PREAH KHAN CONSERVATION PROJECT
HISTORIC CITY OF ANGKOR
Siem Reap, Cambodia

REPORT VI
FIELD CAMPAIGN III

WORLD MONUMENTS FUND
PREAH KHAN CONSERVATION PROJECT
HISTORIC CITY OF ANGKOR
Siem Reap, Cambodia

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FIELD CAMPAIGN III
November 1994 - June 1995

WORLD MONUMENTS FUND

New York
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1. INTRODUCTION

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1. INTRODUCTION

PREFACE

The present report represents the sixth in a series of volumes documenting the work of the World Monuments Fund (WMF) at the Historic City of Angkor in Cambodia. This report documents work accomplished primarily at the site of Preah Khan during Field Campaign III between June 1994 and May 1995.

The conclusion of Field Campaign III coincides with the completion of WMF’s fifth year working in collaboration with the Cambodian Government. Work on site conservation and presentation continues at Preah Khan year-round, with the peak period of activity occurring between November and March. WMF consultant field missions take place in November, January and March. An on-site training program for architecture and archaeology students at the University of Fine Arts Phnom Penh has now been formalized, allowing student participation at Preah Khan virtually year-round. As in past years, production and publication of the annual field report documents the season’s achievements.

As part of its ongoing participation in to the Campaign to Safeguard Angkor, WMF, in conjunction with the Royal Angkor Foundation (RAF), introduced radar images of the entire Historic City of Angkor as provided by the National Aeronautics and Space Administration’s Jet Propulsion Laboratory. Taken by the space shuttle Endeavour during its April and October 1994 flights, these images are valuable new resources for the documentation and analysis of Angkor. With the support of the J.M. Kaplan Fund, Inc., WMF and RAF organized a scientific roundtable in February 1995 in Princeton, New Jersey to discuss space-borne radar imaging and its applications at Angkor. A report on the conference entitled Radar Imaging Survey of the Angkor Eco-Site was printed in March 1995 and serves as Separate Appendix VI/B of this Report.
WMF’s conservation work at Preah Khan, one of the most important sites in the Historic City of Angkor, is developing methods, technologies, and training programs that will contribute to future endeavors throughout Angkor. In order to present the site and WMF’s efforts in the most informative and comprehensible manner possible, construction of a modest building to serve as the Preah Khan Information Center was completed during Field Campaign III. Presently, WMF’s Information Center is the only such facility in all of Angkor. The Center’s permanent exhibition depicts conservation problems and solutions at Angkor, and new brochures help interpret the site for visitors. All of WMF’s field reports are on display and visitors may purchase copies of Angkor Volume V, postcards and tee-shirts. This year the WMF team received many hundreds of travelers from the United States, and guided them through the site. The team also led several organized tours. These activities have all greatly enhanced the funds raised at the site and in New York during the year.

The present report was organized and written by John Sanday, WMF Preah Khan Field Director, and John Stubbs, WMF Director of Programs, with contributions from each of the consultants who participated in the two missions that occurred during this field campaign.

SKETCH HISTORY & DESCRIPTION OF PREAH KHAN

Preah Khan, covering approximately 56 hectares, is an extensive building complex within the Historic City of Angkor, located a short distance beyond the North Gate of the Angkor Thom precinct. It was built by the Khmer King Jayavarman VII as a monastery and teaching complex. Preah Khan is the most prominent of several temple complexes associated with the Northern Baray (often referred to as the Preah Khan Baray), which stretches approximately five kilometers eastward and links Preah Khan with the contemporaneous sites of Neak Pean and Ta Som. This group, one of Angkor’s major urbanistic conceptions, once formed a major part of Angkor’s vast hydrological system, which is now largely in disuse.

According to the Preah Khan stela, the site was dedicated in 1191 AD. Over the next three centuries the temple complex was modified considerably. Four concentric enclosure walls subdivide the monastic complex. The outer wall is encircled by a wide moat, which today encloses a large tract of jungle. This area was formerly the living quarters of the monks and attendants of Preah Khan. The second enclosure wall delineates the principal religious compound, within which temples and shrines dedicated to the Hindu sects of Vishnu (North) and Shiva (West) are densely concentrated. The central and eastern shrines are Buddhist, and the southern quadrants are dedicated to the worship of the late kings.
Archaeological sites in the Angkor region
Like most of the monuments of Angkor, Preah Khan is in a state of ruin resulting from a slow decline following loss of royal patronage in the middle of the 15th century. While evidence suggests that some of the temples and shrines remained in use (probably until the end of the 17th century), it was not until the end of the 19th century that Preah Khan, like many other temples at Angkor, was 'rediscovered' by the Ecole Française d'Extreme Orient (EFEO). EFEO's work is well documented and preserved in Cambodia at the National Museum in Phnom Penh in a comprehensive archive, available in the form of transcriptions and microfiche.

In its present state, Preah Khan is best described as a partial ruin set deep in the jungle of north central Cambodia. It is one of the few temple complexes at Angkor which is still totally surrounded by jungle. The coexistence of these historically significant man-made remains and its relatively untouched natural setting makes Preah Khan one of the outstanding sites at Angkor.

PREAH KHAN PROJECT GOALS


In preceding reports, WMF articulated its course of action at Preah Khan. The development of basic conservation principles and procedures guides the WMF team and its work force in a long-term program to repair, conserve and present Preah Khan as a partial ruin. Due to the magnitude of the task, major reconstruction is not to be undertaken at Preah Khan. Moreover, such an approach would be philosophically dubious. WMF considers its responsibility to consist of stabilizing Preah Khan so that it may be passed to future generations in a state similar to that in which it was found but with the added assurance that modern conservation procedures and technology will render the site structurally sound, thereby substantially extending its life as an exposed archaeological and architectural ruin. In addition, judicious jungle clearance, debris removal and on-site interpretive aids have made Preah Khan more physically and visually accessible and its rich history more intelligible to visitors.
Since 1991, WMF has advocated and administered an on-site training program for Cambodian students in recognition of the immense benefits that students of architecture and archaeology from the University of Fine Arts, Phnom Penh can gain from using Preah Khan as a conservation training laboratory. In the coming 1995/96 Field Campaign IV, the graduate students trained under this program will be integrated into WMF’s professional team. Part of this training is being directed at the craftsmen who are also taught appropriate conservation skills as an extension of the local craft tradition.

WMF considers its long-term role at Preah Khan is assist the present international campaign in establishing the broader principles and procedures required to safeguard Angkor; to provide opportunities for training nationals at both the professional and crafts levels; and, on a more practical level, to establish conservation technologies appropriate for use on Khmer monuments.

FIELD CAMPAIGN I (1992-1993)

The first extended Field Campaign at Preah Khan, from October 1992 to April 1993, initiated the project’s conservation plan. This campaign consisted of three principal field missions of WMF consultants as well as continuous on site work by laborers.
In March 1993, WMF brought five consultants to the site to conduct a documentation and materials testing program. This led to the development of policies for structural repair, consolidation and planning to be further advanced the following year. (See Preah Khan Conservation Project Report IV: Field Campaign I — Project Mobilization including three separate appendices.)

FIELD CAMPAIGN II (1993-1994)

Field Campaign II, which ran from November 1993 to May 1994, consisted of four separate missions. While the activities scheduled for each mission expanded WMF’s involvement and commitment at Preah Khan in particular, various endeavors elsewhere at Angkor evolved further.

Work on-site at Preah Khan was continuous for the seven-month duration of Field Campaign II, which began in November with additional site clearance and preparation for the technical team’s arrival in January.

The first mission in January 1994 engaged a nine-member team at Preah Khan in order to commence cleaning, repair and maintenance of stonework; structural testing, repairs and consolidation at the South Portico of East Gopura III, the Hall of Dancers, and the Lanterns (Bornes) along the West Processional Way; surveying of and proposals for the natural environment; and graphic and photographic documentation for architectural, archeological, engineering and interpretation purposes. The mission’s accomplishments were recorded on video.

During the second mission, in March 1994, the team completed work begun earlier in the campaign and initiated new activities, including structural repairs and archeological soundings. Also, work began on the production of an annual report of WMF’s accomplishments at Angkor.

In April 1994, the third mission within Field Campaign II occurred. Preah Khan Project Manager John Sanday and WMF team members participated in the filming of Struggle for Angkor, which was produced for the U.S. cable television company the Discovery Channel. In the film, Preah Khan was used to demonstrate the present-day efforts to conserve the monuments of Angkor and the cultural heritage of Cambodia. The documentary aired in October 1994.
Based on its experience at Preah Khan and by arrangement with the Royal Cambodian Government, WMF began general maintenance work at nearby Prasat Neak Pean, located in the center of the Preah Khan baray, and proposed possible conservation and protection interventions at other sites within the Historic City of Angkor.

ACKNOWLEDGEMENTS

WMF is grateful to the increasing number of individuals who have served and continue to serve as members of the Preah Khan Field Missions and to the experts who have produced and reviewed this report.

The Preah Khan Conservation Consultant Team for Field Campaign III consisted of the following consultants:

John Sanday, Project Director, WMF Representative in Cambodia;
John Stubbs, Director of Programs, WMF New York;
Predrag Gavrilovic, Structural Engineer;
Kevin Lee Sarring, Architect/Archaeologist in Charge of Records; Ronnie Yimsut, Forest Ranger in Charge of Environment; Martha Singer, Materials Conservator; Sarosh Pradhan, Architect, Autocad Specialist; and Andrew Dennis, Volunteer.

WMF and the consultant team are continually impressed by and appreciative of the hard work and dedication shown by its team of students from the Departments of Architecture and Archaeology from the University of Phnom Penh. During this field campaign, the students produced an excellent set of record drawings under the guidance of documentation specialist Kevin Lee Sarring. This team of students was comprised of architects who have previously participated on site: Mr. Lek Sareth, Mr. Var Maurin, Ms. Cheam Phally, Ms. Chhun Soma, and a newcomer Mr. Sam Kimheng. The team also included returning archaeologists Mr. Chan Chamroen, and Mr. Nay Sophea. WMF especially wishes to thank Dean Sophean of the Department of Architecture for his help and insight. Contributions to this report have also been provided by WMF headquarters in New York, from Executive Director, Bonnie Burnham, and staff members Rebecca Anderson, Daniel Burke, Felicia Mayro, Tony Newman and Monika Riely.

Special thanks are expressed to our hosts the Royal Cambodian Government, and in particular to His Majesty King Norodom Sihanouk; H.E. Vann Molyvann, Minister of State; H.E. Son Soubert; H.E. Nouth Narang Minister of Culture and Fine Arts; and other members of the ministry including Under Secretary Mr. Michel Tranet, Director of National Museum Phnom Penh, Mr. Pich Keo, and Cultural Adviser Mr. Ouk Chea.

WMF would like to express its gratitude to Governor Ton Chay of Siem Reap Province for his support of the Preah Khan Conservation Project; to Mr. Uong Von, Director of the Conservation d’Angkor1 in Siem Reap for his constant support and advice. Gratitude is also extended to the staff of the Conservation d’Angkor.

This year sees the completion of Architect Nils Tremmel’s three-year term as a British Volunteer working with the Conservation d’Angkor. Tremmel contributed greatly to safeguarding Angkor as an adviser not only in his official capacity to the Conservation d’Angkor but also to the many international projects working in Angkor. WMF benefited immensely from his advice and technical assistance.

Following its participation in the meeting of the International Coordinating Committee, WMF would like to express its gratitude to the Co-Chairmen of the Committee: The Honorable Yukio

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1 The Conservation d’Angkor facility in Siem Reap is slated to be re-named Department of Conservation. At the time of this printing, this change had not taken effect.
Imagawa, Ambassador of Japan to Cambodia, and The Honorable Gildas Le Lidec, Ambassador of France to Cambodia; to the UNESCO Secretariat; and to all the teams working at Angkor for their cooperation, advice, and support. Thanks are also due to Mr. Khamliene Nhoyvansvong, UNESCO Representative, and his staff in both Phnom Penh and Siem Reap, Cambodia. WMF would also like to extend its appreciation to the UNESCO staff in Paris, especially Minja Yang and Veronique Dauge.

Martha Singer’s participation in this year’s campaign would not have been possible without the support of the United States Information Service in Phnom Penh and in particular, Mr. David Miller and Mr. Steven Prieto.

Deepest appreciation is offered to NASA’s Jet Propulsion Laboratory for their agreement to conduct the first spaceborne radar imaging of Angkor and participate in the symposium in February 1995. Dr. Diane Evans has been an invaluable advisor and friend to this effort and WMF and its symposium co-sponsor, the Royal Angkor Foundation, cannot thank her enough. WMF also wishes to acknowledge the J.M. Kaplan Fund, whose generous financial support made the conference possible. And, finally, WMF thanks the Royal Angkor Foundation for co-sponsoring the symposium on the radar imaging.

Special thanks go to WMF’s local administration team and work force ably led by Project Assistant Kussom Sarun, with special mention of the house staff at No.4 Wat Bo in Siem Reap. The Preah Khan work force, consisting of 50 masons, metalworkers, foremen and laborers, excelled throughout Field Campaign III and worked hard as a harmonious and dedicated group. WMF thanks the entire project development team based in Cambodia for their contribution to the success of the project.

WMF’s efforts have also been aided by important contributions from considerate individuals acting on their own initiative, both in Cambodia and throughout the world. The ongoing conservation project has attracted a large number of visitors to Preah Khan and to the staff of the WMF House in Siem Reap who are keen to assist in helping the consultants with advice, funds, food treats and medical supplies for both the staff and workers. For these thoughtful and generous deeds the Consultant Team conveys its thanks.

The Preah Khan Conservation Project Team is especially grateful for the continuing support and encouragement of the Board of Trustees of the World Monuments Fund.
SPONSORS

The World Monuments Fund is grateful to the many donors whose generous support sustains its efforts at Angkor, in particular the campaign to safeguard Preah Khan, one of the world's priceless resources. We would like to take this opportunity to list some of the many individuals, including visitors to the site, and organizations whose assistance is most gratefully received.

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2. CAMPAIGN III OVERVIEW

Summary
Missions One & Two — Particulars
2. CAMPAIGN II OVERVIEW

SUMMARY

Preah Khan Field Campaign III commenced after the rainy season in October 1994. At that time Project Director John Sanday visited Siem Reap with specialist Sharosh Pradhan to commence preliminary analyses of possible applications for computer-aided design (Autocad) at the WMF Preah Khan project. Sanday returned to the site in December to introduce volunteer Andrew Dennis to the project and prepare for the both the arrival of a group of 24 visiting sponsors from the World Monuments Fund and the first mission at the beginning of January 1995.

Mission One (January 2-22) overlapped with a WMF sponsors’ visit in January, enabling the consultants to describe to the group their activities at Preah Khan. After preparing work plans with each of the consultants, Sanday joined WMF Director of Programs John Stubbs, WMF Chairman Marilyn Perry, and WMF Secretary Robert Geniesse at a conference entitled The Future of Asia’s Past sponsored by The Asia Society in Chiang Mai, Thailand.

Shortly thereafter in Princeton, New Jersey on 1-2 February the New York office of WMF, in cooperation with the Royal Angkor Foundation, organized a two day symposium on the application of recently provided space borne radar images of Angkor. This symposium was made possible though most generous and cooperative efforts of the National Aeronautics and Space Administration’s (NASA) Jet Propulsion Laboratory.

At Angkor John Sanday spent most of February at Angkor, directing conservation work at Preah Khan and site clearance work at Neak Pean, as well as providing tours of Preah Khan by special request for VIP groups. He returned to Angkor in the middle of March to prepare for Mission Two, when he was joined again by Engineer Gavrilovic and Architect/Archaeologist Sarring. At this time Field Campaign III was drawn to a close and commencement of the compilation of the annual report was begun. In addition the work program to occur during the rainy season was developed for the reduced for implementation by the long term work crew members.
Although limited to only two on-site missions, Field Campaign III concentrated more than in previous years on interventions for structural consolidation, in particular to prevent several imminent collapses and to make the site safer for visitors. The following conservation challenges were given special attention during Field Campaign III.

Since the de-mining and clearance of the original east access road along the bund between Preah Khan and the North (Preah Khan) Baray, it is now possible, and indeed preferable, to enter the site from the East or principal entrance. The team of consultants and the Preah Khan work force therefore concentrated their efforts on consolidating and presenting structures along the principle axial route starting from East Gopura IV.

Priority was given to the consolidation and partial reconstruction of the North West Portico at East Gopura IV which was on the point of collapse. The second stage of work was directed towards the consolidation of the central gateway. It was badly damaged by a large tank or truck which crashed into and severely damaged the north west abutting structure. This structure supports indirectly the roof vaults and the heavy west facing fronton.

In the Hall of Dancers, located on the main east/west axial route within the Temple complex proper, the Consultant team identified the south east sector of the hall as being in need of urgent consolidation — a choice which was justified as the extant quarter vaults were also threatening collapse.

At the invitation of WMF in Britain, John Sanday presented the Preah Khan Conservation Project to His Royal Highness Prince Charles, the Prince of Wales in London at the end of March. Immediately following this engagement Sanday then visited Hong Kong to present a paper on conservation at Angkor at The Asia Society’s Hong Kong Center.

John Stubbs represented the Preah Khan Conservation Project at the 2nd meeting of the International Coordinating Committee for the Safeguarding of Angkor on March 31, 1995. Among the topics Stubbs and Royal Angkor Foundation President, Janos Jelen, presented to the Committee were the initial results of the radar imaging of Angkor provided by NASA’s JPL. Archaeologist Elizabeth Moore played an important role in the overview presentation of the radar imaging project as well.

Landscape Architect/Ecologist Terry Schnadelbach who played a key role in assisting WMF with the space borne radar imaging of Angkor in February 1995, was subsidized in part by WMF for a return to Angkor on June 27-30, 1995 where he made a presentation at the EFEO sponsored Hydrological City of Angkor symposium in Siem Reap.
MISSIONS ONE & TWO — PARTICULARS

January Mission (Mission One): January 2 - January 22, 1995

During this time the following WMF consultants were on site: John Sanday, Preah Khan Project Director; Dr. Predrag Gavrilovic, Structural Engineer; Kevin Lee Sarring, Project Records, Archaeologist; Ronnie Yimsut, Environmentalist; Martha Singer, Materials Consultant; and Andrew Dennis, Volunteer. The Preah Khan team was augmented the student team, which comprised: Lek Sareth, Team Leader — Architect; Var Maurin, Architect; Cheam Phally, Architect; Chhun Soma, Architect; and newcomer Sam Kimheng, Architect. Engineer Olina also joined the team to work under Engineer Gavrilovic. John Stubbs accompanied the special tour of WMF sponsors and contributors to the Preah Khan Project.

