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Celebrating the Generation of Architectural Ideas
Tracing the lineage of Southeast Asian temples

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From its early beginnings in the fifth century, the Brahmanic/Hindu tradition created a rich body of temples which spread across India and influenced temple building in Southeast Asia. The legacy of this ancient diasporic movement remains celebrated today in the admiration of Southeast Asian monuments such as Angkor Wat and Prambanan. However, this architecture evolved over time through a process of long experimentation with philosophies, world-views, and methods. The architectural forms of such monuments have obvious Indian antecedents but the process of their development into distinctive indigenous forms remains difficult to ascertain. This is due both to the lack of textual accounts from the earliest Southeast Asian civilisations and because their architectural remains are fragmented or heavily eroded. This paper draws on a research project that pieces together fragments of evidence from diagrams and canonical descriptions to photogrammetry of temples in India and Southeast Asia. The intention of this is to establish the degree to which Southeast Asian temples are attributable to Brahmanic/Hindu lineage and influence. It will focus on the role of the early Southeast Asian temple site of Sambor Prei Kuk (Isanapura) in Cambodia. Comparing the relationships between cosmology, geometry and physical form in this earlier sites with both Indian and developed Southeast Asian models, it is intended that its generative role within Southeast Asian architectural historiography can be clarified and more fully celebrated.

The architectural forms of Southeast Asian temples have obvious Indian antecedents. However, relating them to these antecedents remains difficult due to the lack of textual accounts from the earliest Southeast Asian civilisations and because their architectural remains are fragmented or heavily eroded. The result of this is that the origins of the great Southeast Asian architectural monuments such as Angkor Wat and Borobudur, and the civilisations that produced them, are much less completely understood than Western monuments of the same period (around eighth to eleventh century CE). While it is well-established that they were at least partially underpinned by Brahmanic philosophies derived from India, the precise nature of such derivations and exchanges (as well as influences from local culture and other sources) remains the source of conjecture. One of the results of this is that the societies of this period in Southeast Asia remain little known except to specialists in Southeast Asian archaeology. This is a great pity as evidence suggests that a number of highly organised and developed societies date from this period. These societies deserve to be celebrated for their own achievements, as well as their seminal role in the development of the civilisations that produced the famous monuments of southeast Asia.

The connections of southeast Asian temples to Indian antecedents has been widely documented. While the development of architectonic ideas from indigenous or other sources cannot be ignored, understanding of Indian connections is thus critical in understanding the architectural developments in Southeast Asia. However, while individual architectural and decorative elements from temples in this region to have been traced to various sources within India, no temple in Southeast Asia has been analysed by direct comparison with Indian examples. This paper describes part of an ongoing research project into this gap. This project draws upon computational modelling of diagrams, canonical descriptions and actual temples in India and Southeast Asia, with the aim of better understanding of the relationship between Indian antecedents and Javanese, Khmer and Cham monuments. More specifically the aim of the project is to establish the influence of Indian prototypes in the construction and conception of Southeast Asian cellae (the cella being the basic cubic sanctuary of the Brahmanic/Hindu temple).

Scholars have explained the origin of individual temple traditions by tracing their basis in canonical text, sacred diagrams and cosmogony. While there are thousands of variations in form, essentially every temple in the Brahmanic/Hindu tradition can be understood through principles outlined in canonc Sanskrit texts (shastras) such as Matamata and Agni Puranas. These texts provide sets of prescriptive rules which touch on all
aspects of temple construction; site selection, formal types, details, and location of sculptural elements. The architectural elements described by such shastras are based on a number of geometric figures known as mandalas, and it is from these ritual and cosmic diagrams that temple plans and superstructure have been generated. Studies of Indic temple geometry have demonstrated the correspondence of canonical descriptions of constructive geometry with the base plans of surviving monuments. However, as these temples were built in dynamic, ever-changing cultural, physical and sectarian contexts, the actual practise of this knowledge was the subject of experimentation over several centuries within the regional schools of temple building. While the shastras may be prescriptive, there exist a multitude of interpretations and variations.

