, namely the *gopura* and the outer corners of the wall, with as few benchmarks as possible in order to minimise any accumulated error.

This resurvey of the *gopura* entrances and the corners of the wall also began at the East gopura. To demonstrate the accuracy of the technique, the resurvey involved recording the location of the West gopura entrance from two different approaches – anticlockwise via the North wall, and clockwise via the South – to establish the variance. On this occasion, only three benchmarks were needed for the Northern route, and four for the Southern. The error between the two routes was 10 cm. These additional points were used as the corrective guidelines for the spatial adjustment software in ArcGIS 9.3.

A.3 Defensive Works – Volume Estimates

Estimates for the amount of materials and labour required to fortify Angkor Wat are largely speculative because the design of the platform and palisade are unknown. All that is known is their imprint in the wall. Furthermore, present day wood and laterite working methods typically employ power tools so any estimate for the labour spent in the preparation of the wall and the assembly of the platform is currently guesswork. The one aspect that can be accurately measured is the total volume of the horizontal postholes – that is, the amount of laterite chiselled out of the inside face – since these were accurately measured: 5.97 m³.

However the vertical postholes were not accurately measured so the following calculations are based on an assumed depth of 0.4m for the large holes (Types 1, 2 and 8) and 0.20m for the small holes (Types 3, 4, 5, 6, and 7).

Table 8.1 - Vertical posthole volume calculations

Type	Shape	Dimension (m)	Area (m ²)	Depth (m)	Iterations	Volume (m ³)
1	Circle	∅ = 0.2	π x 0.1 ²	0.4	25	0.314
2	Circle	∅ = 0.15	π x 0.075 ²	0.4	203	1.435
3	Circle	∅ = 0.1	π x 0.05 ²	0.2	1558	2.447
4	Square	0.07 x 0.07	0.07 ²	0.2	337	0.330
5	Rectangle	0.05 x 0.1	0.05 x 0.1	0.2	117	0.117
6	Diamond	5-7cm	0.05 ²	0.2	71	0.036
7	Diamond	10cm	0.1 ²	0.2	10	0.02
8	Circle or Square	∅ = 15-20cm	π x 0.1 ² x 2	0.4	49	0.028

Therefore the total volume of the vertical holes is 4.73 m³, and the combined volume of all the surveyed postholes is 10.7m³. Experimental work hand chiselling laterite is needed in order to estimate how long this work would have taken.

Estimates for the construction of the platform and palisade will be kept rudimentary because their design is speculative. However, the basic framework of the proposed platform and staircases is quite simple (Figure 8.5). The framework supports a timber platform 0.1m thick which would have a volume of 2.8m³.