A large and enthusiastic group of 24 sponsors participated in this year’s WMF tour from January 7-11. John Sanday led the tour and focused on the work at Preah Khan. A special live classical dance performance was given amidst period bas-reliefs in stone of the dancing apsaras in Preah Khan’s Hall of Dancers.

The focus of Mission One was to begin the work program at the East Gopura IV/North West Portico and the work program at the Hall of Dancers. Under the direction of Kevin Lee Sarring the Cambodian students started an extensive program of surveying and recording both principal areas of activity. The North West Portico was carefully measured, stones recorded and a dismantling plan established prior to the start of any work. Following Field Campaign II’s success in the structural consolidation of the South East Portico of East Gopura III and returning of its deformed columns to the vertical, similar work was undertaken to rectify the North West Portico of East Gopura IV which had been propped by EFEO in the 1950s but was later damaged by a fallen tree branch. At the Hall of Dancers it was decided to undertake a thorough survey of the entire structure and to prepare a set of reconstruction drawings of how the structure looked originally, by recreating, in drawings, the corbelled vaults, quarter vaults and open courtyards. As the recording process developed, various stones were identified and their original positions located. A part in the south east section of the Hall of Dancers, which was discovered to be dangerously unstable, was partially dismantled and reconstructed. Several stones had fractured and were glued and pinned.

With the return of landscape architect Ronnie Yimsut, it was possible to continue the identification and further study of the flora at Preah Khan. A special nature tour is being
developed. With the help of volunteers, many plant and tree species were identified, recorded and labeled. A small brochure was drafted for distribution.

Martha Singer was the newest member of the WMF team thanks to a grant from the United States Information Service. Singer, a materials conservator, prepared a complete inventory of the 72 carved sandstone garudas — anthropomorphized birds who are the guardian protectors of the monastic complex — that are located around the outer enclosure wall of Preah Khan. With help from the students and other members of the team, a condition survey has been completed of each garuda and efforts have commenced to raise funds to repair these unique works of art.

Between January 11-16, John Stubbs and John Sanday, together with WMF board members Marilyn Perry and Robert Geniesse, participated in The Asia Society’s conference The Future for Asia’s Past, held in Chiang Mai, Thailand. Sanday presented a paper on management of historic sites with special reference to Preah Khan.

March Mission (Mission Two) March 17 - April 17 1995

John Sanday returned to Siem Reap on March 18 to inspect progress at the site. John Stubbs visited Angkor after attending the International Coordinating Committee Meeting for the Safeguarding of Angkor held Phnom Penh on March 31. At this meeting WMF reported on its progress at Preah Khan and presented the latest developments relating to the Scientific Roundtable held at Princeton University in February to study the results of radar imaging of Angkor. Kevin Lee Saring and Predrag Gavrilovic returned to Angkor on March 31 and on April 1 respectively, and students Phally, Soma and Kimheng also joined the team for this mission. Work during this period focused on the structural consolidation of the Central Gateway of East Gopura IV, which had been severely deformed by the impact of large vehicle that had rendered the condition of the west lintel and support walls very unstable. Work at the Hall of Dancers shifted to encompass the consolidation of the complete south east section which was considered to be in danger of collapse. The students continued their work of identifying stones and recording the structure and fabric of the entire Hall of Dancers while a section of the work force cleared and sorted the above ground debris covering the paved floor.

The end of the mission coincided with the Cambodian New Year and the members of WMF’s team were happy to participate in a special celebration at Preah Khan. WMF tee-shirts were distributed to the workers as well as a cash bonus in recognition of their hard work.
The students and Kevin Lee Sarring spent several days at the end of the mission preparing publication drawings of the many survey sketches they had prepared to illustrate this report. The students also discussed with the WMF consultants proposals for their diploma theses, which they are preparing for presentation at the end of the year.

In February and June, John Sanday devoted time outside of the missions to administering the project, supervising the technical activities on-site and welcoming special visitors such as Lord Carrington in his capacity as the President of the British Volunteers Service Overseas, and
Paul Redecliffe, the British Ambassador to Cambodia. Throughout the period of February through March many guided tours of Preah Khan were requested by special interest groups such as alumni organizations and friends of museum groups, all having favorable responses.
3. CAMPAIGN III RESEARCH
ACCOMPLISHMENTS

Management & Presentation of the Natural Environment
Preparation of Botanical Record
Inventory of Sculptural Art
Garuda Condition Survey — Enclosure Wall IV
Adopt-a-Garuda
Materials Conservation — Stone Cleaning
Video Documentation Project
Educational Assistance — University of Beaux Arts
Radar Imaging Survey of the Angkor Eco-Site
3. CAMPAIGN III RESEARCH ACCOMPLISHMENTS

MANAGEMENT & PRESENTATION OF THE NATURAL ENVIRONMENT

Stage 2 — Implementation

In January 1995, Landscape Architect Ronnie Yimsut again joined the WMF team to further develop plans for environmental protection and natural resource management at Preah Khan. He was assisted by volunteer naturalist Andrew Dennis from Oregon.

Yimsut and Dennis assessed the clearance work accomplished during the previous year and helped formulate additional proposals to enhance the presentation of the site. The following is a synopsis of these activities and recommendations:

- Preparation of an environmental site plan for Preah Khan consisting of sketches showing site presentation, interpretation and environmental conservation.

- Recommendations for developing site and nature themes for WMF’s Preah Khan Information Center, including display formats, signage and information distribution.

- Planning and implementation of environmental enhancement at the east entrance of Preah Khan at the jetty to the North Baray.

- Planning and development of a nature trail through Preah Khan to enhance the visitor experience.

- Initiation of the nature trail program by providing a special guided tour to the WMF group of sponsors along the nature trail and a general introduction to the environment of the Angkor Archaeological Park.

- Disengagement of Enclosure Wall IV and assistance with the Garuda Survey and Inventory.
• Preparation of a preliminary survey of the forest environment of Neak Pean and development of a work plan for future environmental conservation at the site.

• Provision of guidelines for the Preah Khan students for their diploma studies at Neak Pean.

Site Planning and Project Implementation Plan

Following an assessment of the completed disengagement work, the work force focused its activities on the following specific activities:

Site Clearing for Nature Trail: A trail was cleared along the outer edge of the moat from the West Processional Way in a northerly direction to the East Processional Way passing the North Entrance. The next steps include clearing a three-to five-meter wide pathway of underbrush which will be maintained on a regular basis by the site maintenance crew. (See page 35.)

East Entrance — North Baray Landing: The side road off the ‘Grand Circuit’ has been de-mined and graded along the East Bund between Preah Khan’s moat and the North Baray. As a result, the eastern entrance to Preah Khan is becoming more popular. This is also the original principal entrance to the site. With the increasing number of visitors, it is necessary to plan for proper site and access management, which will include a suitable vehicle turning space, an appropriate parking area and careful control of vegetation.

The Landing, an unusual feature of the North Baray, should be exposed and used. Prior to exposing the Landing, measures were taken to remove the undergrowth to create a vista. A large area within the normally empty Baray in front of the landing has been cleared so that when the Baray may flood during the monsoon season, water in the Baray will be visible. This area will be kept clear of underbrush and maintained on a regular basis. (See page 35.)

East Entrance — Processional Way: The East Processional Way has been cleared of undergrowth and tests have been carried out using herbicide to remove deep rooted vegetation. Vegetation and the build-up of soil behind the Lanterns has also been removed. The Processional Way will be maintained on a regular basis.

West Entrance/Exit: Due to the unfortunate placement of public toilets (during March and April 1995) on the sight line of the West Causeway along with the present parking area for buses, it is necessary to plan for suitable landscaping to block the view of any other new construction and provide an appropriate parking area for vehicles collecting or dropping off visitors. It is proposed that the parking area be located on the east side of the road, out of sight. (See page 36.)
Improvements to East Entrance at North Baray Landing.

Management of Vegetation in Moat: During the 1994/95 Field Campaign, sections of the moat were cleared of vegetation for 100 meters from the causeways on the west, north and east sides of Preah Khan. The intention is to create reflecting pools and partially recreate the appearance of the original moat. Already lotus flowers and water lilies have returned and the experiment has greatly enhanced the approach vistas to Preah Khan. It is therefore proposed to maintain the moat by continued removal of aquatic plants. During the dry season the moat is empty, and tree stumps and debris are being removed and any pieces of building stone are carefully documented and removed to dry land. (See page 36.)

Exposure of Banks to Moat: It is proposed to expose what remains of the steps along the banks of the moat by clearing vegetation to a distance of 100 meters from the West, East and North Causeways. This will be carried out under strict archaeological supervision. Beyond the original water edge it is recommended that the banks of the moat be protected by removing unwanted plants and undertaking structural repair and consolidation as considered necessary. (See page 36.)
Improvements to West Entrance, Preah Khan.

Vegetation Management Plan for Moat.
General Site Maintenance: The high standard of the presentation of Preah Khan receives abundant comment. Carefully maintained pathways, daily sweeping of the principal visitor access routes, and subtle control of the vegetation constitute the basic maintenance program essential to the presentation of the site. This maintenance program will be continued and further developed during Field Campaign IV.

Information and Interpretation: Proposals are being developed to interpret the flora in and around the Preah Khan complex and to provide information about trees and other plants, including their traditional local uses. Andrew Dennis prepared an illustrated interpretive brochure for distribution at the Preah Khan Information Center. A brochure describing the Preah Khan Nature Trail is planned for production during Field Campaign IV.

Considerations for Removal of Hazardous Trees

A detailed study of those trees posing a hazard to the historic structures and visitors identified three large trees as major threats (tree numbers 45, 46, and 47 — See Appendix C). All three are varieties of the Giant Ficus and are located in the vicinity of the Hall of Dancers. They pose a high risk to the structures to which they are attached, to the Hall of Dancers and to people. (See page 38.)

It is recommended that these trees be examined to ascertain their condition. If they are indeed as dangerous as thought, they should either partially or fully removed as follows:

Option I: Partial removal of branches and its larger limbs in order to reduce the ‘sail effect’ that could topple the tree or break the larger branches during a wind storm (which has previously occurred).

Option II: Complete removal of branches and trunk, leaving the root system in place for educational purposes.

These trees have become part of the history and environment of the site and it is hoped that it will be possible to prolong their life as long as possible. However, many are approaching the end of their average life span and care should be taken to identify and remove them before they fall.
The Preah Khan Fromagere Tree (Giant Ficus).
PREPARATION OF BOTANICAL RECORD

A more in-depth study of the flora, consisting of the identification of trees, shrubs and plants, is being prepared. Species of flora were photographed during the different seasons. Their medicinal and household uses are being noted. For example, a concoction that the workers drink to prevent aching muscles and other problems associated with manual labor is made by boiling the wood from the Chom Bok tree and Bandol Pich vine. This information has been compiled in a small handout. It is hoped that a more detailed illustrated guide to the jungle flora will be available soon.

YEANG
GUM TREE DIPTEROCARPUS
- trunk cut into and burned to collect resin
- resin used to waterproof lumber for houses and boats, or is mixed with charcoal for firestarting
- strong wood used in construction
- families main rights to collect from individual trees for generations
- fast growing

CHOM BOK
- large, buttressed trunk, often with orchids
- strong wood with a good finish
- yellow-green, egg-shaped sour-tasting fruit
- smooth, shaped nut barnacles like coconut shells litter the ground
- bark boiled into vitamin-rich tea
- shelter for cavity nesters
- slow growing

GRA BO
- long leaves hang down
- often growing near water
- fruit inside small, woody seed robbed of insect stings to prevent itching
- medicine for leprosy

SPONG
GIANT FIG TREE FICUS
- smooth, silver, cylindrical trunk
- destructive root systems grow over and around stone buildings
- shelter for cavity-nesting wildlife
- deciduous leaves fall during dry season
- fast growing

SRA LAO
- white, buttressed trunk
- hard wood valued for furniture making
- deciduous leaves fall during dry season

SLANG
- round, inedible orange fruit
- poisonous, button-sized beans used to make local malaria vaccine in small doses

The Plants and Trees of Preah Khan (Leaflet) by Andrew Dennis, March 1995.
INVENTORY OF SCULPTURAL ART

A program of collecting archaeological finds has been maintained throughout all of the WMF field campaigns at Preah Khan. All stone fragments with any adornment, particularly fragments of sculpted figures, are recorded in the archaeological finds book with a detailed sketch, description, dimensions and location of find. The pieces are stored in boxes which are transferred periodically to the Conservation d'Angkor depot in Siem Reap.

In the middle of 1994, a series of raids on the Angkor sites by gangs of art thieves targeted in particular larger pieces such as the naga (a multi-headed snake) heads, guardian lions and inscriptions. The Ministry of Culture and Fine Arts collected all threatened pieces from endangered sites around Angkor. At Preah Khan all the pieces - including the famous Preah Khan stela - have been moved to the Conservation d'Angkor and inventoried on special forms (as described in Preah Khan Field Report IV). Eventually all in situ pieces at risk, including the lintels and frontons, will be recorded.

GARUDA CONDITION SURVEY — ENCLOSURE WALL IV

A unique and remarkable feature of Preah Khan is its collection of sandstone garudas (anthropomorphized birds who are the guardian protectors of the monastic complex). Along the exterior of Enclosure Wall IV are 72 sculptures, placed 35-40 meters apart (four at the corners and 68 along the walls). The garudas stand on pairs of nagas. The large garudas are dominant features of the outer most Enclosure Wall and originally could have been seen from a great distance. In January 1995, dense vegetation, that made access to these regions on the site difficult, was cleared and a condition survey was conducted on the sandstone sculptures. (See Separate Appendix VI/A — Garuda Condition Survey, Enclosure Wall IV at Preah Khan).

General Description

These sculptures were made from multiple blocks of sandstone placed on a laterite plinth against the wall and carved in situ. Sixty-eight sculptures, each approximately three meters wide, are located along the laterite walls approximately every 35-40 meters (see page 41). At each of the corners of the enclosure wall, sculptures similar in iconography, but of much greater dimensions, wrap approximately two to two-and-one-half meters around the corners producing massive and magnificent corner pieces.
Each sculpture has two distinct sections. The lower portion consists of the garuda flanked by a pair of nagas. The upper portion, which rests on top of the wall, is a flaming niche which once held the image of a seated Buddha. Unfortunately, as at other areas of Preah Khan, and indeed throughout all of Angkor, nearly all the Buddhas were defaced in the 13th century.

The sculptures, while having a similar iconography, have been constructed from stone blocks differing in size and orientation. There is a marked difference between the corner pieces and those sculptures placed along the walls. Apart from the obvious variation in size, the corner pairs of nagas have seven heads as opposed to the five-headed nagas accompanying the garudas along the wall. Moreover, each sculpture has its own unique features. For example, some the naga heads gaze straight ahead, while others look up at the garuda; some nagas have crowns, whereas others do not. The garudas are likewise varied.

**Documentation**

This inventory and survey of garuda sculptures constitutes a general overview of their decoration as well as their condition. Once a sculpture has been selected for repair, additional individual documentation will be essential.

Each garuda has been assigned a number (See Separate Appendix VI/A) and, in accordance with other labeling systems at Preah Khan, the first garuda is located on the north side of the West Gopura IV. The numbering system continues in a clockwise direction around Enclosure Wall IV. Each section of the wall (i.e., the region between a gate and a corner) was assigned a directional location. There are eight directional locations (in order: west-north, north-west, south-west, west-south, east-south, south-east north-east and east-north). This allows for quick identification of the location of the garuda within a section of the wall.

The width of each sculpture was measured and the distances between the garudas were also noted. The front view of each garuda is documented by a photograph. If blocks of stone had fallen, or if the only evidence of the sculpture is the space left in the laterite wall, this was documented in place of the sculpture.

**Condition Assessment**

Each sculpture has been rated as either good, moderate or severe (see below), based upon examination of its structural condition and its connection to the laterite enclosure wall. Categories of degradation were determined — stone loss, bio-deterioration, cracks, misaligned blocks and previous restoration work. A diagram showing the sculpture’s condition was prepared and areas of degradation were noted on a set of drawings.
**Structural Condition**

Three categories of condition have been established:

*Good:* The sculpture is connected to the wall and the blocks of stone which constitute the sculpture are aligned (with minor error).

*Moderate:* The sculpture is separated from the wall; a majority of the sculpture is standing, although there is some loss of stone; and varying degrees of bio-deterioration are noted.

*Severe:* Most of the sculpture’s blocks of sandstone and/or regions of the laterite wall have collapsed.

**Material Deterioration**

The following types of deterioration are defined and have been identified on the inventory drawings:

*Loss of Stone:* which includes loss of stone blocks, delamination, and losses around joints.

*Bio-Degradation:* which identifies defects caused by termites, deep root systems, surface vines and algae.

*Cracks:* which have been divided into two categories: large cracks, associated with detachment, and hairline cracks, that appear to be confined to the surface of the stone.

*Open and Misaligned Joints:* these depict structural movement and misalignment of stone blocks.

**Restoration Priorities**

The present condition of the sculptures determines the extent of repair and restoration work required. Most of the work necessary in the overall garuda conservation program will be spent in treating sculptures that are classified as being in ‘good condition’ and some in ‘moderate condition.’ Such examples require relatively minor conservation intervention. However, about 10% of the sculptures are in a serious state of dilapidation or have collapsed or have almost completely disappeared.

*High priority* (Sculptures in Severe Condition): Restoration of these sculptures will require retrieval of the stone blocks from the ground or moat; removal of termite mounds or other
residues, replacement of stone blocks to their original position, excavation, analysis and stabilization of the laterite wall, and structural stabilization of the sculpture.