The simple cella, however, laid the formal foundation of Indian temple architecture. Its basic formal schema comprises the base (pitha), an inner sanctum (prasada) and a superstructure of distinctive form (in particular the curvilinear sikhara of the northern Indian Nāgara tradition). The evolution of the cella embodied a progressive elaboration of this prototypical schema, using a sacred constructive geometry that conveyed the syncretic Brahmanic cosmology. The morphology of the Indian temple and its progressive development can thus be followed from the earliest extant cellae in the fifth century to entire thirteenth century complexes and temple cities across India and Southeast Asia. The project aims to shed light on the extent to which the geometric evolution of Southeast Asian temple cellae form are attributable to their Indian antecedents, and by extension, to the textual and diagrammatic prescriptions of known shastras or canonical texts. It focuses on two fundamental elements of the cella: the base plan and the superstructure form, in order to trace influences and model the similarities (and differences) between Southeast Asian examples and their possible Indian antecedents.

However before extrapolating on the method by which this might be achieved, a brief note needs to be made on the similarities that have been described between Indian and Southeast Asian temples. The architecture of the Pallava dynasty of southern India and the Pala, Sena and Gupta dynasties of northern India have all been suggested as being influential in Southeast Asia. Based on formal resemblance, similarity in plan-form, parallels in decorative motifs and clues found in inscriptions, several individual examples of Indian architecture have also been considered as precedents. These have included the temple of Bhitagon near Cawnpore in Uttar Pradesh, the Paharpur remains in Bengal, Orissan temples, and the cave-temples of Ajanta and Ellora. More specifically, the similarities between Southeast Asian cella superstructures and the sikhara superstructures of the Nāgara tradition have been noted by several authors.

The verity of these connections remains difficult to conclusively establish. Apart from the fragmentary nature of the architectural evidence from the earliest Southeast Asian polities, the extension of temple traditions from India into Southeast Asia is further complicated by the fact that while there are several extant Indian shastras, very few architectural texts remain from Southeast Asian Brahmanic/Hindu civilisations. Only the Balinese Asta Kosala provides a relatively complete set of prescriptive documents. This is, however, a vast topic, and so both the project and this paper will concentrate on a single location, Sambor Prei Kuk of the Chen-La kingdom in what is now central Cambodia. This site has been chosen for its pivotal role in the development of southeast Asian architecture. Sambor Prei Kuk is of particular importance as it is both the earliest known site with monumental architecture and the oldest ensemble of Hindu-Buddhist architecture in Southeast Asia. The early history of southeast Asian states remains conjectural, but around the fifth or sixth century CE definite evidence emerges of recognisable kingdoms. The most prominent amongst these on the southeast Asian mainland was firstly the kingdom of Funan which controlled present-day Cambodia and southern Vietnam from its capital Oc-Eo on the Mekong delta. Funan is notable in that it was a maritime empire, its power based on controlling trade around coastal southeast Asia, including that between China and India. As a result, ideas regarding religion and the edification of royal power were both assimilated and adapted to local conditions. It is even noted that the founding legend of Funan and that of the Indian Pallava dynasty have a remarkable number of similarities. Reports from Chinese visitors also indicate Funanese adoption of a version of Brahmanism but the precise nature of belief in Funan is unknown. Henri Parmentier speculated on its architecture on the basis of extant remains and subsequent temple architecture in Cambodia and Champa but this is entirely inconclusive. There is little extant evidence but it is supposed that most Funanese architecture would have been timber.

However much more architecture remains from Chen-La, Funan’s successor as the dominant power in the region, and the first major Khmer kingdom. Chen-La was based in the centre of what is now Cambodia and its king Isanavarman subjugated Funan in fifth century CE. Isanapura, his capital, is considered to be the site now referred to as Sambor Prei Kuk. However, due at least in part to the instability of Cambodia, Isanapura/Sambor Prei Kuk has received remarkably little attention for such an important site. While Henri Parmentier dated its monuments in 1927 based on inscriptions found at the site, and B.P. Grosier postulated their chronology in 1962, due to the interregnum forced by the Khmer Rouge extensive investigations have only occurred comparatively recently. While there are other outlying remains still being rediscovered, the central site consists of three major temple precincts, designated central, southern and
northern groups by Parmentier. Each precinct contains a number of brick and sandstone structures, all eroded to some extent, but including several whose overall form and extant detail are enough to suggest a clear idea of their former grandeur. Central sanctuaries are surrounded by subsidiary structures and walled enclosures. The southern group contains the most extensive structures and is considered through its inscriptions to be directly connected with Isanavaran. 17 A central square sanctuary being surrounded by five smaller sanctuaries in an inner enclosure and another six in an outer enclosure. Gopura (gateways) connect the enclosures and the city outside. The other groups have a similar layout and the whole city is enclosed by two layers of city walls covering an area of four square kilometres.