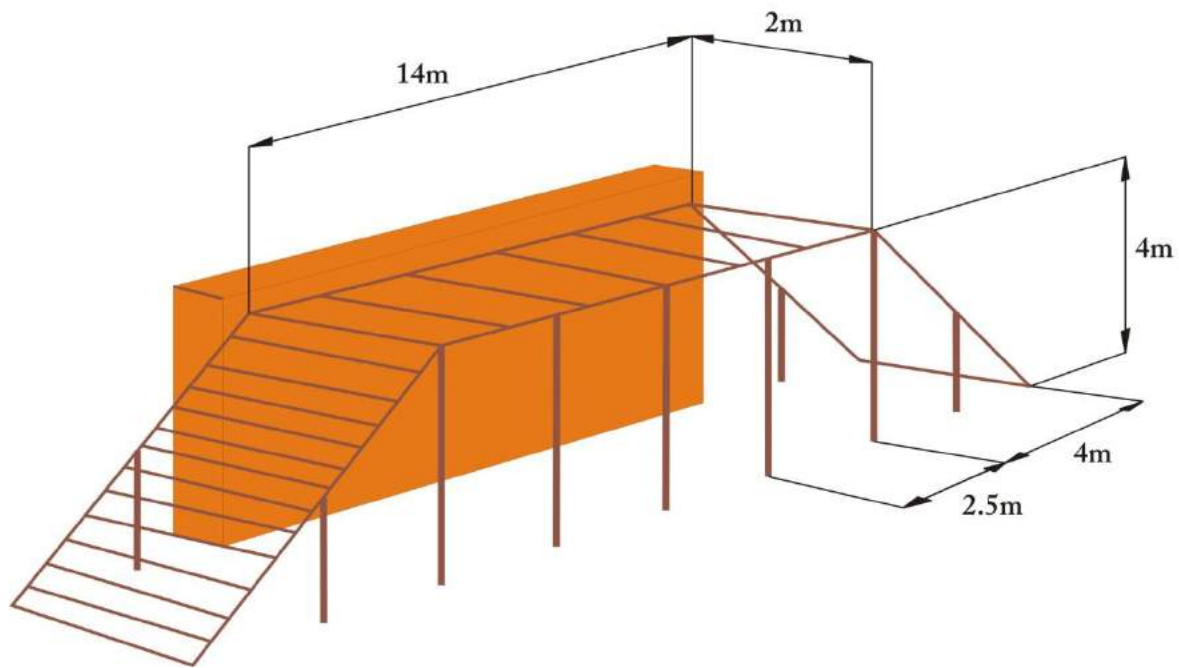


Figure 8.5 - Proposed model for the framework of the platform and staircases

The following table gives the dimensions of the components.

Table 8.2 - Volume estimates for the proposed platform and staircases

Component	Cross Section (m ²)	Length (m)	Volume (m ³)	Number	Total Volume (m ³)
Horizontal beam	0.1 x 0.2	2	0.04	7	0.28
Support posts	Π x 0.125 ²	4	0.2	5	1.0
Platform bracing	0.1 x 0.2	14	0.28	2	0.56
Stair rails	0.1 x 0.2	5.5	0.11	4	0.44
Stair supports	Π x 0.125 ²	2	0.1	4	0.4
Stairs	0.1 x 0.2	2	0.04	30	1.2

Thus the platform and staircase framework would require 3.88m³ of timber which brings the volume of the whole structure to 6.68m³. The 1071 horizontal postholes (although their patterning varies in places) would support 153 of the proposed structures and require a

total of 1022m³ of timber. Similarly, based on the calculations in Table 8.1 a simple palisade consisting of vertical posts to a height of 1.5m would require some 37m³ of timber.

The timber required to build this platform would not have been available in the immediate vicinity of Angkor Wat, as most of these would have been economic trees – palm trees and other bushes – for the harvest of food products (e.g. coconuts) and thatch (palm fronds). Therefore the timber must have been sourced from further afield, so additional research is needed to gauge the labour expended in this venture. Likewise, an experimental assembly of the proposed structures would be needed to calculate how long this activity would have taken.

A.4 Further Research

Further research on this topic can be carried out in two main areas: further field survey and excavation.

A.4.1 Field Survey

Additional field survey needs to be conducted on Angkor Wat itself, as the West wall was left incomplete in this regard. This was due to time constraints and the nature of the top of the wall – the sandstone coping stones which obscure the centre of the top of the wall. Postholes were located that were partially covered by the coping stone, and hence other postholes may be underneath it.

To locate the postholes of the platform in the ground a GPR survey may be useful. GPR has been used in the vicinity of the enclosure wall but this was only immediately around the North and East gopura. Although GPR has so far had limited success in locating postholes (Sonnemann pers. comm.) additional survey along the enclosure wall may prove successful, especially along the inside of the East wall between the East gopura and the South gateway, which is currently a grass lawn and clear of all undergrowth (Figure 8.6).

As noted, the Royal Palace also has an array of postholes in its enclosure wall and these too need to be studied. The patterning these postholes exhibit is more varied than those at Angkor Wat yet at a glance patterns are noticeable. Any relationships between the modification of the two enclosure walls needs to be ascertained as this would strengthen our understanding of the development of these timber structures.

Finally, a general inventory of Angkorian enclosure walls needs to be compiled. It is possible that such features similar to the postholes on top of the wall (like at Angkor Wat) have been overlooked. Although a huge task this needs to be done to confidently rule out alternative explanations for the postholes' function, especially those which are related to the wall's construction process.

A.4.2 Excavation

Excavation needs to be carried out from up against the inside face of the enclosure wall to several metres out in order to locate the holes for the support posts of the platform.