Medium priority (Sculptures in Moderate Condition): This category has the greatest range of deterioration. If most of the sculpture is still standing, but separated from the enclosure wall, structural stabilization and attachment to the wall may also be required.

Low priority (Sculptures in Good Condition): Work required for the restoration may include cleaning the surface, removal of vines, plants, etc., or consolidation of the stone in local regions, but overall there is minimal intervention.

General Maintenance (All Sculptures): All sculptures will require periodic checking and maintenance to ensure the absence of plants, roots, insect nests, etc. and to check on structural movement.

An ongoing program for the evaluation and treatment of stone is being undertaken at Preah Khan. In previous seasons research and practical interventions of an experimental nature have taken place and are recorded in Report V, Field Campaign II (See Stone Conservation Principles and Procedures by Preusser and Briscoe, May 1994). The restoration of garuda sculptures will be consistent with that work.

Repair Recommendations

Removal of Termite Nests: The hard packed accretion of termite nests will require chisels to remove the earth from the stone. Metal implements should not come into direct contact with the stone. Moreover, during excavation from the ground, undercutting the object ensures that its surface will not be damaged. Bamboo spatulas and other implements which are softer than the stone should be used to minimize the possibility of damage when working in close proximity to the stone. The last layers of accretion may require careful mechanical removal and controlled testing will be needed to determine the best procedure. If the strength of the termite residue is stronger than the stone, attempts to either remove the clay or chip at it may damage the stone’s surface. Therefore careful testing should be undertaken to find the most suitable way of softening the clay.

Removal of Surface Vines and Roots: Systemic herbicidal treatment using a well tested product such as Monsanto’s ‘Round-up’ is recommended. Treatment is most successful if undertaken at the beginning of the plants’ annual growth cycle. Once the vegetation has died it
will dehydrate which, as a result of its shrinking, makes its removal from crevices and joints easy. It is always necessary to wait until the plants have shriveled. For larger roots the concentration of the herbicide mixed with water must be increased.

**Structural Underpinning:** In some places local settlement of the foundations has occurred, especially in the laterite bases directly under the garudas. In such cases it will be necessary to level the platform under the sculpture using concrete with a steel mat reinforcement set beneath the upper course of laterite. In regions where the wall and garuda have fallen, the foundation of the wall may also require consolidation and the stonework above reinforcement.

**Adhesives:** An adhesive which is equal to or less than the strength of the stone should be considered so that if the adhesion fails, it will not induce stress on the joined stone leading to new breaks or damage to the sculpture. While consolidation using adhesives is not reversible, it can be the only suitable procedure to ensure the future survival of the stone and the structure. Tests using the Sika product ‘Sikadura’ used in conjunction with stainless steel dowels have proven successful and so far it seems the consolidant best suited for use at Preah Khan.

**Pins:** Structural stabilization of some of the sculptures will require the use of pins. A system which uses stainless steel pins and sleeves is considered optimal since it provides for increased mechanical bonding and, if detailed properly, allows for easier reversibility.

**ADOPT-A-GARUDA**

During WMF’s January 1995 sponsors’ tour a fundraising campaign was launched to conserve the garudas of Preah Khan. A conservation price, ranging from $5,000 to $25,000, has been placed on the heads of each of the 72 garudas. Foundations or individuals sponsoring a garuda will have their names recorded near the sculpture as a donor to the Preah Khan Conservation Project. Their names will also be included on the garuda frieze planned to decorate the interior of the Preah Khan Information Center. WMF trustee Sam Miller adopted the first garuda in this sub-theme campaign, the nickname of the restored garuda to be Rosetta.

It is anticipated that some 30% of the total funds raised through the Adopt-a-Garuda program will be contributed to the Preah Khan Conservation Project to support site maintenance, technical research, and the on-site training program for students of the University of Fine Arts in Phnom Penh.
Section of Wall Cleaned But Untreated.

Sections of Wall Cleaned and Treated Against Regrowth.
MATERIALS CONSERVATION — STONE CLEANING

Stone Cleaning Assessment

Dr. Frank D. Preusser first visited Preah Khan in March 1992 to conduct a preliminary study of stone conservation problems. At the time he also conducted small cleaning tests of carved stone surfaces covered by biological growth (See report Report III, Conservation Plan). Dr. Preusser carried out a more detailed study of Preah Khan during the January 1994 mission within WMF Field Campaign II. Preusser’s report, written jointly with conservator Frank Briscoe, is published in its entirety in Appendix B of Preah Khan Conservation Project, Historic City of Angkor, Report V, Field Campaign II (1994/95).

As regards the cleaning and treatment of lichens and mosses, Preusser’s report states (see page 137): ‘It was decided to clean three additional areas of approximately 1 m² each in the Central Tower’s Room 5 on the Main Tower (also known as East Gopura II, Room 1) and to treat the right half of each cleaned area with a highly diluted (approx. 10 mg/l) solution of copper sulfate (CuSO4) in bottled water (three spray applications). The areas were chosen on the basis of their micro-climates as indicated in the intensity of the biological activity. The cleaning was done with water from the moat and soft brushes. The areas were first presoaked with water from the moat and then gently brushed with a generous supply of water. After drying, the right half was sprayed three times with the copper sulfate solution, allowing the test areas to dry between applications.’

Visual analyses have been made to assess the in-situ tests described in the above mentioned report and the treatment using copper sulphate has clearly controlled the growth of lichens and mosses. (See page 47.)

The Preah Khan Stela

After a series of thefts from sites at Angkor, the Conservation d’Angkor removed the famous Sanskrit inscribed two-meter high Preah Khan Stela from its location, close to the central shrine, and placed it for safekeeping at the Conservation d’Angkor depot (see frontispiece illustration). Although its removal represents a loss of one of the most significant and interesting features to be found at Preah Khan, it is of priceless historical importance, thus its protection is of foremost concern. See Appendix C: ‘Preah Khan Stela Translation’ (Claude Jacques) Report IV: Field Campaign I — Project Mobilization, Preah Khan Conservation Project.
Following Dr. Preusser’s suggestions (Report V, Field Campaign II), a high quality replica is to be made from the original, once the latter has been cleaned and preserved. The replica will be installed at the stela’s original position at Preah Khan. It is planned that translations of the inscription will be provided in both French and English, and made available as a separate site brochure.

**VIDEO DOCUMENTATION PROJECT**

The results of the various initiatives undertaken during Field Campaign II have met with considerable success. New Dominion’s documentary on Angkor entitled *Struggle for Angkor* was shown on U.S. cable television on the Discovery Channel in October 1994. It ranked in the top four of within its series in the year of its airing. The film depicts the various threats to the monuments of Angkor — war, neglect and tropical vegetation — and the local and international efforts to conserve and present this important World Heritage site. Preah Khan is featured in the film, including interviews with WMF sponsored student trainees and Project Director John Sanday.

WMF itself has produced a short film that captures the atmosphere of the work at Preah Khan. Seventeen hours of footage taken by Wayne de la Roche during the January 1994 mission has been condensed. The film records the activities of the students and the 10 consultants present during that period.

An archival record of the overall progress of the Preah Khan conservation project is being kept by the project director. At the beginning of each mission John Sanday records a walk through the site with a running commentary describing the work achieved since the last recording. In addition, he identifies and comments on any specific activities or points out issues worth noting.

Such archival tapes were used to create a film describing the structural consolidation process used to save the South East Portico of East Gopura III. The film, with on-site commentary, shows how the work proceeded over a three-month period.
EDUCATIONAL ASSISTANCE — UNIVERSITY OF BEAUX ARTS

General

This year has seen the graduation of two archaeological students who trained at Preah Khan. Both have been fortunate enough to be selected for further training abroad. It has also been the final year of study for five architectural students at the University of Beaux Arts, who did special study work at Preah Khan. In the past twelve months each has been busy with the preparation and execution of their approved diploma theses. At the end of Field Campaign III in April, the Dean of Architecture joined the students at Preah Khan to review their research program and to discuss future training activities at the site.

Training Activities in Phnom Penh

Since the appointment of the new Dean to the Faculty of Architecture, Architect Sophean, WMF has established a strong relationship with the Department of Architecture. Conservation training is slowly being introduced into the curriculum and, for the first time, students may elect to undertake a building conservation topic for their dissertation. The five architectural students who have worked and studied with the WMF team at Preah Khan have divided into two groups and are preparing reports and dissertations based on the Preah Khan Conservation Project.

Following the enthusiastic response to Dr. Predrag Gavrilovic’s presentation to the Department of Architecture in January 1994, Engineer Gavrilovic returned to give another presentation to a large group of students. The Dean of Architecture presided over the event, and five professors from the University were also in attendance. The two-hour illustrated lecture session, entitled ‘Structural Consolidation, Repair and Strengthening of Monuments in Preah Khan,’ gave a brief introduction to WMF’s activities worldwide and discussed WMF’s activities at Angkor, in particular at Preah Khan. Engineer Gavrilovic described in greater detail the process of structural analysis and, with photographs, demonstrated methods of repair and consolidation using minimal intervention.

Training Activities at Siem Reap

The WMF consultant team was pleased to welcome the architectural students again to Preah Khan on several separate occasions during Field Campaign III. Under the guidance of Kevin Lee Sarring, the students assisted in the documentation of structures for which interventions were planned during months of January through April 1995. The students also spent time researching and preparing survey drawings for their dissertations on various aspects of Khmer architecture. (See Appendix G.)
During Field Campaign III, a portfolio of 76 sketches, surveys and finished drawings were prepared recording East Gopura IV, the Hall of Dancers, and the West Vishnu Complex. The students also worked at Prasat Neak Pean, preparing sectional drawings, plans and elevations showing the relationship of Prasat Neak Pean to Preah Khan.

The students also took part in discussions concerning structural consolidation of selected structures at the Preah Khan and, as part of their dissertation work, have made their own assessments with the assistance of Engineer Gavrilovic. Each student received a Certificate of Attendance, which they can add to academic credits required to complete their degree courses.

Architectural dissertations at the University of Phnom Penh must be submitted before the end of 1995. Students Sareth and Maurin presented their joint study on the Conservation of Preah Khan at the end of August 1995 and Phally, Soma and Kimheng by year’s end. These are thought to be the first dissertations concerning the conservation of historic monuments by Cambodian students in almost twenty years and Sophean, the Dean of Architecture, is taking particular interest in their development. He visited Angkor and spent two days at Preah Khan and other sites to observe the progress of the students and to discuss the broader aspects of preparing dissertations on monuments conservation. John Sanday has been serving as diploma tutor for both groups and has been asked to support the students during their formal
Students at Work in the Hall of Dancers.
assessments. All WMF consultant team members are obliged by the terms of their contracts to assist in teaching and advising students who work at Preah Khan. See WMF Angkor Reports III, IV and V for documentation of such efforts.

Miscellaneous Educational Assistance

The two archaeology students Chan Chamroen and Nay Sophea, graduated at the end of 1994 following the submission of their dissertations. To complete his diploma, Chan Chamroen presented a study on the role of water at Angkor, a very topical field of research due to the recent provision of space borne radar imagery of Angkor as received from NASA’s Jet Propulsion Lab in December 1994. (Radar imaging offers new data for reading variations in moisture presence.) He subsequently received a scholarship to the University of Hawaii as part of the East-West Exchange Program and is expected to return to become a member of the professional team of Cambodians at Preah Khan. Sophea studied Khmer bridges of the Angkor Period and, following his graduation, spent time in Borobodur, Indonesia where he was trained in the technique of anastylosis (the reassembly of original material). The Indonesian Government intends to use this restoration method at its recently initiated restoration of a small gopura associated with Pimeneakas in Angkor Thom.

Lek Sareth has been accepted for one year’s post graduate training at the Frank Lloyd Wright School of Architecture in the United States. Following the formal receipt of his diploma from the University of Fine Arts, Phnom Penh at the end of November 1995, he will leave for training at Taliesen West in Arizona and Taliesen East in Wisconsin. Funding for Lek Sareth’s post graduate education was secured by WMF from the The Starr Foundation, PATA Foundation, and Samuel H. Kress Foundation.

On Site Work Force Training

Work force training has continued in tandem with conservation campaigns in the field at Preah Khan. Two stone working groups have now been formed and are working exclusively on the consolidation of stone structures. Activities this year concentrated on realigning selected structures, exploring the capacity for moving stones using hydraulic jacks, and developing skills to glue and pin fractured stones. Both teams have become very adept at this work and developed ingenious methods for applying adhesive in ways which prevent damage or disfigurement to the stonework. Some of the masons are honing their skills in stone dressing and in carving new stones to replace structural elements that are either missing or damaged beyond repair.

A special group of carpenters is responsible for the temporary propping of all structures in danger of collapse. This group regularly monitors all structural danger zones, especially
through the monsoon period, and ensures the integrity of temporary structural supports throughout the site.

The Blacksmith's Workshop.

In their third year of work at Preah Khan the team of blacksmiths are now knowledgeable in the manufacturing of all the necessary structural steel bands, straps, bolts, specialty cutting implements etc. Other project teams working at Angkor often call on them to fabricate miscellaneous special steel work. During their free time, the blacksmiths make replicas of cutting knives as souvenirs of Preah Khan.
RADAR IMAGING SURVEY OF THE ANGKOR ECO-SITE

The First Scientific Roundtable

The World Monuments Fund and Royal Angkor Foundation (RAF) conducted the first scientific roundtable on its Radar Imaging Survey of the Angkor Eco-Site at Princeton University in Princeton, New Jersey on February 1-2, 1995. The purpose was to assess data collected by the National Aeronautics and Space Administration (NASA) space shuttle Endeavour during its April and October 1994 missions and determine criteria for analyzing the information provided. Using NASA’s Jet Propulsion Laboratory (JPL) SIR-C/X-SAR Earth Imaging Radar system, Endeavour collected images of specific archaeological and ecological sites in Cambodia to assist in the documentation and analysis of the Historic City of Angkor in response to a proposal submitted jointly by WMF and RAF which was formalized on July 15, 1994.

The roundtable offered a rare opportunity for specialists in archaeological and ecological fieldwork to join forces with scientists in outer space-based radar imaging research to learn how this state-of-the-art technology might assist in the pursuit of the knowledge of the past. NASA’s Jet Propulsion Laboratory (JPL) was eager to assist WMF and RAF in the analysis of Endeavour’s radar imaging of Angkor, and the J.M. Kaplan Fund (New York) supported this cooperative effort.

It was the first general meeting of the international project team to determine the criteria and to establish a detailed program for the analysis of information provided by NASA as it applies to Angkor and its hinterland. Participants were able to discuss the potential of the research possibilities afforded by the availability of this new technology and develop a list of objectives for the overall research project. Subsequently a plan of action was organized, to engage other researchers and to address possible future collaborations with NASA on the subjects of cultural heritage conservation, historic eco-systems and archaeology. The conference was seen as a significant advancement in an ongoing dialogue between NASA’s JPL, archaeologists, and other researchers exploring new possibilities in archaeological research, site conservation and cultural resource management.

Today most of Angkor is hidden beneath a dense rain forest canopy, which impedes a thorough study of the site in relation to its environment. Radar imaging technology has already proven of great assistance to researchers in Cambodia in increasing their understanding of how
the Angkor complex grew, flourished and later fell into disuse over an 800-year period. Of major significance will be the data now in hand through radar imaging which could lead to the effective reconstruction of parts of the vast hydrological system of canals, moats and reservoirs which have faded from view at the site today.

The roundtable results were published in the separate report entitled *Radar Imaging Survey of the Angkor Eco-Site, Report of the First Scientific Roundtable* and were first presented publicly at the International Coordinating Committee on the Safeguarding and Development of the Historic Site of Angkor (ICC) held in Phnom Penh, Cambodia on March 31, 1995. (See Separate Appendix VI/B.) This presentation further stimulated an EFEO-sponsored symposium held in Siem Reap in late June 1995 entitled *Hydrological City of Angkor*. Landscape ecologist Terry Schnadelbach and archaeologist Dr. Elizabeth Moore attended the conference as representatives of WMF and RAF. (See Appendix B.)

In early July Angkor Eco-Site Project Co-Director Janos Jelen spent a most productive week at the facilities of NASA/JPL in Pasadena, California where advanced agreements were made between the Royal Angkor Foundation and JPL regarding the sharing of databases and systems in relation to present and future research at Angkor.
4. GENERAL CONSERVATION ACTIVITIES

Stone Replacement & Conservation
Policy for Stone Recycling
General Disengagement
Plant Control
Treatment of Wall Tops at Enclosure Walls II & IV
4. GENERAL CONSERVATION ACTIVITIES

STONE REPLACEMENT & CONSERVATION

Background

At the International Coordinating Committees meeting held in Phnom Penh at the end of March 1995, WMF's initial approach to the replacement of defective or missing stones was reviewed. The committee's appraisal focused on the ethics of replacing missing stone, recycling stone from Preah Khan versus the use of new and different materials to indicate clearly that the replacement is a modern intervention.

Structural Consolidation & Stone Repair — Appropriate Conservation Technology

During the first half of 1994, WMF consultants developed techniques to repair and strengthen stone masonry at Preah Khan involving what is considered to be appropriate materials and methods. A range of recommended intervention techniques derived from an extensive program of testing as per proposals in the Preah Khan Conservation Plan (Report III). Research and experimentation took place during the first major intervention project at Preah Khan when consolidation began in January 1994 during Field Campaign II at the South East Portico East Gopura III.

From mid January through April 1995, following the successful conclusion of this initial intervention, WMF addressed a similar situation at the North West Portico of East Gopura IV and conducted urgent consolidation work at the Hall of Dancers. These activities have been segregated here specifically to demonstrate WMF's policy concerning the replacement of stone, which are briefly outlined below.

The South East Portico — East Gopura III (As Found Condition)

As a demonstration location for structural consolidation and stone repair in Field Campaign II, WMF selected the South East Portico East Gopura III. Threatened with total collapse, this
structure required immediate and extensive structural intervention. Some of the principle problems observed at the time of survey were:

- several lintel stones were fractured or split and several had lost their bonding. Stones located above the lintel, which also serve as a structural supports, were also missing;

- after the partial collapse of the portico, the columns were driven into the platform on which the portico stands, causing the deformation of the platform;

- the roots of a large Tetramiles Nudiflora (Fromagere) tree caused some deformation to the platform and several of the stones which form the edge of the platform were missing or lost.