These structures have been mostly dated from the first half of the seventh century CE, and so Sambor Prei Kuk represents a key period in Southeast Asian architectural history. Its monuments, as well as being largely constructed of durable materials and so the most permanent legacy of its society, also embody beliefs and ideas that extended beyond its particular culture and location, demonstrating the existence of a wider Brahmanic religious and political environment in seventh century southeast Asia. As Higham notes, it can be gathered from both the detailed epigraphs on the site and by contemporary accounts that Sambor Prei Kuk’s temples held key positions in its economy as well as its religion and cosmology. Temples were directly under the administration of pon, or persons of high rank, titles passed through the female line under the auspices of a mixture of local deities and imported Brahmanic ones. Pon formed an elite circle and the temples were their centres for the accumulation of wealth through tribute and tax. 18

The general composition of several of these shrines can be directly related to the Brahmanic model; a square or rectangular podium on top of which sits the cubic cela, and then topped with an elaborate superstructure composed of tiers of gradually reducing height and width forming a pyramidal tower-like structure. While there are numerous variations on this basic schema the overall form of the rectangular shrines represents a clear link to both Indian temples of the same or slightly earlier periods, and to the temples at Angkor that were to supercede them by the early ninth century. 19 Connections with Java are also apparent both from the architectural and epigraphic records. As Higham notes, several of the motifs found on the structures at Sambor Prei Kuk are also found in India. These include the prominent depiction of the makaras over either ends of the lintels to sanctuary openings, and the depictions of inhabited palace-like structures (on several of the sanctuary walls) noted from the Ajanta Cave-temples. 20

Thus there are a number of clues as to the derivation of Sambor Prei Kuk’s architecture. However as Mannikka notes in her detailed account of the analysis of Angkor Wat; the challenge in reconstructing Cambodia’s historical and architectural past, then, lies in an expanded literacy: the ability to ‘read’ architecture and sculpture for meaning and stylistic development; the ability to ‘read’ the remains of canals, foundations, earthen levees, moats, and ancient walls to reconstruct the past from the ruins and debris it left behind. 21

Some of this ‘reading’ can be derived from general principles of Brahmanic/Hindu temple form. Geometry and measure plays an important role in the conception and construction of temples, and concrete representation of Brahmanic cosmology. As well as being both the object of worship and the abode of the deity, the temple is the threshold between humanity and the divine. The tower-form of the sanctuary superstructure as the embodiment of Mt Meru is the most literal representation of this confluenve of meanings, and since such superstructures are clearly present at Sambor Prei Kuk’s temples, such connotations seem to apply. The articulation of recesses, pilasters and other wall elements also resemble Indian prototypes. 22 However, these factors need to be distinguished from other influences, both cultural and technological. Factors such as the development of structural systems from timber to brick construction and the probable influence of local timber tradition cannot be ignored. While the actual methods of derivation remain the subject of speculation, the later Khmer temples at Angkor evidence a relationship between astronomy and architectural dimensions that suggests the trigonometric application of sacred geometry. 23 From this can be deduced that such principles might apply to the temples at Sambor Prei Kuk. However, while cosmological correlations have been found at Angkor Wat and other monuments through extensive measurements, discerning the precise relationships between traditional texts, sacred diagrams and temple construction conjectural. It is difficult to pinpoint exactly how a particular monument relates to particular Sanskrit texts, also exactly where, how, when and by whom cultural influences have been transmitted.

The answers nevertheless seem embedded in the architectural remains and this project attempts to ‘read’ these remains to derive a position as to their formal derivation. In this, our approach might be compared in a propositional sense to Robin Evans’ theories on projective geometry. As Evans once asked, ‘Why is it not possible to derive a theory of architecture from a consideration of architecture?’ 24 Evans uses a series of translations to track the development of architectural form through projective geometry. In this the building as object is perceived through a series of drawings to the finished product, a projection informed by the subjective experience of buildings. While Evans develops a proposition about how architecture develops through the translation of drawing into building, of representation into actuality, our particular challenge is the opposite, the translation of building through the geometric and proportional clues present in its form back to its description. This is being undertaken in the understanding
that an absence of clear evidence makes connections between generic descriptions in sacred texts and specific monuments problematic.\(^2\) As Dumarcay has argued, using the octagonal temples at Sambor Prei Kuk as his example, the development of southeast Asian architecture can be construed as a series of gradual permutations and variations on basic models, based on the progress of technological advancement as much as the flow of religious ideas.\(^3\) Interpretation is thus the key to obtaining a level of understanding, and determining an appropriate approach.