Although one such excavation was carried out by GAP in 2010, the pit produced no finds consistent with the proposed structure. The two by one metre East-West running test pit (Figure 8.6) which was positioned up against the East wall just South of the South gopura would have had little chance of detecting any trace of the proposed structure, which to have been useful would have projected several metres from the wall. A larger excavation trench located at the interface of several of the posthole features would have the best chance of finding traces of the structure. That is, an excavation which overlaps the transition between a set of horizontal holes and the adjacent gap and projects out from the wall would locate the end support posts and one of the proposed staircases.

Another area which needs to be excavated would be up against the gateways. A piece of charcoal from underneath these modifications would establish a more accurate *terminus post quem* for the infill. Again, the excavation would be best located on the interior of a gateway which exhibits or is located sufficiently close to the transitional features described above. Either of the West gateways on the North and South walls would be the best places because they seem to bridge a transitional area. Furthermore since they both feature multiple phases of construction it could be possible to establish a relative chronology for these too.



Figure 8.6 – Trench 6 from the GAP III excavations at Angkor Wat, 2010

A.5 Posthole Distribution

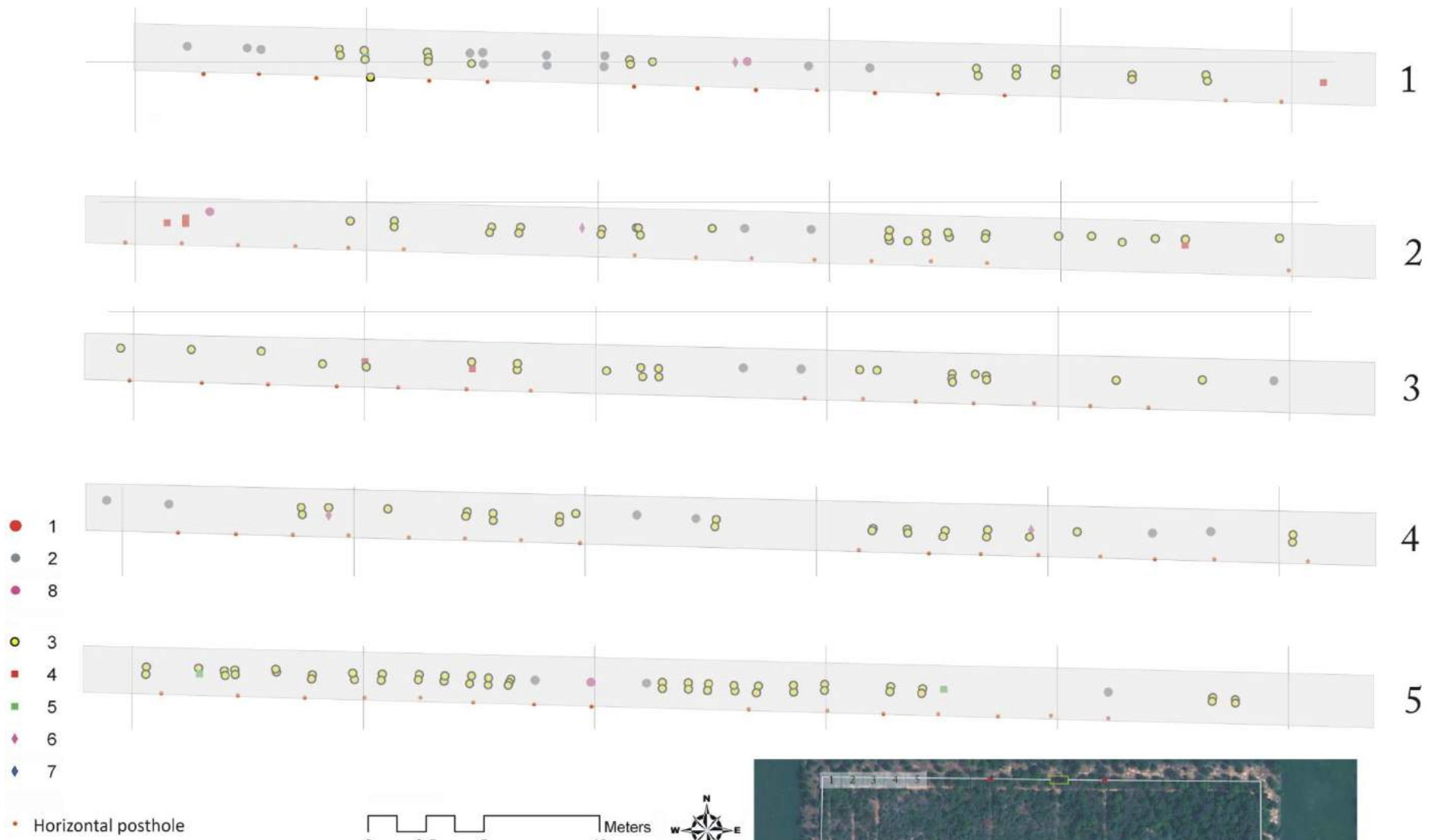
The complete dataset is presented here which, given the multi-scalar nature of the postholes and the wall, this Appendix breaks the dataset into panels. The walls which run East-West (the North and the South walls) are presented as 50m panels from left to right (West to East), while those which run North-South (the West and the East walls) are presented as 40 m panels from top to bottom (North to South). Each panel is numbered and the inset illustrates the panel's precise location along the wall. Note also the legend for the Types of posthole. Finally recall that the enclosure wall is skewed slightly to clockwise, hence the variance from the cardinal axes.