The South East Portico — East Gopura III (Repairs Undertaken)

(A description of the process of repairs and details of all interventions are described in *Preah Khan Conservation Project Report V Field Campaign II, Appendix VI/A*)

After extensive graphic, photographic and video documentation of the South East Portico/East Gopura II, a program of repairs and consolidation began with each step of the repair process being carefully recorded. The program of work included unloading the structure by removing several structural stones, jacking the massive stone columns back to a vertical position, and resetting the stones that had been removed.

Specific interventions to the stonework at the lintel level consisted of:

- carefully gluing and pinning broken stones;
- injecting epoxy resin into fractures to seal and/or strengthen; and
- placing and pinning steel plates (sealed in epoxy resin) across stone joints to tie and strengthen failing joints.

Specific interventions to the wall ends of the portico consisted of:

- partially dismantling open joints of stonework;
- applying horizontal pressure using hydraulic jacks to push stones back to their original vertical position; and
- reinstating missing structural stones in wall ends using replacement stones.
South East Portico, East Gopura III, Examples of Stone Replacement.
Specific interventions to the platform consisted of:
- removing loose fill and replacing it with a dry, weak mass concrete mix which is isolated from contact with the stone by heavy duty polythene sheeting;
- re-levelling the top of the foundation to facilitate the repair of the platform wall; and
- reinstating missing structural stones with replacement stone (each being discretely dated) and profiling replacement stones to conform only with the outline of the missing stone.

When the heavy stone vaults above it partially collapsed at an unknown time in the past, the platform was severely disrupted by tree roots and heavy eccentric point loads from the columns. To reset the columns and vaults, it was necessary to level and realign the stones forming the platform as well as remove and replace several tons of accumulated earth and debris beneath the first layer of pavers. It was also decided that the bases of the guardian lions would be reassembled and reconstructed (several parts of the lions were rediscovered, hidden in the undergrowth).

Of the 15 newly cut limestone pieces used in the consolidation and reconstruction of the platform, seven are structural, six are replacing or protecting the substructure that had been damaged by the tree, and two can be described as cosmetic. All new stones contribute to the consolidation and protection of the platform — preventing spill out and bulging which is a common failure in many of the platforms at Angkor. Water intrusion into is also mitigated by these interventions. (See page 63.)

The North West Portico — East Gopura IV (As Found Condition)

The Ecole Francaise d'Extreme-Orient (EFEO) undertook some emergency repairs at the North West Portico — East Gopura IV, probably in the 1950s, by placing a reinforced concrete column to support a fractured stone lintel. Recently, a heavy branch from a nearby tree fell across the vaults of the Portico causing near collapse, although the vault stones are still in place. Some of the principal problems observed at the time of survey were:

- the concrete column originally provided by EFEO supporting the lintel had shifted and was no longer functional;
- several vault stones were broken in two or had shattered from impact causing the vaults to fall inward and jam themselves;
- the West end bearing of the South lintel, which had been supported temporarily by the concrete column, was shattered;
- the pair of western columns were leaning 30 cm out of vertical to the west.
- the fronton had partially collapsed and the fallen stones have been stacked nearby;
the impact of the collapse caused deformation to the platform and several stones from the wall of the platform were lost;
- concrete patches inserted by EFEO to replace broken or crushed pieces of stone, in the 1950s, were now separating from the stone; and
- a now loose and ineffectual steel tie had been placed around the south west column and tied back to the wall end.

The North West Portico — East Gopura IV (Repairs Undertaken)

Work on East Gopura IV started at the beginning of Field Campaign III and is described in Section 5.

Following the completion of graphic, photographic and video documentation a program of repairs and consolidation began likewise at the North West Portico/East Gopura IV. Each repair process was also carefully recorded. The work program included unloading the structure by removing several structural stones, jacking the massive stone columns back to a vertical position, and resetting stones that had been removed. Several stones belonging to the fronton were located and put back in their original position.

Specific interventions to the vaults and lintels consisted of:
- making a new bearing end from new stone to replace the shattered lintel end, then gluing and pinning the new lintel end to the old stone;
- carefully gluing and pinning the broken vault stones;
- injecting epoxy resin into fractures to seal and/or strengthen them; and
- placing and pinning steel plates (sealed in epoxy resin) across stone joints to tie and strengthen failing joints.

Specific interventions to wall ends of the portico consisted of:
- partially dismantling open joints of stonework and its reconstruction;
- applying horizontal pressure using hydraulic jacks to push stones back to their original vertical position; and
- replicating missing structural stones in wall ends with replacement stones.

The ease with which the portico was repaired and consolidated was noteworthy in comparison to the difficulties faced by the team during its firsts efforts at the South East Portico East Gopura III. Throughout these trail conservation interventions the need to replace severely damaged stones that are important to the structural integrity of these structures and consolidate each using a structurally and visually compatible material also became apparent.
Similar to the problems faced in the repair of the platform of the South East Portico — East Gopura IV, several structural stones at the North West Portico — East Gopura IV were damaged beyond reuse or are missing. These stones should be replaced with new ones to secure the integrity of the platform.

**Alternative Interventions**

The principles concerning replacement stonework at Preah Khan were derived at by addressing the following questions:

- Should major structural interventions be made to appear as a ruin?
- If interventions are made should not another material be used?
- Should 'historic' stone be recycled?

WMF has established guidelines for its interventions at Preah Khan following its basic premise that Preah Khan should be conserved and presented as a partial ruin. WMF's immediate and urgent task at Preah Khan is to prevent, wherever possible, further deterioration at the site, including collapse. The consultant team sees as its responsibility also to ensure the safety of any persons on-site. It is only possible to address the above mentioned questions by employing varying degrees of structural intervention. All such structural consolidation is designed and executed with minimal intervention in mind.

The use of matching stone replacements where truly necessary is both viable and philosophically defensible at Angkor where such interventions are kept to a minimum and where each new stone insert is discernible on close examination. The temples of Angkor were built of what the Khmers considered the most noble material — stone — to honor the gods and kings for whom they were constructed. Aesthetically the buildings are dependent on a harmony of materials. These facts, plus careful consideration of the other possibilities, have shaped the present conservation approach. WMF Consultants have taken note of the rapid deterioration of reinforced concrete used in earlier interventions in the 1950's. Concrete in any form is considered by Khmers as a base material and its use wherever possible should be avoided. In many instances earlier uses of concrete structural props and lintels are failing and, in some places, have themselves required emergency temporary support.

The recycling of 'historic' stone may on first impression appear to be questionable, though the practice in this application is justified since a) the quarries of the Kulen hills are presently inaccessible and may be depleted, and b) the historic stone being recycled is anonymous and would never contain any traces of fine carving or builders marks. (Even if it were possible to reopen the quarries at Kulen, the quality of stone available is likely to be inferior to that used originally at Preah Khan.) All historic stones that have been recycled in Preah Khan are plain
Sketches Showing Replacement Alternatives for South Lintel.

undecorated ashlar stone that were found in locations remote to collapsed structures and have thus lost their historic or archaeological context. In all cases the stones are unidentifiable and have been lying hidden in a decaying state. The chances of these stones ever being identified and returned to their original position are extremely remote.
The positive aspects of using recycled stone are: the recycled pieces come from the same quarry bed as the pieces they are replacing; they are ‘seasoned’; and they provide an excellent color match. In cases where it is necessary to pin and glue ‘new’ stone to old, the structural and visual compatibility of recycled stone juxtaposed to original building fabric is excellent.

When assessing the procedure of recycling stone it is important to consider the quantity of stone likely to be required for replacing the odd structural member. Given the very measured interventions planned for the structural consolidation of Preah Khan according the its Master Plan, the total amount of recycled stone required will be a very small percentage of the total amount of unidentifiable and unfinished stone found at Preah Khan.

When considering the use of other materials, specifically concrete, the following characteristics should be considered: the ultimate strength of concrete is dependent on its careful preparation; the structural and material compatibility of stone and concrete is not good; the bonding and color matching qualities are inferior to stone on stone.

Finally to ensure easy recognition, any replacement stones are simply profiled to generally blend with their location. For example, stones forming the edge of platforms or parts of a cornice are profiled to continue the lines and function of its original adjacent stones and detailed so as to shed rainwater. To ensure ease of identification, each replacement stone is marked unobtrusively with the initials WMF and year.

At Preah Khan there will be no newly carved decorative stonework such as apsaras, garudas or foliage motifs.

**POLICY FOR STONE RECYCLING**

Thus the usage of recycled stone in historic buildings at Preah Khan is articulated in the following policy:

1. New stone should be used for the replacement of missing or damaged stones when such repairs are unavoidable and of a structural nature only.

2. New stone is defined as:
   a) either new stone from the original Kulen Sandstone Quarry in Phnom Kulen, if available and accessible, to match original in color and quality; or
b) reused ‘anonymous’, non-specific, and undecorated stone which has been salvaged from Preah Khan. It should be selected for color match and correct bed, cut, dressed, and inserted so as to minimize destruction of adjacent in situ stone.

3. Exposed surfaces of new stone should be tooled to be compatible with, yet distinct from, adjacent existing stone. New stone should not recreate design nor ornamentation, other than generally matching the profiles of water shedding details.

4. All new stones should be unobtrusively dated with the year and occasionally labeled ‘WMF’.

PLANT CONTROL

The introduction of the herbicide ‘Up-Down’ produced by Ladda Co., Ltd. in Bangkok has simplified the clearance of vegetation near or on the architectural of Preah Khan. This chemical, which is similar to Monsanto’s ‘Round-Up’, acts systemically in killing unwanted plant material. It is considered ‘environment friendly’ and harmless to humans and animals.

Several experiments were undertaken in January and February off using ‘Up-Down’ herbicide to control plant growth along the East Processional Way. Most tests were only moderately successful. The treatment was repeated again at the beginning of the monsoon season, to test its efficacy on paved surfaces. If successful, this treatment could be used, to a limited extent, each year to control plant growth on paved areas throughout the presented areas of the temple complex.

Other promising results in using the herbicide have been noticed in tests for controlling tree and shrub growth on the monuments themselves. As the roots of various types of plants grow and expand, sapling trees, especially, can cause structural collapse to towers and walls. Removing the roots systems of intrusive saplings is very difficult, unless the stonework is dismantled, because the far-reaching pliable roots of the sapling take firm hold of the stonework. If, however, the plant is first killed, they dehydrate and shrink making their removal much easier and causing no damage to the stonework. Herbicide experiments on the towers of East Gopura IV have proven very successful and within a year it has been possible to remove well established shrubs from joints between the stones.
NW Portico, East Gopura IV - Replacement Stone.

Dating of Replacement Stone.
TREATMENT OF WALL TOPS AT ENCLOSURE WALLS III & IV

Among the most threatened of the structures at Preah Khan are its characteristic laterite enclosure walls, which are affected by plant growth especially at their top edges. The porous nature of laterite stone and the condition of most lengths of wall tops today make these areas particularly susceptible to plant growth. Experiments were carried out in January 1995 in controlling plant growth at wall tops with the results being only minimally successful. This was due, in part, to choosing the wrong spray mixture and applying it in the wrong time of the plant's growth cycle.

Using a newly developed spray mixture having a higher concentration of herbicide, the experiment was repeated at the beginning of the monsoon season in June 1995.
Spraying Herbicide on East Processional Way.
5. STRUCTURAL REPAIR & CONSOLIDATION (ONGOING)

East Gopura IV - N.W. Portico
East Gopura IV- Central Gateway
Hall of Dancers - Overview
Hall of Dancers - South East Sector (Phase I)
Hall of Dancers - South East Sector (Phase II)
Urgent Temporary Consolidation
5. STRUCTURAL REPAIR & CONSOLIDATION (ONGOING)

East Gopura IV Structural Repair.

The following section describes the structural interventions that were undertaken at Preah Khan during Field Campaign III. The scope of structural consolidation work at Preah Khan was expanded this during the present campaign based on the successful structural consolidation and repair of the South East Portico of East Gopura III which occurred in Field Campaign II. Based on lessons learned in the field some several work methodologies could be further refined. In addition the workers have become more proficient and as a result the the regular workers comprising the structural consolidation team are working smoothly and efficiently.

In accordance with WMF's guidelines for interventions at Preah Khan, building components that have undergone repair and consolidation are structures considered unsafe which are located on principle visitor routes and/or structures which are in imminent danger of collapse. Specific consolidation and repair projects within Field Campaign III included East Gopura IV/North West Portico; East Gopura IV/Central Gateways and the Hall of Dancers.
EAST GOPURA IV— N.W. PORTICO

The consolidation and repair of the North West Portico of East Gopura IV was identified as a structure in danger of imminent collapse due to the failure of several structural members, its former isolation in the jungle, and, more recently, a large limb of a nearby tree falling across the portico. The latter caused serious damage and disruption to the earlier structural concrete supports which were placed by EFEO as temporary supports when they were working at Preah Khan in the mid 1950's.

Repair and consolidation of this portico was selected also because it would provide useful examples of consolidation interventions for the repair of vaults; and splicing of new pieces of stone to an original lintel. A considerable degree of manipulation of the structure was also required to reestablish its former structural integrity.

Location The portico is part of East Gopura IV, the principle gateway to Preah Khan from the east where it passes through the outer enclosure wall. The gopura, consisting of the usual triadic arrangement of passageways in two sizes, is located on the principle east-west axis of the temple complex and is fast becoming the most popular entrance for visitors now that the eastern access road has been opened. The portico (one of four in this gopura) is located on the west side of the smaller northern passageway.

As-Found Condition, Analysis & Diagnosis The as-found condition of the N.W. Portico was classified by the WMF consultant team as being in danger of total collapse and therefore was selected as an example of its kind, appropriate for structural consolidation and partial rebuilding. The top six vault stone courses and decorative cresting had dropped and had become precariously wedged. The cap stones of the vaults had broken mid-span and the fronton stones had fallen to the ground.

Due to the impact of fallen masonry, the enframing square columns of the portico had pitched forward 2.5 degrees, their top ends moving 40 cm westward. The portico itself had separated vertically from the tower structure by about 5 cm, except at the foundation level, creating three major joint opening patterns. The pilaster corners of the main tower, within the portico, were crushed due to eccentric loading caused by the above-mentioned failures. Although the foundations of the overall structure have evidently remained sound, localized eccentric loading has caused the columns to punch into the ground, their bases having settled, thus causing bowing in both directions from its north to south central axis.
NW Portico General View—East Gopura IV
Prior to Consolidation, January 1995.

NW Portico General View—East Gopura IV

NW Portico South Elevation—East Gopura IV
EFEO's previous efforts to consolidate the structure were evident and included such work as concrete patches to the vaults; some concrete patches to the northern lintel and an attempt to consolidate the west end of the southern lintel using mass concrete. The southern lintel was, in fact, propped into place with a reinforced concrete dead shore which had subsequently fallen. The south column had some ineffectual exposed steel tension bars which were attached to the tower wall.

In general, other than the impact from the fallen tree, the causes of the portico's deteriorating condition were typical of failures in this type of structure as noticed throughout the site.

**Documentation — Measured Survey & Archaeological Record** Prior to commencement of any work at the portico, detailed as-found archaeological drawings were prepared following WMF's documentation procedures and the structure was extensively photographed.

The drawings which were prepared by the Preah Khan student group consisted of detailed plans and elevations at a scale of 1:25 of all whole stones and stone fragments, with particular attention given to recording crack and open joint patterns.

Prior to the removal of any stones, each stone was numbered and referenced on the drawings facilitating accurate dismantling and reconstruction, which permitted studies of possible structural consolidation interventions. (See pages 79-80.)

**Conservation Process, Structural Repair & Stabilization** During the first mission of Field Campaign III in January 1995 a design for structural consolidation for the portico was prepared and the process of repair and stabilization was initiated. The first stage included the erection of suitably designed steel scaffolding around the structure including the provision of special hoist beams above the roof vault. This system allowed for all stones within the superstructure to be easily lifted and stored on the scaffolding, thereby avoiding the necessity of lowering stones to the ground each time.

In this manner, the large damaged south lintel was lifted from its position and stored on the scaffolding. As the break in the stone caused by shear stress extended beyond the bearing point, it was decided to repair the lintel by splicing on a new piece of stone. The replacement of the broken south lintel was performed with extreme care by carving a new piece of stone in the exact profile of the fracture. The new stone has been joined to the old by drilling and inserting five stainless steel rods and gluing the prepared faces with epoxy resin. The outer edges of the joint were sealed with Sika's 'Sikadur 732' epoxy mortar and after 24 hours 'Sikadur 752' epoxy resin was injected into the joint. The lintel was replaced to its original location following the realignment of the column.
Concrete might have been considered as an alternative repair technique, however, due to material incompatibility and skilled craftsmen on-site, stone was chosen.

The weight on the columns was temporarily removed, wherever possible, and the columns were carefully realigned using hydraulic jacks. When the columns were first returned to their vertical position it was noticed that their laterite bases had shifted. It was then necessary to separate the column bases from the platform structure and realign the bases. During this process the footings were leveled and strengthened by ramming a dry mix of concrete beneath the column bases.

Following this procedure was possible to reset all misaligned stones of the portico and close numerous open joints with only minimum intervention. (See page 82.) During the process the team was reassured when the stones could be returned to their original locations with such precision. The lintel beams of the portico were subsequently re-set and process of reconstructing the stone roof vaults began.
NW Portico South Elevation—East Gopura IV
Referenced Measured Survey.

NW Portico North Elevation—East Gopura IV
Referenced Measured Survey.
The fronton was partially reconstructed using several fallen stones which were found nearby in the jungle. Their original positions were easily determined and the implications of their reassembly were analyzed beforehand in various reconstruction drawings. The fractured vault capstones were carefully rejoined *in situ* by dowelling with stainless steel and gluing with epoxy resins. (See page 82.)

The large open joints and cracks separating the portico from the tower were skillfully closed with the use of hydraulic jacks. The simple application of continuous pressure off the structural scaffolding enabled many of the stones to be eased back into their original position - a distance of up to 5 cm.

Various pieces of ashlar stonework which had been crushed by eccentric stresses were cut out and replaced in-kind. Each new piece of matching limestone is inscribed with the initials WMF and the date 1995. New stone inserts were connected using stainless steel pins and epoxy glue.