This interpretation will be aided by a mixture of computational techniques to analyse the constructional geometry of temples. While bearing in mind the influences from other sources, computational modelling of spatial information provides a new tool for researching the genesis and evolution of temple forms, enabling the piecing together of spatial information from a large number of fragmentary sources. Through the use of architectural photogrammetry, computer form models can be generated from existing temples and compared with models derived from textual canons (shastra rules and diagrams). While, as Affleck and Kvan observe, the majority of virtual heritage projects attempt to create in the computer a realistic representation of their subject, this is not the primary intent of this project (though it is a possible application).\(^4\) Partially this is an attempt not to fall into the trap of mistaking realism for authenticity, but essentially what is important is not so much to recreate Sambor Prei Kuk, but to uncover how its architecture was developed by comparing its formal properties with models from which it may have been derived.

Computation of spatial information will be used to plot any links between architectural remains and the principles of geometrical and architectural composition as presented in the texts. The representation of the building through the series of computed points is not just a device for visualisation but a description of its underlying geometry perhaps analogous to the trait that Evans describes as the instructional device for the complex cutting of French renaissance stonework.\(^5\)

This technique has been previously applied to the reconstruction of surface geometry of a tenth century stone superstructure; the temple of Ranakdevi at Wadhwan in Western India.\(^6\) Based on descriptions of mathematical and geometric constructions described in the literature, the horizontal and vertical profiles of the cella superstructure were generated to model the form of the superstructure (Figure 1).\(^7\) Michael Meister has indicated how the horizontal profile of such a temple depends on the number of offsets and the proportional relationships between each offset based on the subdivision of the sixty-four square grid.\(^8\) Thus, the horizontal profile of the temple of Ranakdevi was determined by recursive subdivision of the ritual grid of 64 squares, with the basic module (mulastra), of this grid being determined from field measurements. Following Meister's method, the offsets of the profile were then determined based on the mulastra. The horizontal profile has three offsets (each with four faces, or caturanga) and these are proportionally related to the basic module. The extrusion in the vertical direction is based on a curved profile (rekha). Following Kramrisch and Dhaky, Datta's previous work shows how this curve could be computationally generated based on textual descriptions.\(^9\) At the same time, the physical geometry of the Ranakdevi temple was extracted using a mixture of manual measurements and close range architectural photogrammetry. This was used to construct architectural detail and compare its form with the textually derived geometry. A parametric model of the three dimensional surface was then developed. By tiling the abstract geometry with a sequence of scaled units derived from the local geometry of each motif, empirical measurement and textual construction were superimposed and compared.

**FIG. 1:** SURFACE GEOMETRY OF THE TEMPLE OF RANAKDEVI AT WADHWAN. SURFACE SUBDIVISION OF THE SUPERSTRUCTURE IS CONTROLLED BY THE CONTROL PANELS IN PLAN AND IN SECTION.