Figure 8.7 (page 134) – North wall panels

Figure 8.8 (page 138) - East wall panels

Figure 8.9 (page 142) - South wall panels

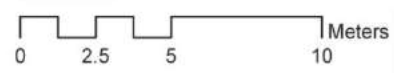
Figure 8.10 (page 146) - West wall panels





- 1
- 2
- 8
- 3
- 4
- 5
- ◆ 6
- ◆ 7

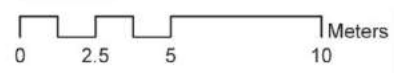
● Horizontal posthole

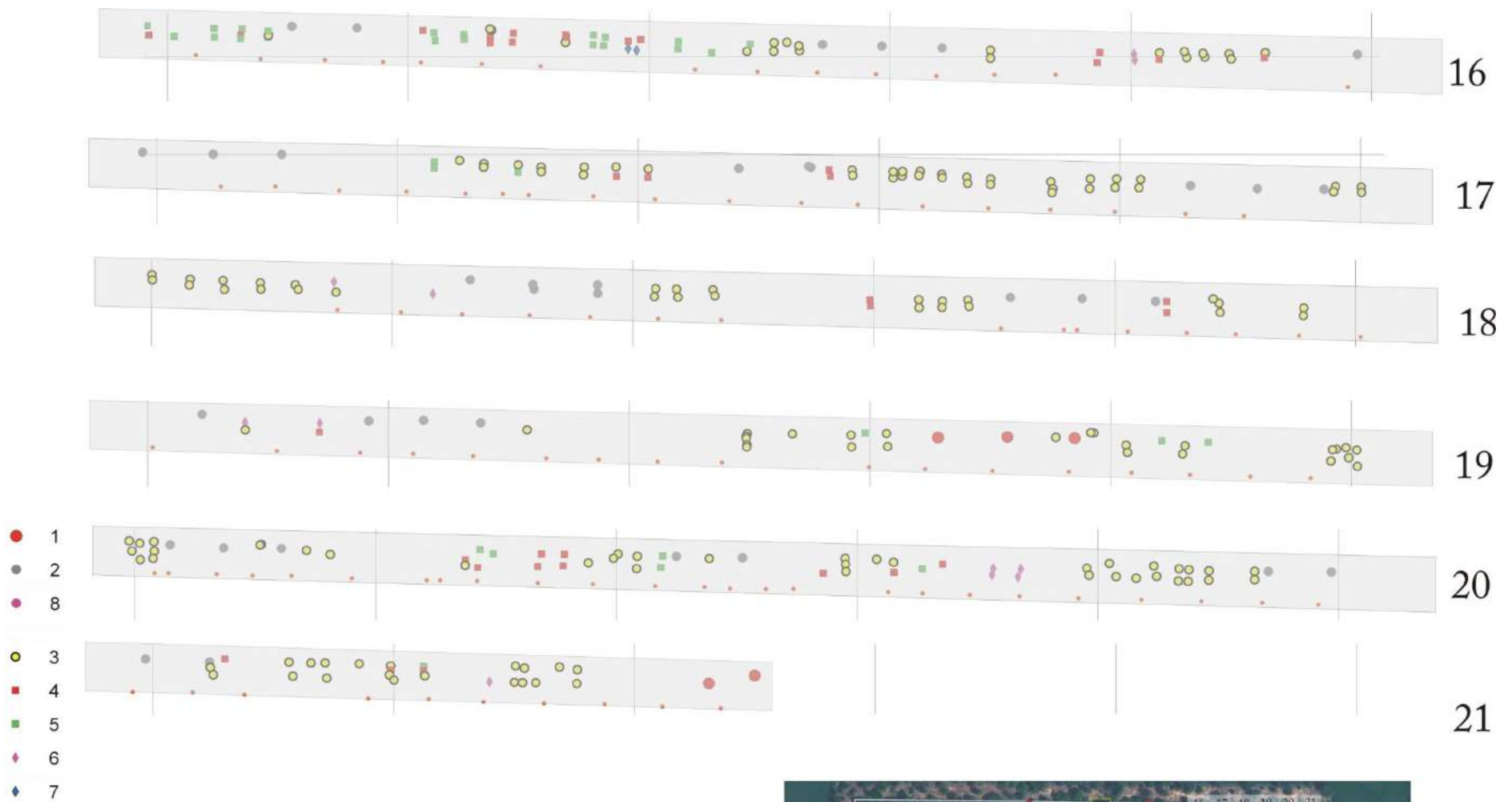




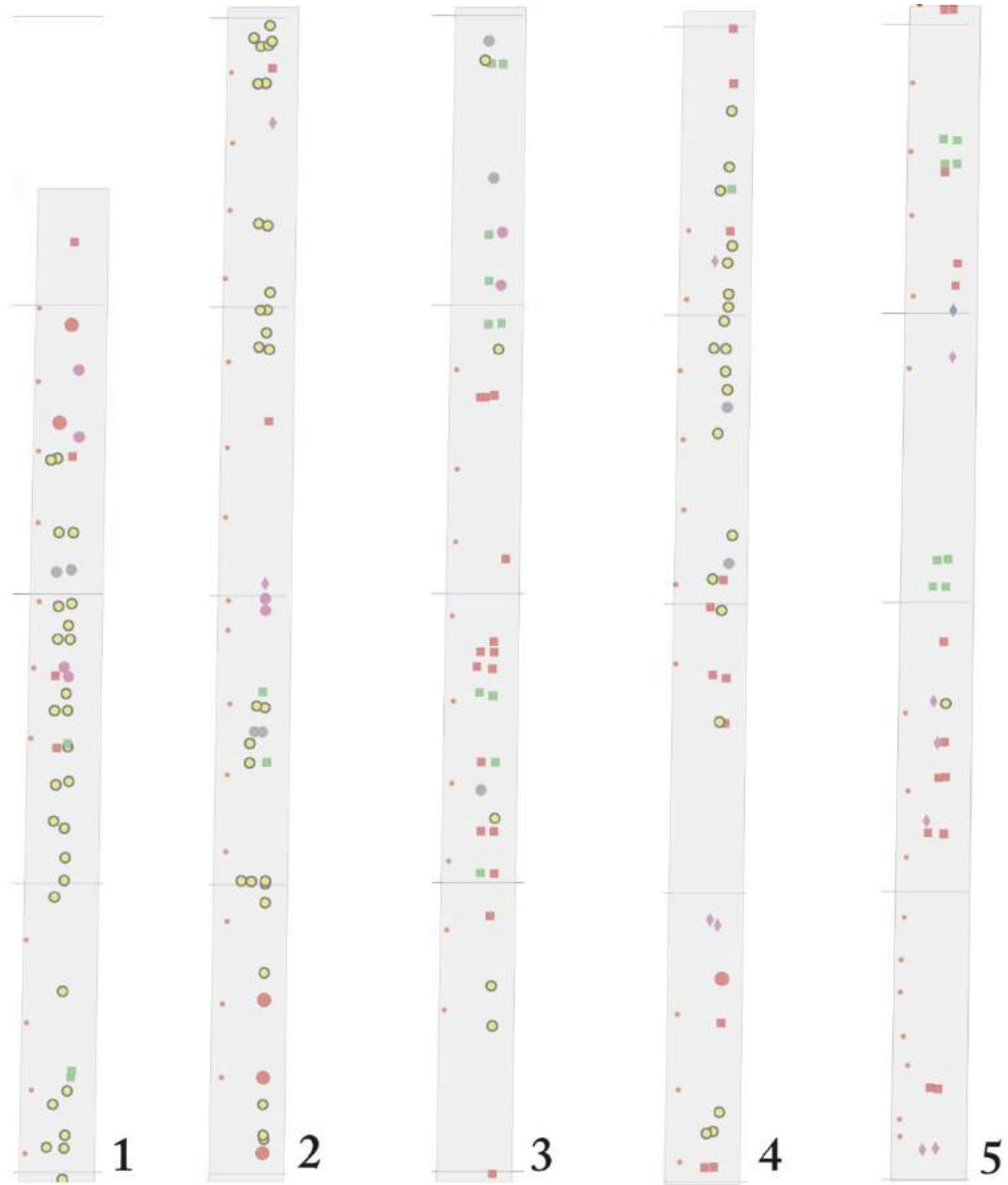
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● Horizontal posthole