Following reconstruction of the roof vaults, the damaged platform was carefully leveled, as conditions permitted, and the original pavers reset.

A relatively minor intervention was the realignment of a door jamb that had been disturbed during the structural failure. The open joints were invaded by a termite nest causing further deformation. The nest was cleaned out and the stone jamb was pushed back into a vertical position after the lintel had been raised with a hydraulic jack. The jamb was eased into position using horizontal pressure also from the hydraulic jack.
NW Portico West Elevation — East Gopura IV Work in Progress.  
(Note Fronton Stones in Foreground).

North West Portico Column Base Detail — East Gopura IV.  
Exposure of Column Base Prior to Realignment.
Vault Top Strengthening.

**Removal of Concrete Elements**

All the reinforced and mass concrete interventions undertaken in the 1950s had failed, rendering the structure unsafe. The supporting concrete column was no longer functional and the bonding connection between concrete and stonework had failed. For structural rather than aesthetic reasons, all concrete elements have been removed and replaced with stone. Thus, the problems of repairing stone buildings with concrete has been well demonstrated.
EAST GOPURA IV— CENTRAL GATEWAY (ONGOING)

Following the valuable experience gained in working on East Gopura III — South East Portico and East Gopura IV/North West Portico, the work force proved its capability of undertaking the more complicated consolidation of the central gateway East Gopura IV. While the physical task of the was greater, the methods required were essentially routine. This gateway is the main entrance to the Preah Khan complex and, sometime in recent history, either a military tank (judging by scars to stone paving) or a heavy truck caused severe structural damage to its central passageway. The vaults directly above the passageway were also damaged. Since visitor safety is of major importance at Preah Khan the WMF consultant team selected this project as the next most urgent task at the site.
Location  The central gateway of East Gopura IV is the most prominent of the four entrance passageways to Preah Khan. The damaged portion of this grand portal is located on the north east corner of the structure.

As-Found Condition, Analysis & Diagnosis  EFEO performed basic repair and consolidation work at the central gateway, and the majority of it was structurally sound. The recent damage from vehicle impact affected the north support wall. Several stones were dislodged, and the north end of the massive overhead lintel was sheared at its point of contact with its supporting wall. Subsequent movement has caused further structural disruption to the stone vaults. The foundations of the walls appear sound, as no sign of movement is apparent, but the platform or plinth lining the wall base has been disturbed.

Documentation—Measured Survey & Archaeological Record  Following standard WMF procedures, the student team documented the structure with measured drawings prior to commencement of any work. Each stone was numbered and keyed to the drawings of record.

Conservation Process, Structural Repair & Stabilization  The WMF consultants examined the structure at close range from the scaffolding. Once all the stones had been numbered, a program for their removal was determined in consultation with the stone foreman and stone workers in order to ensure that existing structural stability would be maintained during the repair procedure.

Many of the corbelled vault stones were dislocated and had tipped inward. It was therefore necessary to first secure them in situ temporarily, and systematically unload and store them on the scaffolding. The remaining stone vault elements were then removed and temporarily stored.

Once the bearing wall was relieved of its loading from above through dismantling, hydraulic jacks were used to apply pressure to the base of the wall to close the open joints. This procedure was performed at each stone course until nearly all open joints were closed. The dismantled stones were then reassembled in their original positions above and joints throughout this portion of the structure were tightened.

Because the northern end of the principle lintel (spanning 2.70m) had a fractured bearing point, the upper lintel and the fronton were completely unloaded. The defective bearing end was examined and found to be crushed beyond repair. It therefore was recommended that a new stone bearing end be spliced onto the lintel. Work on this detail has been postponed and awaits supervision by Engineer Gavrilovic in October 1995. In preparation for this task, the crowning stone of the fronton, which was previously fractured and then repaired by EFEO with external steel armatures, has been carefully dismantled, cleaned and is now ready for
Central Gate East Gopura IV — Work in Progress.
reassembly. The repairs will be carried out using stainless steel dowels and epoxy resins. The repaired fronton elements will be returned to their original prominent position, once the defective lintel has been repaired.

Central Tower — Proposed Interventions

Having examined the central tower of East Gopura IV, the WMF consultant team decided to continue the analysis of the structure in greater detail at the beginning of Field Campaign IV. Much of the decorative stonework has fallen off the tower, exposing the basic structure and revealing several severe vertical separation cracks which have become prominent on the west elevation. It was planned that the stone workers devote time during the monsoon period to identify stones from this collapse and determine the problems of reconstruction of the various pieces at ground level.

At the outset of Field Campaign IV in October 1995 Engineer Gavrilovic will make his recommendations for the appropriate structural consolidation of the central tower, which will depend somewhat upon the number of stones from the tower that can be identified.

Work Plan for Central Tower - East Gopura IV

The work at the central gateway of East Gopura IV is ongoing. A work plan has been designed which allows for the coordination of consultant supervision on site with their time availability, yet still allows work to be ongoing. Work has been planned to coincide with the visits of the consultants as follows:

<table>
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<th>Activity</th>
<th>Completion Date</th>
<th>Consultant</th>
</tr>
</thead>
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<tr>
<td>Step 1</td>
<td>Dismantle stones as described</td>
<td>May 15 '95</td>
<td>(Completed)</td>
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<tr>
<td>Step 2</td>
<td>Expose Defective Lintel</td>
<td>May 30 '95</td>
<td>(Completed)</td>
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<tr>
<td>Step 3</td>
<td>Close Open Joints at Wall Base</td>
<td>June 10 '95</td>
<td>(Completed)</td>
</tr>
<tr>
<td>Step 3</td>
<td>Reassemble Stone Vaults</td>
<td>June 14 '95</td>
<td>Sanday</td>
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<td>Step 4</td>
<td>Repair Bearing End</td>
<td>October 5 '95</td>
<td>Gavrilovic</td>
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<td>Step 5</td>
<td>Replace Fronton etc.</td>
<td>October 12 '95</td>
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<td>Check Central Tower Structure</td>
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<td>Step 7</td>
<td>Dismantle Scaffolding</td>
<td>November '95</td>
<td>Sanday</td>
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The Hall of Dancers — South East Sector.
HALL OF DANCERS — AN OVERVIEW

Work commenced during the 1994-95 season at the Hall of Dancers, a building which is one of the significant features of Preah Khan. The large cruciform vaulting system used to construct the Hall of Dancers resulted in what must have been one of the most impressive interior spaces at Angkor. This ambitious design consisting of various arrangements of corbelled arches proved to be correspondingly vulnerable. The widest spans of roof vaults collapsed possibly as early as abandonment of Preah Khan in the 15th century, judging from pottery fragments found a in one of four water basins within the building (though the date of this pottery and the context in which it was found remains to be verified). Much of the remaining structure is in a very unstable condition.

The Hall of Dancers was most likely named after the eight finely carved lintels of ephemeral dancing apsaras. These lintels span the length of the four principal doorways leading from the central crossing. On axis to the north beyond the building and over a raised causeway is Preah Khan’s other principal architectural marvel, the famous two-story pavilion.

Due to its size, its finely carved bas reliefs and its prominent location along the principal east-west axis of Preah Khan, the Hall of Dancers is a major point of interest for visitors to the site. As such the WMF consultant team was concerned about safety from falling stones, and improved presentation of the building. At present all dangerous sections have been temporarily supported to avert the threat from falling stones.

Location The Hall of Dancers is located at the eastern end of the religious complex directly west of Gopura III East. It lies along the principal east-west axis leading to the central shrine.

Measured Survey The University of Beaux Arts students students in architecture and archaeology have, under the guidance of WMF consultants, conducted an in-depth survey of the as-found condition of the Hall of Dancers resulting in detailed measured archaeological drawings. The survey includes a floor plan identifying all the paving stones and various general plans, sections and elevations. Diagrammatic drawings have been prepared for each of the areas under repair to indicate the arrangement of stones. One set of drawings depicts a numbering system which was established to record the location of each stone.

Structural Stabilization Survey In preparation for masonry stabilization designs, a survey and assessment of structural separation was carried out at the Hall of Dancers. Structural separations were defined for purposes of this survey as being patterns of movement or stress, manifested as open joints and/or cracks, that are visible over three or more stone courses. A
visual survey conducted from the ground level identified and recorded individually some 150 structural separation patterns on a 1:100 scale plan. This inventory was part of a study undertaken by the student group as a permanent record of structural conditions, and will assist WMF’s consultant team in establishing a list of priorities for planning future interventions at the Hall of Dancers. The WMF team reviewed each of the 150 structural separations and evaluated each for treatment. Where treatment was considered necessary, the structural damage level was further categorized as:

‘A’ — Severe structural damage requiring emergency attention,
‘B’ — Moderate structural damage requiring periodic monitoring and eventual consolidation, or
‘C’ — Not Severe structural damage requiring only periodic monitoring.

Only 8% of the structural separations at the Hall of Dancers are listed as category ‘A,’ 3.7% are listed as category ‘B,’ and 7.5% are listed as category ‘C.’ (See Appendix F.)

Graphic and photographic documentation for the archaeological record of all category ‘A’ separations began during this field campaign and will be completed during Field Campaign IV.

Typical structural separations were observed under the following conditions and in the following locations:

• where a series of stone header joints are aligned vertically providing no bond;
• at door lintel bearing points;
• at the center of lintels/beams over doors or between columns;
• at door jambs abutting ashlar walls;
• above column heads;
• at column side braces;
• at vault connections to entablature;
• through column shafts; and
• between distinct structural building units.

The general distribution of structural separation noted at the Hall of Dancers reveals no particular overall pattern of movement. However, those areas classified in category ‘A’ require emergency structural stabilization intervention. This occurs in three locations: the south east sector, the north transept, north west sector and the south west corner of the enclosing wall. The method developed for documenting and classifying the structural priorities of the Hall of Dancers will help identify future emergency stabilization needs and future work programs elsewhere at Preah Khan.
Stone Identification Inventory

As part of the survey program the students, assisted by the workers, have been identifying decorated stone blocks and, where possible, determining their exact position for relocation on the survey drawings. As the stones are encountered in above-grade 'degagement' operations, they are stacked in piles according to their type but also with reference to the location in which they were found. For example, the stones from each of the various half-vaults have been segregated and stacked together, as have the stones from the central vaults.
South East Half Vault— Hall of Dancers, January 1995
Prior to Consolidation and Repair.

South East Sector Half Vault — Hall of Dancers, January 1995
Column Detail Prior to Intervention.
HALL OF DANCERS - SOUTH EAST SECTOR (PHASE I)

The south east sector of the Hall of Dancers has been identified as being in critical need of consolidation. If the column adjacent to the axial route, which is severely distorted, should fail it would cause the collapse of the largest intact corbelled vault assemblies remaining in this building.

Location Phase Two is a continuation of Phase One to the south which is described above. Although structurally separated, this is an extension of the same arrangement, and encloses a small open courtyard. As such it forms an important architectural feature in the layout of the Hall of Dancers, one of its four cloistered reflecting pools.

As-Found Condition, Analysis & Diagnosis Careful investigation and structural analysis have revealed that the capital of the central column was in danger of imminent collapse. The top stone had been forced askew and the loading had become eccentric. Part of the upper body of the column had spalled and the column head itself had split due to an imbalance of top loading. (See page 92.)

Entire lengths of stone vaults had tilted threatening collapse of the entire structure. This condition probably occurred at the time of the collapse of the central vault. The failure of the adjacent half vaults compounded this condition.

Documentation— Measured Survey and Archaeological Record Following WMF's standard procedures, the structure was measured, drawn and photographed by the student team prior to the commencement of any work. Numbers were allocated to all stones and recorded on drawings. Many of the largest fallen stones from this area of the Hall of Dancers have been identified and are referred to on the survey drawings.

Conservation Process, Structural Repair and Stabilization The initial stage of the process of conserving this portion of the Hall of Dancers involved the construction of a sound tubular steel scaffolding along the axis of the column and lintel system, over the half vault, and along the side of the corresponding aisle structure. The scaffolding provided support to the overall structure, a platform on which to unload stones, and a base from which to operate. The scaffolding was also designed to provide the necessary strong points from which a gantry could be rigged to lift stones.

The first task was to repair and realign the column in the most dangerous condition by repair with a newly carved stone insert. This step was followed by realigning the capital. Although part of the capital was missing, it was not replaced, because it played no structural role.
Repairs to the damaged column utilized a technique which was tested on a column in the South West Sector of the Hall of Dancers during Field Campaign II. (See Report V Separate Appendix VI/A, Structural Repair and Consolidation Methods.) To unload the column, hydraulic jacks were used to raise the beams. Steel belts were temporarily placed around the upper part of the column to close the cracks. The column was then drilled across the crack and stainless steel dowels were inserted. ‘Sikadur 732’ epoxy mortar was used to seal the edges of the cracks, after which the cracks were injected and flooded with ‘Sikadur 752’ epoxy resin. Later a new stone patch was cut to replace the spalling stone, then drilled and fixed in the same way with stainless steel pins and epoxy resin. (See page 95.)

As a result of the large deformation of the stone half vaults in this section of the Hall of Dancers, the whole section, which was for the most part intact, was carefully dismantled and documented during the process. After the repair and reconnection of the column and lintel, the vaults were reassembled, ensuring proper connection to the main portal frame. Damaged sections of structural stonework were replaced with new stones. Due to structural necessity, one particular keystone in the vault was replaced with a newly cut stone. (See page 92.) Where bearing ends of existing vaults had failed, a new section of stone was spliced to the old, then bolted and glued using stainless steel and epoxy resin.
South East Sector — Hall of Dancers
Strengthening of Column Head.

Once the structure was unloaded, the associated supporting walls were checked and any open joints were closed using horizontal pressure from hydraulic jacks. In this way the wall was restabilized. (See page 89.)

HALL OF DANCERS - SOUTH EAST SECTOR
PREAH KHAN, ANGKOR

South East Sector North Elevation - Hall of Dancers. Isometric Drawing Showing Repairs Undertaken.
The WMF consultant team considered the options for continuing work at the Hall of Dancers and elected to continue in the south east sector. The structures there appeared to be the most in danger of collapse: there are several fractured beams and lintels, distorted columns and a unique corner return vault - the only section of this kind to survive in the Hall of Dancers.

As Found Condition, Analysis & Diagnosis This sector is one of the most intact in the Hall of Dancers. Many of the half vaults are still precariously in situ. However, due to collapse of the major portions of building, in particular its great cruciform central section, many of the columns and lintels have fractures and are misaligned. There are many different examples of failure, most of which are localized. During the 1950s, EFEO undertook several interventions using cast in place reinforced concrete. Most of these interventions have failed and, in some cases, have caused further structural damage to the stone elements which now temporary support at least.

Most of the potential for collapse is due to local structural failure caused by either material deterioration or stones that have fallen from the structure for various reasons. Such failures can be easily remedied.

Along the southern side of the Hall of Dancers, several of the beams and lintels that formerly supported the half vaults have failed. Here too, reinforced concrete had been used to reinforce the lintels. Much of this previous repair work has failed because the bearing provided at the point where the beam ends met column capitals was insufficient. As a result most of the beam failures noticed today have occurred at this junction.

Documentation - Measured Survey and Archaeological Record Following WMF’s standard procedures, the structure was measured and recorded by the student team prior to the commencement of any work. Numbers were allocated to the stones and noted on the drawings. Several sketches documenting the more important specific conditions were also prepared by the students.

Proposed Conservation Process Many of the structural consolidation and repair interventions proposed for this part of the Hall of Dancers will follow the same procedures used elsewhere at Preah Khan.

- After the stones have been recorded and referenced, all structures need to be checked and, where necessary, stones will be temporarily placed on nearby structural scaffolding. During this process it is recommended that all concrete support lintels and props be removed and the stone lintels repaired by gluing and dowelling the typical
lintel fractures using three 12mm stainless steel dowels bedded in epoxy resin. (For details of this repair process, see page 96.)

- It is also necessary to consolidate the deformed capitals to the columns by refixing them with small diameter stainless steel armatures and epoxy resin. These interventions will restore the bearing surfaces for beams that they support.

- In cases where a section of a column has spalled below the capital and the column has tilted causing eccentric loading, one possible solution would be to form a bracket in new stone that could be then bolted to the column to support the stone capital.

- In cases where the lintels or beams have split horizontally, it will be necessary to drill, glue and bolt the fractured sections together prior to repairing the vertical fracture.

- When the structure is unloaded, all pillars that are not perpendicular to their bases should be reset in a vertical position. If necessary, the bases should be freed to allow necessary movement.

**Work Plan**

Following discussions on site with the Chef de Chantier, the WMF consultants have prepared the following work plan to enable the consultants to be on site to supervise the more complicated structural interventions.

<table>
<thead>
<tr>
<th>Step</th>
<th>Activity</th>
<th>Completion Date</th>
<th>Consultant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1</td>
<td>Dismantle stones as described</td>
<td>May 15 '95</td>
<td>(Completed)</td>
</tr>
<tr>
<td>Step 2</td>
<td>Expose Defective Lintels</td>
<td>May 30 '95</td>
<td>(Completed)</td>
</tr>
<tr>
<td>Step 3</td>
<td>Remove &amp; Repair Lintels/Beams</td>
<td>June 14 '95</td>
<td>Sanday</td>
</tr>
<tr>
<td>Step 3</td>
<td>Repair Column Capitals etc.</td>
<td>June 14 '95</td>
<td>Sanday</td>
</tr>
<tr>
<td>Step 4</td>
<td>Repair Defective Vaults</td>
<td>October 15 '95</td>
<td>Gavrilovic</td>
</tr>
<tr>
<td>Step 5</td>
<td>Reassemble Stone Vaults</td>
<td>October 15 '95</td>
<td>Gavrilovic</td>
</tr>
<tr>
<td>Step 6</td>
<td>Dismantle Scaffolding</td>
<td>November 5 '95</td>
<td>Sanday</td>
</tr>
</tbody>
</table>

Following the dismantling stage, all major interventions will be checked by consultants prior to the work force moving to the next stage.
URGENT TEMPORARY CONSOLIDATION

During each mission the WMF consultant team checks the structural condition of those structures that are most accessible to average visitors of the site and, where necessary, added measures for protection are implemented, usually in the form of temporary shoring. In some instances, the removal of debris accumulation or the sorting of fallen stones will expose an unstable structure that requires urgent stabilization. These activities may not be part of a ‘Project’ as listed in the 1995/96 Field Campaign IV, but are usually small problems which can be corrected and made safe in less than a week. The methods and materials used for such repairs have already been implemented with successful results by the stone working groups.