**FIG. 2:** THE MOTIF GEOMETRY OF THE CENTRAL SPINE IS RECOVERED INTO A THREE DIMENSIONAL TIE MADE OF TWO INTERLACED SEGMENTS, A BACK PLATE AND UNITS COMPOSED OF CARVED PATTERNS.
The advantage of this process over manual methods is partly a matter of speed, both of data collection and of making geometric comparisons. Changes can be easily incorporated in any stage, whether due to revision of assumptions or the testing of alternatives. The method, while based on the most complete available data, remains open to the inclusion of parameters derived from new evidence. This is a critical point in a field where interpretation of archaeological and epigraphic remains is an ongoing project. Where divergent interpretations of geometry might be applied, the modelling process allows variances to be mapped and tested and points of departure recorded. Further to this, since the models of the surface geometry are based on generic constructions, they can be easily transferred to other, similar forms such as related but different schools of temple building. In the placing of Sambor Prei Kuk between its possible antecedents and Angkor, the use of constructive geometry as a generator allows the study of the evolution of temple architecture form over time as a series of related instances of arising out of similar techniques. As any post-colonialist would argue, history is a matter of narrative precedence and brick and stone can be made as complicit in a narrative as any other material. However, the bulk of the audience for such reconstructions are local and international tourists who, while they might certainly recognise a shoddy reconstruction from a finely crafted one, might not be aware of the degree of speculation involved in its production. One of the benefits of working within a virtual environment is that such speculations can be developed to consider alternative interpretations, without literally concretising any one favoured approach. Plural hypotheses can be developed from consideration of the data collected, drawing on relationships between photogrammetric measurements, texts, translated inscriptions, historical/legendary accounts and other archaeological evidence. Comparison of plan and sanctuary geometries of the heavily eroded superstructures of the temples will also be useful in understanding architectural developments presently implied largely by epigraphic records. This will also be later compared with cellae of the similar periods and/or locations in Southeast Asia to gain a more complete picture of the lineages and traces of ideas both from Indian sources and within the region, in particular the influence of Brahmanic Javanese culture on Chenla.

There is a certain urgency to this. Sambor Prei Kuk is comparatively undisturbed at present but at more well-known sites such as Angkor, or Borobudur and Prambanan in Java, actual reconstruction of once-eroded monuments has been, and is being, extensively carried out. This is happening in accordance with widely varying philosophies by a large number of local and international organisations. At Angkor Wat for instance, a team from Japan’s Sophia University are currently reconstructing the west causeway incorporating new stonework to seamlessly represent its ‘original’ state. Meanwhile at Preah Khan the World Monuments Fund aims, as is described in one of its reports on the site works, not to reconstruct the temple site but to maintain its monuments in such a way as they are:

... presented to the public as an exposed archaeological and architectural ruin. In addition, judicious jungle clearing, debris removal and on-site interpretive aids have made Preah Khan more physically and visually accessible and its rich history more intelligible to visitors. The WMF seeks to pass Preah Khan on to future generations in a state similar to that in which it was found, but with the added assurances that, by using modern conservation technology, the site will be rendered structurally sound and the natural environment will be sustained.\[17]

Differing stances on issues of authenticity and historiography are implied by this variance in conservation methods, and ideally such issues would be resolved prior to their application at actual temple sites. This is, of course, highly unrealistic. Cambodia is a poor country and cultural tourism represents an urgent source of future income. Moreover because of its impoverishment, there is heavy dependence by Cambodian authorities on external funding from a variety of competing international conservation bodies and funding sources. Sambor Prei Kuk is important in this respect because it is still partially unrestored, partially unreconstructed and partially overgrown, decisions as to its possible redevelopment remain in progress.

It is also important in that the temples of Sambor Prei Kuk embody a fundamental part of the world-views through which Chen-Lao society operated. Our study is concentrated on the underlying form of the temples rather than trying to visualise or recapture their social milieu, but the remains of buildings are the main surviving element here. While there exist the remains of buildings on such sites that point to the existence of other important institutions, obtaining a greater knowledge of the temples can only increase our appreciation of a site that deserves to be much better known than it is. In a broader sense temples are celebrations of their culture, demonstrating to the fullest extent the architectural aspirations of their people, and the most lasting legacies of their civilisation. The temples of southeast Asia also celebrate cross-cultural contact, the meeting of an Indian diasporic culture with indigenous ones, the trade in ideas between emerging civilisations and the merging of local and global ways of seeing the world. Our fundamental challenge is to what extent can we decipher such cross-cultural linkages in southeast Asian civilisations, and to what extent can new empirical tools and techniques help us in their interpretation.
NOTES


4 Kramrisch, The Hindu Temple.


8 Chihara, Hindu Buddhist Architecture in Southeast Asia.


13 Chihara, Hindu Buddhist Architecture in Southeast Asia, p. 11.


15 Chihara, Hindu Buddhist Architecture in Southeast Asia, p. 75.


17 Higham, Early Cultures of Mainland Southeast Asia, p. 247.

18 Higham, Early Cultures of Mainland Southeast Asia, p. 252.

19 Chihara, Hindu Buddhist Architecture in Southeast Asia, p.79.

20 Higham, Early Cultures of Mainland Southeast Asia, p. 249.


23 Mannikka, Angkor Wat: Time, space, and kingship, p. 4.


28 Evans, The Projective Cast.


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