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- Horizontal posthole



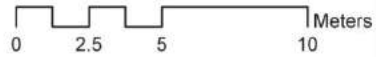
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- Horizontal posthole



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- Horizontal posthole



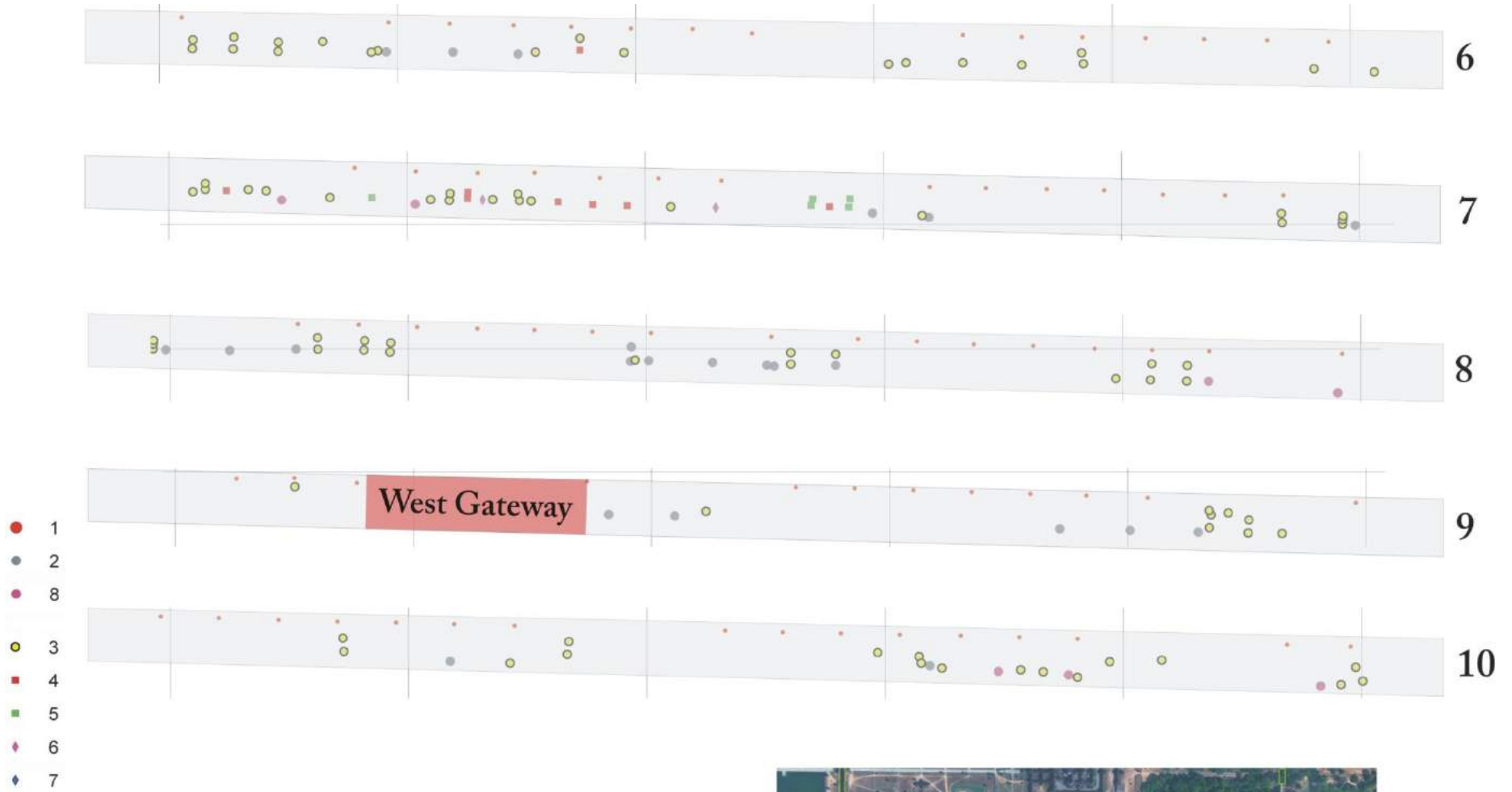
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- Horizontal posthole