The most significant needs for intervention in upcoming months have been identified by Engineer Gavrilovic as follows:

- East Gopura IV - South Portico North West Corner
- East Gopura III West Porch Door South Jamb
- East Gopura III - East Portico North End Wall
- Hall of Dancers - South East Sector, General Stabilization (Ongoing)
- Hall of Dancers - South West Corner of Enclosing Wall
- North Gopura III - South Porch West Window
- Shiva Temple Complex - Central Tower North Door
- Shiva Temple Complex - East Passage two West Windows
- Shiva Temple Complex - South Gopura North East Dvarapala

Most of these locations have carefully placed timber shoring in place which has arrested the threat of collapse at least temporarily. It is expected that more permanent solutions will be implemented at most, if not all, of these locations during the 1995/96 Field Campaign IV.
6. RECOMMENDED STRUCTURAL INTERVENTIONS

Enclosure Wall IV - Consolidation & Reconstruction
Enclosure Wall IV - North East Section
Stabilization Program for Sandstone Garudas
6. RECOMMENDED STRUCTURAL INTERVENTIONS

ENCLOSURE WALL IV — CONSOLIDATION & RECONSTRUCTION

Enclosure Wall IV which is bordered by a moat forms a rectilinear boundary enclosing the Preah Khan temple complex. Excluding the gopuras, the total wall length is approximately 2,760 meters. The precinct contained within the perimeter walls of Preah Khan measures 950 meters in the east-west direction and 750 meters in the north/south direction. The wall is built of laterite stone blocks laid on a stepped laterite foundation measuring approximately 1.25 meters deep. The laterite used in the construction of Preah Khan’s outermost protective enclosure and elsewhere at the site is thought to have been excavated from the moat. The average wall height is 3.25 meters and its average thickness is 1.25 meters. Monumental sandstone gañidas are spaced along the outward face of the wall approximately every 35 meters. The garudas stand the full height of the wall with what appears to be minimal connection to the wall itself. (See Separate Appendix VI/A.)

A preliminary survey of the condition of the wall, made after its complete disengagement from the jungle last year, indicated the following: 76% of the wall (2,093 running meters) is in sound condition; approximately 8% (230 running meters) is tilting three degrees from vertical; 44 meters (approximately 2%) of the shaped wall caps have collapsed; and some 14% (396 meters) of the wall has collapsed completely.

The WMF consultant team is considering the reconstruction of the collapsed sections of the Enclosure Wall in order to further insure site security. If the wall were to be completely restored, normal access to the temple could be again controlled through the four axially placed gopuras.

During Field Campaign II some 22 meters of collapsed wall at the eastern part of Enclosure Wall IV, located north of East Gopura IV, was cleared and readied for reconstruction. It is estimated that it would take 20 workers approximately three months to restore this collapsed wall section. At this rate, all damage to Enclosure Wall IV at Preah Khan could be reconstructed over a period of approximately four and a half years at a total cost of about $55,000. A description of the work involved in the repair of the test reconstruction of the at the east wall follows in the next section. This overall Enclosure Wall IV Repair and
Reconstruction Project could dovetail well with the Adopt-a-Garuda Project which is aimed at conserving all of the 72 garudas which line Preah Khan’s uniquely ornate protective barrier.

ENCLOSURE WALL IV — NORTH EAST SECTION

Location  A 22-meter section of Enclosure Wall IV located directly North of East Gopura IV collapsed at an unknown time. This length of typical wall section, represents one of the longest at Preah Khan’s perimeter wall to have fallen.

Present Condition, Analysis & Diagnosis  The WMF consultant team decided to analyze this particular section of the wall as part of the development of a prototype for the general repair, consolidation and reconstruction of the outer perimeter wall.

As described in WMF Report V Field Campaign II (pp. 40-41) this section of wall was cleared and surveyed in its ‘as found’ condition. Although the wall had collapsed towards the moat, it had done so in a uniform manner, making it possible to identify the layers of laterite blocks and
Enclosure Wall IV (North of East Gopura) East Elevation Survey.

Enclosure Wall IV East. Section Through Foundation.

Enclosure Wall IV. North of East Gopura IV.
even their coursing. During the first investigation phase, the stone blocks were cleaned and stacked in an orderly way to facilitate reconstruction. Record drawings showing sections and elevations were prepared and the stones were numbered to facilitate reconstruction. Areas of the foundation at the collapsed section of wall were excavated and examined to ascertain the cause of the failure.

The results indicate that the deformation that caused the wall to overturn had taken place in the foundation itself, and was not the result of an often quoted theory that most structural failure at Angkor is due to the effect of a fluctuating water table causing subsidence in the ground itself.

It is possible that, due to proximity to the moat, the presence of moisture had degraded some laterite blocks which, because the ground slopes down from the wall base to the moat, could have caused some settlement and slippage.

In January 1995, an additional excavation was undertaken to examine the condition of a sound section of the wall’s foundation. Observations made during this excavation will be used as a basis for designing a new foundation base for the fallen section. (See page 105.)

*Conservation Process, Structural Repair & Stabilization* The following recommendations are made for the reconstruction of this section of fallen wall as a test for doing more of the same elsewhere along Preah Khan’s perimeter wall.

- excavate and remove the existing laterite blocks along the full stretch of the collapsed section of the wall so that a new concrete slab foundation can be laid. This intervention is restricted to the collapsed section.
- prepare and consolidate the ground to receive the foundation.
- prepare a reinforced concrete slab 25 cm deep by 75 cm wide, or raft foundation, along the total length of the collapsed section of wall using 2 levels of 12 mm-diameter reinforcing steel bars at 15 cm centers lengthwise. (See page 107.)
- stabilize the remaining section of laterite foundation and reconstruct new foundation above the new concrete slab.
- reconstruct the wall above the new foundation, by reusing existing laterite blocks following, wherever possible, the original sequence of construction.
- carefully dismantle the deformed sections of laterite wall as far as the fracture lines and make ready for consolidation. Where possible allow for good bonding or ‘toothing’ between old and new construction. (See page 105)
- form new connections to exposed ends of existing walls, as per drawings, by drilling and inserting 12mm stainless steel pins 70cm long and placing 2 pins per stone per course. The matching replacement laterite blocks should be drilled and prepared accordingly. (See illustration below.)

**Proposed Work Plan for Repair and Reconstruction**

It is projected that 20 stone workers could complete the reconstruction process of this section of walling in approximately three months. Based on the results of this reconstruction program, it will be possible to establish the time required to complete the reconstruction of all damaged sections of Preah Khan's outer Enclosure Wall IV. Using the present estimate of a three-month completion period for a 20-member work force for this section, it would probably require four and a half years to reconstruct all damaged sections of the outer wall.

![Enclosure Wall IV Section Showing Repair Recommendations.](image-url)
STABILIZATION PROGRAM FOR SANDSTONE GARUDAS

The Garuda Inventory

A complete and detailed survey has been prepared of the 68 sandstone garudas located around Enclosure Wall IV and the four large corner garudas. The survey identified the style and condition of the sculptures and prepared a work plan for their repair and conservation. A summary of the methodology and results is contained in Section 3, ‘Campaign Research Accomplishments.’ The full inventory is presented in Separate Appendix VI/A — *Garuda Condition Survey, Enclosure Wall IV at Preah Khan.*

General Structural Assessment

Having classified the condition of the 72 individual garudas, a structural assessment has been made which identifies the reasons and causes for their as-found condition. In nearly all cases, failure of the laterite base on which the garudas sit has caused structural separation, or partial or total collapse. The dead load of the sandstone sculptures tends to create a point load on a relatively slender base. Where moisture has weakened the laterite wall footing the crushing of laterite can ensue which will eventually lead to collapse. Another problem which has been noticed at the outer walls of Preah Khan has been the invasion of the space between the laterite and the sandstone by termite nests, which tends to create a wedging action at critical stone joints. (See also Restoration Priorities — Section 3)

General Recommendations for Stabilization

General recommendations for stabilization and repair of laterite enclosure walls at Preah Khan have been addressed elsewhere in this report.

*General:* In all cases it is recommended that, after each garuda has been cleaned of debris, termites and vegetation, the foundation bases are carefully checked and consolidated by piecing in new laterite or floating in a new reinforced concrete base.
Category 'A' (Severe Deterioration)

- Disengage and clear the area and excavate locate missing sandstone pieces.
- Stones should be fitted together and drawings prepared to assess condition and the feasibility of reconstruction.
- Assess the condition of the platform and either re-form in reinforced concrete as described above or consolidate the existing laterite footing using new laterite blocks.
- Reconstruct the garuda or rebuild as necessary in a vertical position. If the wall is inclining it will be necessary to tie the largest stones back into the wall.

Category 'B' (Moderate Deterioration)

- Clear the immediate area and, in the case of partial collapse, locate all missing stones.
- Check foundations and repair or strengthen as necessary.
- Remove all vegetation, preferably by spraying with herbicide.
- Close all open joints between stones.
- If the stonework has been infested by termites, carefully remove all traces of clay from joints and from back of garuda.
- For serious cases of detachment from the laterite wall, drill and pin using stainless steel dowels and epoxy resin for gluing principal stones to wall, as indicated in diagram.
- Drilling should be into the rear side of the garuda relief from the other side of the enclosure wall.

Category 'C' (Minor Deterioration)

- Clear around the base of the garuda and remove all traces of termite infestation.
- Consolidate foundations as necessary
- Remove all vegetation, preferably by spraying with herbicide.
- Close all open joints between stones.
- Pin back any of the large stones which have separated or are threatening to separate.

Proposed Work Plan for Repair & Reconstruction The Adopt-a-Garuda fund raising campaign will dictate the work plan for the repair and restoration of the garudas, though it is recommended that the garudas listed in the ‘A’ (Severe) category receive priority attention. It is hoped that at least two or three garudas will be conserved each season.
7. ADMINISTRATIVE MATTERS

WMF/Royal Government Relations
Labor Management
Visitor’s Information Center at Preah Khan
Project Promotion
Local Promotional Efforts
International Technical Committee Meetings
7. ADMINISTRATIVE MATTERS

WMF/ROYAL GOVERNMENT RELATIONS

The new administration in charge of the International Campaign to Safeguard Angkor is establishing more comprehensive control of the Angkor site. WMF officially submits its reports to the International Coordinating Committee at its annual meetings.

A WMF representative has attended the ICC meetings held over the past year. A report summarizing the *Radar Imaging Survey of the Angkor Eco-Site: Report of the First Scientific Roundtable*, and other matters, were presented by John Stubbs at the second ICC meeting held on the March 31, 1995 in Phnom Penh. The disks which contain the data pertaining to Angkor and its hinterland was handed over to the the Royal Government of Cambodia at the time.

John Sanday had the honor of being a co-presenter with representatives of the Royal Cambodian Government at two Asia Society conferences this past year.

John Stubbs and John Sanday have had several opportunities to discuss in detail WMF’s program of activities with State Minister H.E. Van Molyvann, who has supported all of the the World Monuments Fund’s efforts to assist the international effort to safeguard Angkor. Through the good offices of H.E. Van Molyvann, WMF has made presentations to other agencies of the Royal Government of Cambodia such as those in charge of tourism and infrastructure at Angkor.

WMF maintains very close communication with the Ministry of Culture and Fine Arts through regular meetings with the Minister, H.E. Nouth Narang, and his staff. Mr. Uong Von, Director of Conservation d’Angkor in Siem Reap, visits the project regularly and has always made himself available for discussion. All the organizations contributing to the Campaign to Safeguard Angkor attend monthly meetings at Conservation d’Angkor, which provides an opportunity to discuss progress and request advice or assistance from the department. A weekly staff meeting is also held at Conservation d’Angkor, and a representative from the Preah Khan Project attends in order to keep the larger Preah Khan project team informed.

The staff at Preah Khan are always prepared to receive visitors from government departments and happy to share information with both government and non-governmental organizations.
Monsieur le Directeur,

Je vous remercie infiniment de votre noble lettre qui vient de me parvenir ce soir et des 2 magnifiques volumes Report V Field Campaign II.

Je regrette beaucoup de ne pouvoir visiter votre admirable PREAH KHAN CONSERVATION PROJECT, car après la cérémonie au Bapuon et au Bayon, demain 21 Février 1995, je devrai retourner à Phnom Penh.

Je rends hommage à vous-même et à tous vos collaborateurs et j'exprime ma profonde gratitude à WORLD MONUMENTS FUND pour votre noble et généreux sauvetage du très important PREAH KHAN.

Veuillez agréer, Monsieur le Directeur, l'assurance de ma haute et cordiale considération.

Siemreap-ville, le 20 Février 1995
Chef de Chantier Instructing Work Force.

Dispensing the Pay Roll at the Site Depot.
**Administrative Staff**

WMF’s assistant site manager, Kussom Sarun, is responsible for administration of all local staff and normal daily activities related to the Preah Khan Conservation Project. Sarun skillfully manages the site in partnership with Ouk Samon, the Chef de Chantier, and is also responsible for the project’s local accounts, sales at the Preah Khan Information Center, and the acquisition of various handicrafts now available for sale at the Information Center. Sarun is also in charge of the administration of the WMF House in Siem Reap, which serves as the quarters for the consultant team and students during the field missions. The housekeeping is in the capable hands of Sun and her assistants, Ros Ari and Morom. They have kept house, cooked and done the laundry for members of each of WMF’s missions over a three year period.

**LABOR MANAGEMENT**

World Monuments Fund has maintained a labor force of 51 workers under the supervision of Chef de Chantier, Mr. Ouk Samon, who has served in this position for two years. Samon has managed the site with great care and responsibility, and is well respected by the workers and the WMF consultant team.

Under Ouk Samon there are two *sous chefs de chantier* who each direct one group of approximately ten stone workers each. These groups have worked with the consultants and have become proficient in the handling of the stonework during the various consolidation and repair procedures.

The blacksmiths are another important and highly productive group at Preah Khan. They have their own forge and are responsible for the manufacture and maintenance of all metal tools used on the site, from the making of masons chisels and grass cutters tools to the special metal clamps used in structural consolidation.

A skilled group of carpenters has been busy with the construction of the new WMF Information Center and its adjacent storage depot. The carpenters, working with two pairs of sawyers, built the present structure using hand-sawn timbers cut from dead trees found in the Preah Khan jungle (as per design’s in *Preah Khan Report V*).
There are two maintenance teams. One is responsible for immediately shoring up all structures in danger of collapse under the supervision of WMF consultants, and checking and maintaining these temporary supports throughout the site on a regular basis. The other team is responsible for the careful and controlled disengagement of the site from the jungle and for maintaining these cleared sections year round.

Following WMF’s policy for maintaining and presenting Preah Khan to visitors, the site is swept regularly of leaves and all garbage is collected.

**Working Hours**

The working hours established at the beginning of last season were maintained throughout Field Campaign III. The winter schedule of eight hours (7:00-11:00 am and 1:00-4:00 pm) begins in October and runs through to the middle of April (Cambodian New Year). The summer schedule of seven hours, (7:00-11:00 am and 1:00-3:00 pm) begins in mid-April and runs through to October. A limited amount of overtime was required.

Attendance over the past year was generally excellent and workers were given days off with pay at the discretion of the assistant manager in the case of illness or religious commitments. The whole work force received two days holiday with pay over the New Year in recognition of its loyalty and hard work.

**Workers Wages**

A polite debate among the various international organizations working at Angkor concerning wages has been resolved. The Conservation d’Angkor in Siem Reap and each of the international projects have standardized their rates. The following rates were current for Preah Khan Field Campaign III:

**Monthly Salaries**

<table>
<thead>
<tr>
<th>Position</th>
<th>Salary</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assistant Manager</td>
<td>$380</td>
<td>Per Month</td>
</tr>
<tr>
<td>Chef de Chantier</td>
<td>$100</td>
<td>Per Month</td>
</tr>
<tr>
<td>Sous Chef de Chantier</td>
<td>$60</td>
<td>Per Month</td>
</tr>
<tr>
<td>Administrative Assistant</td>
<td>$40</td>
<td>Per Month</td>
</tr>
<tr>
<td>Guardian</td>
<td>$28</td>
<td>Per Month</td>
</tr>
</tbody>
</table>

The monthly salary total amounts to equivalent of $926 for 11 people, including house staff.
Daily Wages

Chefs de Groupe 4,500 Riels Per Day
Ouvriers 4,000 Riels Per Day
Flottants 3,500 Riels Per Day

The average pay roll amounts to the equivalent of $2,000 per month for a work force of 50.
The WMF Preah Khan Information Center.

WMF Preah Khan Information Center—Close-up.
VISITOR'S INFORMATION CENTER AT PREAH KHAN

The Preah Khan Information Center opened officially during the WMF sponsors tour in January 1995. At that time exhibition panels on Angkor and the work at Preah Khan, prepared by WMF in New York, were displayed. Handicrafts made by local craftsmen and tee shirts designed by the students are also on display at the Center. Visitors can also study the many reports that WMF has prepared during the course of its work at Angkor. These reports and other items such as tee shirts are given to visitors in recognition of donations they have made towards the Preah Khan Project. The Center not only provides a good on site exhibition space but serves as a useful meeting and resting place following a tour of the site.

Encouraged by positive feedback, WMF plans to augment the permanent exhibition with archival photographs as well as ‘before’ and ‘after’ photographs of work completed at Preah Khan. It has also been proposed to use part of the exhibition space to introduce visitors to the flora of the surrounding jungle.

PROJECT PROMOTION

WMF was given the great opportunity to promote the Preah Khan Conservation Project through two Asia Society seminars this past year. John Sanday presented a paper entitled ‘Project Site Management in Angkor’ at the Asia Society’s seminar The Future for Asia’s Past at Chiang Mai, Thailand. There were 350 delegates at the conference, including four participants from WMF: board members Marilyn Perry and Robert Geniesse, and WMF Director of Programs John Stubbs. Keith Eirinberg, a consultant recommended by WMF, served as rapporteur.

Sanday was also invited to present a paper on Preah Khan to a seminar at the Asia Society Hong Kong which aimed to inform local residents of threats to Asian monuments. The seminar drew media interest, including an interview on the local radio station’s ‘Breakfast Show.’ Sanday has also been asked to contribute articles to several technical and arts journals published in Hong Kong.

WMF recently opened a new affiliate office in London, World Monuments Fund in Britain. On the occasion of its inauguration, attended by HRH Prince Charles, Prince of Wales, John
Sanday was invited to speak on WMF’s work at Preah Khan. Sanday’s presentation was one of the three that represented WMF’s past, present and future projects. It is hoped that the Preah Khan project will benefit from the publicity received during this splendid event as well as the new contacts made in the UK. Plans are in hand for a special tour of Angkor to be arranged for members and friends of WMF in Britain.

Events have been held in New York to promote WMF’s activities at Angkor. A very special occasion was the Cambodian New Years party held on April 19. John Sanday gave a brief illustrated talk in a private suite at The Rainbow Room in Rockefeller Center, and fellow Angkor travelers mingled afterwards to exchange experiences and to plan further visits. Cambodians attending the event included His Excellency Sisowath Sirirath, Cambodian Ambassador to the UN, who was the Guest of Honor. His Excellency addressed the gathering following Sanday’s presentation. The event was a great success and it is encouraging to see how support has grown in such a short time.

Across the year WMF is constantly promoting its various conservation projects and related programs using a variety of means. Presentations range from interviews for the news media and publications to special appeals. One scientific inquiry regarding Angkor which WMF conceived and developed over the past year in collaboration with the Royal Angkor Foundation which turned out to be newsworthy was the procurement of spaceborne radar images of Angkor from NASA’s JPL. The image of Angkor and its possibilities became somewhat of a media spectacle, and was reported through radio and the print media to an estimated cumulative total of over 30 million people.

LOCAL PROMOTIONAL EFFORTS

Preah Khan has become a very popular destination for special groups through word of mouth. Many of the following groups made requests at the site for special guided tours and several members of the groups gave generously to the project fund. The following is a list of some of the special tour groups: The National Trust for Historic Preservation (U.S.); Academic Travel Abroad, Washington DC; Dr. Helen Jessup’s Group, Washington DC; Arrangements Abroad, New York; Nature Himalaya, Oregon; Asian Art Museum of San Francisco; New Orleans Museum of Art; Travel Dynamics, New York; and Travel Corporation of America, California.

Through these groups it has been possible to publicize the Preah Khan Project throughout the U.S. and, with hope, this awareness will help to increase financial support from the private sector. Many organizations have requested to formalize these special tours of Preah Khan during the forthcoming travel season and are prepared to make a contribution to the project.
As a result of these special tours funds in excess of $15,000 have been raised in the last 18 months. The Preah Khan staff has also encouraged the local guides to promote the project and an incentive is given to those guides who help with local fund raising endeavors. One long-term objective is to raise sufficient funds to support the Preah Khan work force locally through the Information Center. There are plans to enhance the stock of handicrafts and souvenirs already available there with books, postcards and good quality custom-made jewelry.

INTERNATIONAL TECHNICAL COMMITTEE MEETINGS

WMF representatives were invited to attend as observers the second and third sessions of the International Coordinating Committee on the Safeguarding and Development of the Historic Site of Angkor, held on October 5, 1994 and March 31, 1995 respectively.

John Sanday attended the October meeting and was asked to present a resume of the work completed by WMF since the previous meeting and to outline the program for the forthcoming season. Sanday also announced that proposals had been submitted jointly by the New York office of WMF and the Royal Angkor Foundation to NASA's Jet Propulsion Laboratory and there was a possibility that the space shuttle Endeavour would record information on Angkor. WMF invited all meeting delegates to visit Preah Khan to discuss the work in progress. The presentation was well received.

John Stubbs attended the second meeting in March and provided an update on the progress at Preah Khan. Stubbs and principal collaborator Janos Jelen, Chairman of the Royal Angkor Foundation, also presented the findings of the workshop held in Princeton, New Jersey at the beginning of February. A meter-square color photo print of the Angkor site and a six-meter long swath print showing most of the Mekong delta were presented at that time to the Royal Cambodian Government with copies of the report entitled *Radar Imaging Survey of the Angkor Eco-Site: The First Scientific Roundtable*. The report was received enthusiastically and it is expected that this new state-of-the-art information resource will greatly aid future research at Angkor and the region.
APPENDICES

A. Drawings Record List
B. Symposium Report by T. Schnadelbach
C. Hazard Tree Plan
D. Work Directives - 1994/95
E. Work Plan & Budget - 1995/96
F. Hall of Dancers Crack Inventory & Plans
G. Excerpts from Preah Khan Student Theses
H. Promotional Posters
I. Site Display Brochures
J. Drawings of Finds
APPENDIX A

DRAWING RECORD LIST
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APPENDIX B

SYMPOSIUM REPORT
by Terry Schnadelbach
Trip Report: ANGKOR ET L'EAU; Colloque International

R. TERRY SCHNADELBACH

An international conference on Angkor Archeological Park was held in Siem Reap, Kingdom of Cambodia on 28 to 30 June 1995 under the joint sponsorship of UNESCO and the Ecole Francais d'Extreme Orient. Prof. R. Terry Schnadelbach, Landscape Architect, Ecologist and Historian, at the invitation of UNESCO and the Council Superior for National Culture, Kingdom of Cambodia, attended the conference with financial support of both UNESCO and The World Monuments Fund.

The Conference was attended by over seventy delegates representing local and national Cambodian officials, UNESCO officials and interested researchers. Researchers was the term used to refer to those who are actively working on some aspect of archeological, historical, hydrological, restoration or planning of the Angkor Archeological Park and / or region. This term also applied to NGO representatives. Researchers from many foreign nations including England, Denmark, Hungary, Italy, Netherlands, Australia, Japan, France and the United State, were in attendance.

Conference Summary

The main theme of the conference was, City of Water Works / Hydraulic City. Many of the specialized researchers were hydrologist. This theme was commented on by the Cambodian Minister of State, Hon. M. Vann Molyvann who, in his opening remarks, posed the fundamental question of whether Angkor should be a "dead" city or if it should be a "living" city (site).

Each day's program began with the morning devoted to tours of the Archeological Park or the Siem Reap region. The first afternoon's program centered around an exhausting endurance test of heat, humidity, lengthy readings of papers prepared on the subject by the foreign researchers. Each presentation was followed by aggressive and lengthy questioning. The highlights of these presentations were:

* Historical Queries and Questions Remaining to Be Discovered at Angkor, by Jacques Dumarcay, EFEÓ
* A Structural Analysis of Angkorian Architecture and the Methods of Failure/Collapse, by Georgio Croci
* A Review of the Hydrological Barays, Moats, Basins and Canals; Their Form and Water Flow Quantities, by Ferenc Garami.
* A Description of Current Agrarian Crop Production in the Inundated and Irrigated Farmlands Bordering the Tonle Sap Lake, by Jean-Pierre Carbonnel
* A presentation and description of the new Tourist sector to be developed south of the Archeology Park, north of the N 6 and east of the Siem Reap River by Pierre Clement , Architect and Urbanist ARTE/BCEOM Team (see North Baray below).
* The Ecology of the Angkor complex and new discoveries from the space borne radar
On the second day, the Conference body was divided into three groups each with a different focus and concurrently different morning field trips. The afternoon was dedicated to discussions. These focus groups were on the following subjects:

- Hydraulic systems and archaeological structures
- Hydraulic systems and agriculture
- Socio-economic constraints on the use of water

Schnadelbach attended the second group, in the morning and the third group in the afternoon in order to obtain the most diverse point of view. The Agricultural group discussed the role of the Western Baray and the conflicting demands of water for agriculture, settlements (Siem Reap and the new hotel sites) and the archeology park. Jacques Pouplar, Engineer on the Tourist Hotel Site, ARTE/BCEOM Team presented the water demand for the new hotel facilities, the cleaning of the Siem Reap River, a limited rehabilitation of archeological site's hydraulic works and a limited quantity of agricultural rejuvenation of fields east of the River. To address these issues, the ARTE/BCEOM Team has recommended the rehabilitation of the Northern Baray. It is believed to have clearly been designed and used for drinking and bathing in the time of the Khmers.

Rehabilitation would reconstitute the environmental setting of the Neak Pean monument and hopefully lead to a full restoration of the monument itself. To rehabilitate the Northern Baray, it would be necessary to cut and remove the existing vegetation, import some clay soils to line the bottom and rebuild the perimeter dykes on three sides (the north side is excavated into the ground due to topography). There was a wide ranging debate on how far to rehabilitate this baray as originally the baray was three feet lower than today and without dykes (except for the south side as the original was excavated out of the existing earth). The central monument, Neak Pean was originally reached by boat and was open to the edges of the baray. At some period, the baray was filled with silt and rather than excavating to the original grade, the Khmers raised the perimeter dyke and built a new linear dyke around the Neak Pean monument cutting it off visually from the baray. The debate centered on whether to rehabilitate based on the existing design or to follow the original Khmer baray design.

The socio-economic group discussed the issue of the living versus the dead city concluding firmly in favor of a living Archaeological Park. That was defined as keeping the existing villages and Buddhist monasteries within the park. New development and village expansion is to be discouraged, but the existing agrarian habitation was believed to add vitality and a degree of protection to the park.

At odd times during the last two days, there were presentations requested by the Minister of State Mr. Vann Molivann when he thought of them or that had been scheduled but missed due to overruns in time. These included:

* **Satellite Radar Imagery at Angkor** by Elizabeth Moore.
* Indigenous populations in the eastern baray, by Fabian... (last name not heard).
* The ecological workings of the Tonle Sap and its estrian areas, by R. Terry Schnadelbach.
The third and final day was devoted to discussion and policy formation with proposals placed for approval and/or adoption. Of those that were committed to:

* Angkor Archeological Park is to remain a "living" site.
* The plan for the Tourist sector was approved.
* The Rehabilitation of the Northern Baray east of Preah Khan was seen as the best site for any increased water storage and that its rehabilitation would be supportive of restoration efforts of the Neak Pean and the Preah Khan.
* The restoration of the internal water works of each monument is to aid in the stability of the groundwater and therefore the stability of the monuments.
* The designation of the Tonle Sap as a World Natural Preserve by UNESCO with adequate funding for research and protection.

Siem Reap, Kingdom of Cambodia
28, 29, 30 June 1995
APPENDIX C

HAZARD TREE PLAN
APPENDIX D

WORK DIRECTIVES - 1994/95
GENERAL
The following is an updated list of activities that have been discussed at Preah Khan with the Chef de Chantier, Ouk Samon and Administrative Assistant Kussom Sarun who will be responsible for undertaking the following work. This programme is to be dovetailed with the programme prepared for Prasat Neak Pean which is attached to this note.

MAINTENANCE - GENERAL
The East and West Processional Way, The North West and East Causeways and all paths on the East/West and the North axial routes should be swept and maintained as required, but a minimum of at least once a week. Clearance from now on should be restricted to those areas that have already been disengaged. No new areas of clearance should be cut back unless specifically instructed.

ENCLOSURE WALL IV
Continue the clearance of the wide path as instructed. Once the outer path has been cleared, commence on the inner path as instructed by Ronnie Yismut. No trees should be cut without my permission. No grass clearance should take place on the walls as they will be treated with herbicides and the leaves should be there for treatment to be successful.

EAST GOPURA IV - SOUTH PORTICO PAVING
Continue preparation of plinth stones and prepare silhouette of mouldings only. Otherwise, the work should be continued according to instructions provided in the May - July Work Programme and for the August - October Work Programme.

CLEARANCE OF EAST PROCESSIONAL WAY
DO NOT CLEAR the vegetation from the East Processional Way. On my return at the end of November we will experiment with a full treatment of Herbicide.
TIMBER PREPARATION
Continue as before.

DEPOT & INTERPRETATION CENTRE
Continue as before. Complete construction including additional bay at North (As already commenced). Plan to complete this work by the end of November. All the doorways to be used by visitors should be raised to minimum of 2 metres in height.

PATHWAY BETWEEN EAST GOPURA IV & EAST GOPURA III
Now that the path and drainage have been completed, continue clearance of the dead wood still lying alongside the path as before.

CLEARANCE OF BASE OF ENCLOSURE WALL III
Continue clearance as before

TEMPORARY EMERGENCY SHORING
Continue as before

CLEARANCE OF DEBRIS ALONG INTERNAL WALL BASES
Continue as before but ensure there is no standing water against wall bases as well where ever possible.

MOAT CLEARANCE
Maintain clearance of moat to a distance of 50 metres on the North side only of East and West Causeways and on both sides of the North Causeway as discussed on site.

CLEARANCE OF CAUSEWAY NORTH & EAST
Remove all earth from Causeways to prevent further vegetation growth. Carefully remove stones from any depressions repack with laterite and gravel and replace stones as before. Wherever possible remove old tree roots.

EAST JETTY TO BARAY
If in need of extra work, carefully remove topsoil and vegetation from the whole of the area that has been checked for mines. Do NOT undertake any digging below 5cm.
NORTH GOPURA IV & EAST GOPURA IV
Continue clearance and reorganisation of sandstone blocks on the inside of Gopuras (Similar to West Gopura IV) and cut back shrubbery to display the wall. If possible rearrange the stones to make up the Frontons and/or vaults.

EASTERN ACCESS ROAD
Following the demining of this route by COFRAS, a programme of work should be introduced to make good the road and prepare a small parking area BEFORE the road crosses the Causeway vista. This work should be planned for the beginning of September to be completed by the beginning of October.

SIGNAGE
I will arrange for plastic signs to be made in Phnom Penh.

THE PREAH KHAN FORGE
To continue work as previously described

JOHN SANDAY
PROJECT DIRECTOR
PREAH KHAN CONSERVATION PROJECT

Cc: - Preah Khan Conservation Project - Site Office (2 Copies)
    - World Monuments Fund, New York
    - Conservation d'Angkor, Siem Reap
    - The Ministry of Culture & Fine Arts, Phnom Penh (2 Copies)
    - Nils Tremmel, VSO, Conservation d'Angkor.
ACTIVITIES OF WORLD MONUMENTS FUND AT ANGKOR
DECEMBER 1994 - MARCH 1995

Summary
The WMF team were in Angkor for a three week period between 2nd - 23rd January 1995. During this period the team reviewed the work so far completed at Preah Khan and then planned its work for the current season. Two specific sites were selected for specific structural consolidation interventions to be undertaken - at the North West Portico of East Gopura IV and part of the structure in the Hall of Dancers. WMF's main focus of research and recording has been focussed on the Hall of Dancers where detailed plans sections and elevations are being prepared by the student group. A record and condition study is being prepared also of the 72 sandstone Garudas which are placed at intervals around the outer Enclosure Wall of Preah Khan.

The WMF team has continued its work clearing the jungle at Neak Pean and the student team has been mapping and recording the site including a cross section drawn from Preah Khan to Neak Pean.

WMF is pleased to announce in this report that great developments are taking place in the interpretation of the data received from NASA's Space Shuttle flights during August and October last year. In February 1995, WMF hosted a workshop at Princetown USA where specialists of different backgrounds worked towards establishing common ground on which to expand a unique form of non destructive archaeology - archaeology from space.

World Monuments Fund Special Tour
As in previous years, the WMF brought out a group of its Board members and sponsors to introduce them to the work that the Foundation is undertaking at Angkor. There were 23 people in the group from five different countries. The group visited all the major sites in Angkor, spent a total of a complete day in Preah Khan which included a special Classical Dance performance in the Hall of Dancers. The group are very supportive of the WMF programme in Angkor and have pledged their support to help continue WMF's activities there.

World Monuments Fund at the Asia Society Seminar, Chiang Mai
Several members of the above group continued on to the Asia Society's seminar "A Future for Asia's Past". John Sanday gave a paper on Site Management at Angkor and highlighted the activities of different groups working at Angkor as well as describing WMF's work at Preah Khan. The Seminar was considered a great success and provided opportunities for people working on similar historic sites projects in Asia to create an interesting forum for discussion. Several participants visited Angkor following the Seminar.

Field Campaign III - Mission I - January 1995
The WMF fielded its first mission of Field Campaign III (1994/95) in January 1995. The team was led as before by Architect John Sanday and consisted of:
Consultant Engineer Dr Predrag Gavrilovic adviser on structural consolidation
Architect Kevin Lee Sarring - Adviser on Archaeological Recording
Forester and Landscape Architect Ronnie Yismut - Adviser for the Environment

Program Director John Stubbs from World Monuments Fund Headquarters New York joined the team for part of the mission.

As in previous missions, the Preah Khan Student Group returned to participate in Mission I. The group consisted of:

Architect Lek Saretfa (Group Leader)
Architect Var Maurin (Deputy Leader)
Architect Ms Cheam Phally
Architect Chhoun Soma
Architect Sam Kimheng
Engineer Neth Ollyna

The Student Group assisted the WMF consultants in survey and research at the two principle sites of the North West Portico, East Gopura IV and in the preparation of a complete set of survey drawings at the Hall of Dancers.

Progress at the Preah Khan Conservation Project

Reversal of Entrance
WMF are grateful to the ILO work force and the Deminage group for opening up the link road to the East Entrance to Preah Khan. It is now possible to enter Preah Khan from the East and to safely view the start of the Northern or Preah Khan Baray. As a result of the opening of this road visitors are able to visit the Site in the intended sequence. The WMF Team have now cleared the East Processional Way and formalised the East axial pathway. The landing jetty from the Baray has been totally cleared and it is hoped in the near future to undertake some more detailed archaeological research of this area.

Establishment of Preah Khan Information Centre
Following a grant from the Pacific Asia Travel Foundation (part of PATA) WMF has established a small Information Centre and Site Depot at the western end of Preah Khan. The structure is a useful model as it is built in the traditional style has footings that do not disturb the ground and has been cunningly protected against termite invasion. The centre houses a small but growing exhibition of work at Preah Khan and it is hoped to collect early photographs and drawings of the site for display. There is also a section dedicated to the Preah Khan's environment.