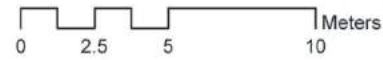


● Horizontal posthole



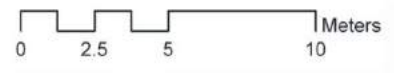


● Horizontal posthole





● Horizontal posthole





● Horizontal posthole



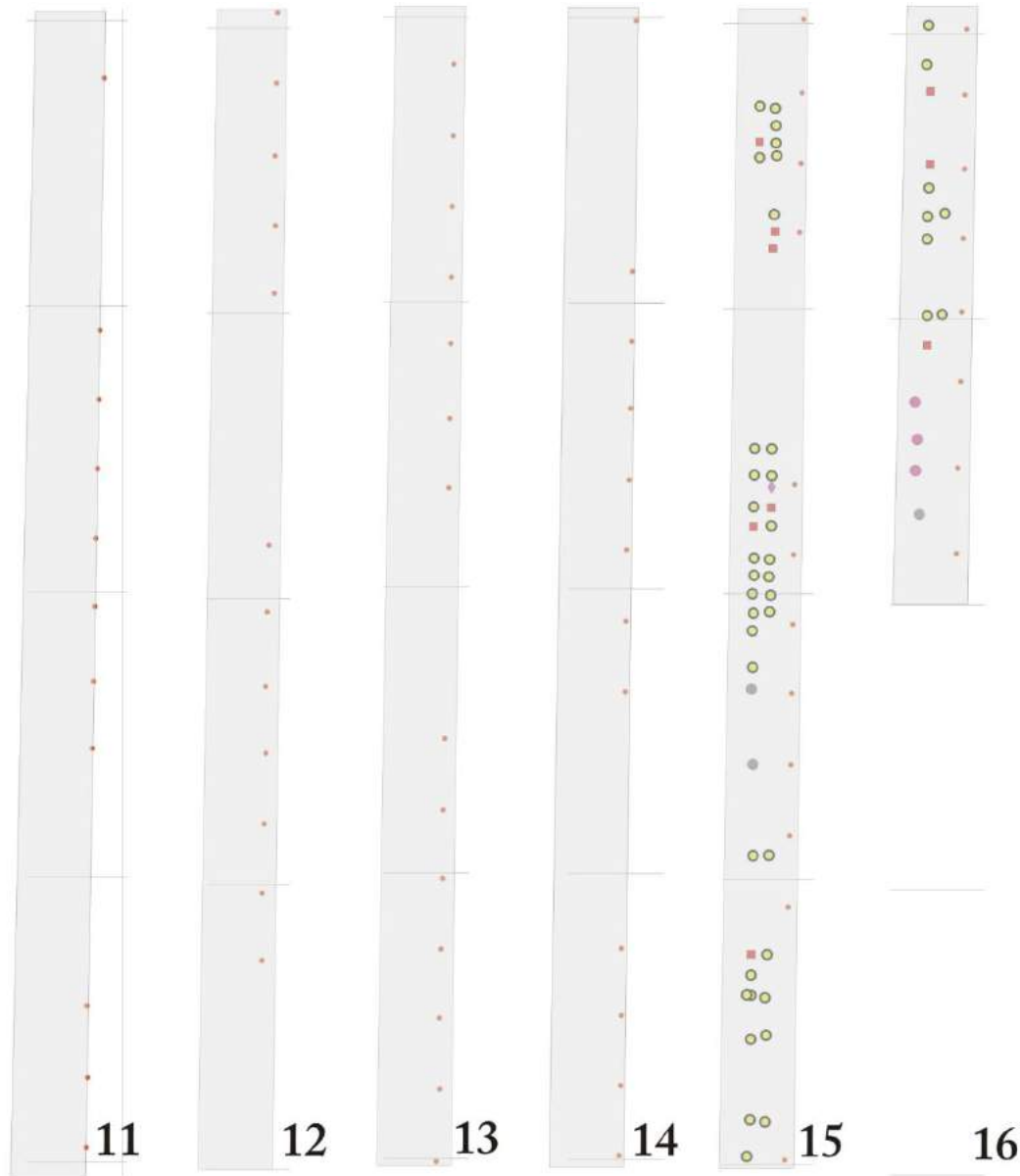
- 1
- 2
- 8
- 3
- 4
- 5
- ◆ 6
- ◆ 7
- Horizontal posthole



- 1
- 2
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- 3
- 4
- 5
- ◆ 6
- ◆ 7
- Horizontal posthole



- 1
- 2
- 8
- 3
- 4
- 5
- ◆ 6
- ◆ 7
- Horizontal posthole



A.6 Chronology of Events

Table 8.3 - Table of Chronology

Year	Ayutthaya	Angkor/Cambodia	Champa/Dai Viet	Source
1296/7		Angkor had recent wars with the Siamese		Smithies 2001: 89
1371			Champa sacks Hanoi	Miksic 2007: 92
15 th century			Champa preoccupied with relations with Vietnam	Vickery 2004: 1, 42
1421			Champa attacks Cambodia	Miksic 2007: 92
1428			Chinese ousted from Hanoi	Buttinger 1972: 43
1431	Ayutthaya attacks Angkor, installs puppet king			Vickery 2004: 27
1471			Cham capital Vijaya conquered by Dai Viet – although Champa resistance continues	Buttinger 1972: 46
1502-1527			Tumultuous period for Dai Viet with 8 kings in 25 years, 6 of whom were assassinated	Buttinger 1972: 48
1528		Param Reachea II establishes Lovek		Ewington 2008: 95
1532			Mac (Dai Viet) civil war begins	Buttinger 1972: 48
1546		Bas-reliefs commenced at Angkor Wat		Pakdeekham 2008: 40
1549	Unsuccessful attempt to attack			Ewington 2008: 97

	Lovek			
1553	Ayutthaya invades Cambodia	Param Reachea II fights invasion at Pursat		Ewington 2008: A.2 152
1564		Bas-reliefs are completed at Angkor Wat		Pakdeekham 2008: 40
1566	Unsuccessful attempt to attack Lovek			Ewington 2008: 97
1569	Burmese conquest of Ayutthaya			Reid 1993: 7
1579		Enclosure wall repaired, towers gilded		Lewitz 1970: 112
1585/6		Angkor Thom occupied, defensive works not mentioned		Groslier 2006: 50
1587	Unsuccessful attempt to attack Lovek			Ewington 2008: 97
1590	King Naresor regains independence from Burma			Ishii 1993: 181
1592			Mac (Dai Viet) civil war ends	Buttinger 1972: 48
1594	King Naresor captures Lovek, armies invade Cambodia via Battambang, Pursat and Angkor	Lovek captured by Ayutthaya		Ewington 2008: 97
1611			Dai Viet again on the offensive against Champa	Vickery 2005: 80
1620			Nguyen-Trinh (Dai Viet) civil war begins	Buttinger 1972: 48
1623-		Japanese pilgrim draws map of		Peri 1923

1636		Angkor Wat		
1636		Dutch merchants arrive at Lovek		Ewington 2008: 98

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