Nature Trail
WMF are fortunate in having on its team a Cambodian, now living in Oregon USA, who is a trained forester and environmentalist. It has provided the opportunity to develop a programme to study and protect the forest environment unique to Angkor and more especially, Preah Khan. WMF is in the process of developing a nature trail through the Preah Khan jungle providing visitors with a new insight to Angkor and promoting a return visit to the site. A small leaflet has been prepared and is available free at the site.
Commencement of Work on North West Portico - East Gopura IV
Following serious damage to the north-western Portico as a result of a tree falling on it in 1989, this interesting architectural element, which had received some consolidation at the time of EFEO's 1950's interventions at Preah Khan, was selected for emergency consolidation work. The whole structure was leaning 32 cm out of plumb; the large southern lintel had fractured as a result of shear force and the vaults seemed on the point of collapse.

Prior to any interventions, the structure has been studied carefully measured and recorded, stone by stone, in detailed drawings and photographed.

Work, which is still continuing, has entailed the unloading of the principle structure, the realigning to a vertical position both columns, using hydraulic jacks; the splicing of a new piece of stone in place of the shattered bearing end of the south lintel; the consolidation of joints by careful insertion of steel ties and the consolidation of disrupted foundations. The work is planned to be finished at the end of April 1995.

Programme of Research and Recording in Hall of Dancers
The main focus of the WMF team during Field Campaign III is concentrated on the research and recording of findings at the Hall of Dancers. The Student Group have prepared detailed plans at a scale of 50:1 which includes the paving plan and location of the principle fallen stones. The team has also measured and drawn both short and long sections through the whole space. The Consultants and the Student Group are now in the process of reconstructing drawings of the complete original Hall of Dancers.

Commencement of Structural Consolidation in Hall of Dancers
Due to the large spans in the Hall of Dancers, most of the vaulted roof structures have collapsed and have created unstable conditions for most of the remaining tall structures. The WMF team decided that it was a matter of urgency to consolidate these threatened structures and have embarked on a programme to strengthen the structures as found with the minimal amount of intervention. Using technology previously developed, the stone structures are being carefully repositioned into a vertical position, where necessary lintels and beams are being linked with steel straps to provide proper linkage and the vaults are being repositioned. In some cases it has been necessary to dismantle the paving and reestablish level foundations. In such cases the original stones have been laid to the correct levels and stainless steel wedges and a dry mix concrete has been rammed under the stones to ensure stability.

Reconstruction of Collapsed Enclosure Wall IV
The Consulting Engineer and a team of stoneworkers have analysed the reasons for structural failure of the stretch of wall due North of East Gopura IV. Failure has taken place at ground level and is not caused by defective foundations. The wall will be reconstructed of a reinforced foundation, details for which will be decided at the beginning of April.

Herbicide Treatment Walls and Stone Structures
Throughout the year, experiments have been running on treatment of wall tops and stone structures to remove vegetation. On the Northern tower of East Gopura IV treatment of 5cm Dia. trees with the herbicide has killed and shrunken the invading roots making it easy to remove
them without disturbing the stonework. The Herbicide is systemic, available in Thailand and a based on the formula of Monsanto's well tested "Roundup"

Progress at Neak Pean

General Disengagement and Jungle Clearance
In response to the Royal Governments request, WMF have continued with its clearance programme of Neak Pean following the principles developed at Preah Khan. The tanks have been cleared, the jungle has been cut back to properly expose the structures and the paving around the complex has been exposed. There are plans to cut back the jungle to relate the site once more to the Baray in which it is set.

Student Research Programme
The Preah Khan Student Group have selected Neak Pean as another topic for their thesis. With help from the Preah Khan consultants they have undertaken surveys and prepared some very interesting sections of the site linking it not only to the Baray but also to Preah Khan. They plan to include in their studies research on how water was brought to the site and how it was reticulated through the spouts.

Assistance to University of Beaux Arts Department of Architecture
WMF have continued their informal training programme with the group of five students listed above who have been sponsored over the last several years to work and study at Preah Khan. In January Dr Predrag Gavrilovic provided a formal lecture to the students on site engineering and the consolidation of historic monuments.

The NASA Research Program
Following the report made at the last Technical Committee Meeting in December, WMF was granted funds through the Kaplan Foundation to hold a one day workshop in February 1995 to ascertain the material available following WMF's request to NASA to include Angkor on the recent space shuttle programme. A summary of WMF's report will be available at the meeting and copies of the report on view.

Construction of Visitor Toilets at Preah Khan
WMF are very concerned at the unplanned construction of Toilet Facilities at the western end of the axial route of Preah Khan. Letters have been sent to both the Royal Government and to the UNESCO Secretariat notifying them of this apparent contravention to all legislation being planned for the protection of Angkor. If Angkor is to be protected with assistance from international organisations providing direction, how can such a travesty occur? Toilets are needed but they should be sympathetically designed and located. WMF are prepared to assist in rectifying this contravention subject to the Technical Committee's direction.

JOHN SANDAY
Project Director
Preah Khan Conservation Project

March 1995
GENERAL
The following is a list of activities that have been discussed at Preah Khan with the Chef de Chantier, Ouk Samon and the Administrative Assistant Kussom Sarun. Each activity has been thoroughly described on site by WMF's consulting engineer and the work force has been thoroughly briefed.

EAST GOPURA IV - CENTRAL TOWER
The following are a list of the activities to be undertaken in the preparation and repair of the damaged section of the Central Gateway. This list follows the instructions given by Predrag at the site:

<table>
<thead>
<tr>
<th>Step</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1</td>
<td>Dismantle stones as described by Predrag. All stones should be removed in proper order and stored on the scaffold platforms.</td>
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<tr>
<td>Step 2</td>
<td>Expose Defective Lintel and check condition of stone. If the stone is of poor structural quality a new stone piece will be prepared and fixed following new instructions.</td>
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<tr>
<td>Step 3</td>
<td>Close Open Joints at wall base by applying horizontal pressure from Hydraulic car jacks. Work should be started from the bottom upwards as described on site by Predrag.</td>
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</tbody>
</table>

EAST GOPURA IV - CENTRAL TOWER - STONE IDENTIFICATION
The Chet Koy Stoneworkers Group should spend some time identifying stones that may have fallen from the central tower collapse and reconstruct them at ground level. A decision on the extent of structural consolidation appropriate for the central tower will be made based on the number of stones from the tower that can be identified.
HALL OF DANCERS - SOUTH EAST SECTOR

The following are a list of the activities to be undertaken in the preparation and repair of the damaged structural elements in the South East Sector of the Hall of Dancers. This list follows the instructions given to Sarun and Ouk Samon by Predrag at the site:

In all cases it has been recommended that the concrete support lintels are removed and the stone lintels are repaired by gluing and dowelling the fracture at the base of the lintel using three 12mm stainless steel dowels and epoxy resin, following the instructions given on site.

<table>
<thead>
<tr>
<th>Step</th>
<th>Activity</th>
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</thead>
<tbody>
<tr>
<td>Step 1</td>
<td>Following the recording and numbering, unload structure as necessary to remove fractured stone beams lintels etc.</td>
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<tr>
<td>Step 2</td>
<td>Remove defective lintels and repair using previous technology learnt during previous field campaign, by gluing and dowelling with stainless steel and epoxy resins.</td>
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<tr>
<td>Step 3</td>
<td>Repair and relocate as necessary stone columns and their capitals.</td>
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</table>

As the workplan covers several columns beams and lintels the following specific work is planned:

- Consolidate the deformed capitals to the columns by refixing them with small diameter stainless steel armatures and epoxy resin.
- Reform suitable bearings for the lintels and beams they support using Stainless steel dowels and epoxy glue.
- Where the column has spalled below the capital and the column has tilted causing eccentric loading, form a bracket in new stone and bolt it to the column to support the capital stone.
- In cases where the lintels or beams have split horizontally it will be necessary to drill, glue and bolt the fractured sections together prior to repairing the vertical fracture.
• When the structures are unloaded, all pillars that are out of perpendicular should be reset in a vertical position. If necessary their bases should be freed to allow necessary movement.

MAINTENANCE - GENERAL
The East and West Processional Way, The North West and East Causeways and all paths on the East/West and the North axial routes should be swept and maintained as required, but a minimum of at least once a week.

ENCLOSURE WALL IV
Treat the walltop as demonstrated with herbicide after the first week of rains once the shrubs have produced leaves. The treatment works best if there is no rainfall for a day after treatment.

CLEARANCE OF EAST PROCESSIONAL WAY
Allow one month’s growth of vegetation on the Processional Way. Spray with herbicide and leave well alone.

DEPOT & INTERPRETATION CENTRE
Please deliver letter to Mr Uong Vong following our talk with him and arrange for him and a representative from the Department of Forests to inspect the trees we have selected and obtain their clearance to cut these trees. Once clearance has been obtained continue with the preparation of timber for the extension of the WMF Visitor Centre.

ENCLOSURE WALL IV EAST - EXCAVATIONS FOR INSPECTION
Back fill the excavation pits prepared for inspection of foundations of northern section of Enclosure Wall IV East.

PATHWAY BETWEEN EAST GOPURA IV & EAST GOPURA III
Remove the ridge on either side of the pathway and backfill the rainwater gullies on either side so that it looks like the path on the West side.

TEMPORARY EMERGENCY SHORING
Check out all shoring prior to the monsoon. Change defective props and replace those that do not have folding wedges.

Undertake emergency propping as necessary in the following places.
These are to be temporary wooden props. More permanent interventions will be undertaken during Field Campaign III 1995-96. Their location can be confirmed by Kevin Sarring:

- East Gopura IV - South Portico North West Corner
- East Gopura III West Porch Door South Jamb
- East Gopura III - East Portico North End Wall
- Hall of Dancers - South East Sector, General Stabilization (Ongoing)
- Hall of Dancers - South West Corner of Enclosing Wall
- North Gopura III - South Porch West Window
- Shiva Temple Complex - Central Tower North Door
- Shiva Temple Complex - East Passage two West Windows

All these sections require temporary timber propping with folding wedges. Make sure that the timbers are treated against termites and they are checked regularly to ensure the props are tight in position.

The following emergency intervention will require special attention

- Shiva Temple Complex - South Gopura North East Dvarapala

The stones above the Dvarapala should be carefully removed. BEFORE removing the vegetation, the leaves should be sprayed with herbicide and left for two weeks. This will allow the poison to reach the roots. Afterwards the vegetation can be removed from behind the Dvarapala as necessary. Replace the Dvarapala and provide temporary support only so that I can check the work on my return.

CLEARANCE OF DEBRIS ALONG INTERNAL WALL BASES
Continue as before by clearing all dirt and debris from the interiors and ensure there is no standing water against wall bases as well.

MOAT CLEARANCE
Now that the moats are at their driest, remove all tree stumps, stones that are visible and other rubbish that may have accumulated in the moats to a distance of 50 metres along the North side only of East and West Causeways and on both sides of the North Causeway as discussed on site. Wherever possible expose the laterite steps along both sides of the moat especially along the northern section of the moat.
SIGNS ON SITE
Put up new Danger Signs on the scaffolding where work is in progress. On both sides of scaffolding at East Gopura IV. Put a "No Entry" sign just beyond South Gopura I and block.

NEAK PEAN - GENERAL CLEARANCE
Continue and complete the general clearance programme. Allow vegetation to grow for one month along the pathways and then treat with herbicide.

NEAK PEAN - SIGN
Place a sign at the entrance to Neak Pean similar in design to the Preah Khan sign. It should read:
A World Heritage Site (Green on White)
Prasat Neak Pean,
General Maintenance work being undertaken,
in collaboration with Ministry of Culture, Royal Govt of Cambodia,
by WMF New York,
For Further information, contact WMF Information Centre, Preah Khan.

JOHN SANDAY
PROJECT DIRECTOR
PREAH KHAN CONSERVATION PROJECT

Cc: - Preah Khan Conservation Project - Site Office (2 Copies)
- World Monuments Fund, New York
- Conservation d'Angkor, Siem Reap
- The Ministry of Culture & Fine Arts, Phnom Penh (2 Copies)
GENERAL
The following is a list of activities that will be undertaken during the low season summer months. These activities have been discussed at Preah Khan with the Chef de Chantier, Ouk Samon and the Administrative Assistant Kussom Sarun.

EAST GOPURA IV - CENTRAL TOWER
The work has progressed well. The walls on either side have been reset to lintel level. The lintel end has shattered and will require a new piece of stone to be spliced onto it following the former technique. This procedure is to wait until new stone has been brought from the Kulen Quarry and until Engineer Predrag returns in August.

EAST GOPURA IV - CENTRAL TOWER - STONE IDENTIFICATION
The Chet Koy Stoneworkers Group should continue identifying stones that may have fallen from the central tower collapse and reconstruct them at ground level. A decision on the extent of structural consolidation appropriate for the central tower will be made based on the number of stones from the tower that can be identified.

HALL OF DANCERS - SOUTH EAST SECTOR
Work has progressed well on this section of the Hall of Dancers and has been temporarily halted due to the non-arrival of the Sika epoxy resin. All broken and fractured stones have been removed and cleaned and old concrete supports removed. All leaning columns have been returned to vertical and are ready for resetting lintels.

Instructions prepared for April - June Programme are repeated as the workplan covers several columns beams and lintels the following specific work is planned:

- Stone lintels are to be repaired by gluing and dowelling the fracture at the base of the lintel using three 12mm stainless steel dowels and epoxy resin, following the instructions given on site.

- Consolidate the deformed capitals to the columns by re-fixing them with small diameter stainless steel armatures and epoxy resin.

- Reform suitable bearings for the lintels and beams they support using Stainless steel dowels and epoxy glue.

- Where the column has spalled below the capital and the column has tilted causing eccentric loading, form a bracket in new stone and bolt it to the column to support the capital stone.
In cases where the lintels or beams have split horizontally it will be necessary to drill, glue and bolt the fractured sections together prior to repairing the vertical fracture.

MAINTENANCE - GENERAL
The East and West Processional Way, The North West and East Causeways and all paths on the East/West and the North axial routes should continue to be swept and maintained as required, but a minimum of at once a week during the rainy season.

HERBICIDE TREATMENT
Using the new spray and the new mix ratio of 1 litre of Herbicide to 7 litres of water continue spraying as demonstrated in the following sequence set out below. Remember the treatment works best if there is no rainfall for a day after treatment. It does NOT matter if it has rained before application. Please keep records in a special note book of dates of spraying, prevailing weather conditions. Check the treatment weekly to ensure treatment has been successful.

1. East Processional Way
2. Roofs of East Gopura IV
3. North East Pavilion
4. Roofs of East Gopura III
5. Wall tops of Enclosure Wall III commencing NW Corner going East
6. Wall tops of Enclosure Wall IV from West Gopura going North

SCAFFOLDING SUPPORT TO NORTH EAST PAVILION
Replace the scaffolding support to the North East Pavilion following details provided by Engineer Predrag. This work is urgent and must be completed before the rainy season sets in.

CLEARANCE AROUND ENCLOSURE WALL IV
Ensure that the pathway around both sides of Enclosure Wall IV are kept clear throughout the monsoon. We plan to start work on some of the Garudas in the October mission.

DEPOT & INTERPRETATION CENTRE
Following receipt of permission to cut down identified dead trees, from Mr Uong Vong the Department of Forests, these trees can now be cut and prepared. Work should continue with the construction of the temporary visitors shade and preparation for the extension of the WMF Visitor Centre. Designs for the Centre extension will be approved by the Ministry of Culture and Fine Arts before construction can take place.

PATHWAY BETWEEN EAST GOPURA IV & EAST GOPURA III
Following instructions and demonstration on site, continue with work prepare the east pathway so that it looks like the path on the West side.
TEMPORARY EMERGENCY SHORING
Continue to check out all shoring on a regular basis. Change defective props and replace those that do not have folding wedges.

The following emergency intervention requested in the last instruction has not been completed and instructions are repeated:

- Shiva Temple Complex - South Gopura North East Dvarapala

The stones above the Dvarapala should be carefully removed. BEFORE removing the vegetation, the leaves should be sprayed with herbicide and left for two weeks. This will allow the poison to reach the roots. Afterwards the vegetation can be removed from behind the Dvarapala as necessary. Replace the Dvarapala and provide temporary support only so that I can check the work on my return.

CLEARANCE OF DEBRIS ALONG INTERNAL WALL BASES
Continue as before by clearing all dirt and debris from the interiors and ensure there is no standing water against wall bases as well.

MOAT CLEARANCE
Continue work on the clearance of the moats by removing all tree stumps, stones that are visible and other rubbish that may have accumulated in the moats to a distance of 50 metres along the North side only of East and West Causeways and on both sides of the North Causeway as discussed on site. Wherever possible expose the laterite steps along both sides of the moat. Clear the West bank of the western moat and expose the laterite steps as far as the laterite goes or up to the 50 metre point, whichever is less.

SIGNS ON SITE
Put up new Danger Signs on the scaffolding where work is in progress. On both sides of scaffolding at East Gopura IV. Put a "No Entry" sign just beyond South Gopura I and block access.

NEW STONE
Make an order for delivery of new stone from the Kulen stone quarries as soon as possible. Check average sizes of stones required for minimum sizes otherwise acquire a small truck load of the largest stones available. The Indonesian Pimeneakas Project is also needing stone so the order could be combined. As the new stone is to be used for replacing missing structural stones so it must be of best quality, it is recommended that two masons from the project go to the quarry for selection of stone.

REARRANGEMENT OF STONES AT EAST AND WEST GOPURAS
Stones that have fallen at the East and West Gopuras should be re-arranged and grouped, at ground level, to form the original architectural elements.
NEAK PEAN - GENERAL CLEARANCE
Continue and complete the general clearance programme. Allow vegetation to grow for one month along the pathways and then treat with herbicide after treatment has been completed in Preah Khan.

SUPPORT TO STUDENT DIPLOMA INVESTIGATION
Following approval from the Conservation d'Angkor Directorate, Spot excavations to verify original water levels should be undertaken under the direction of a qualified archaeologist at spots selected in consultation with the researchers.

NEAK PEAN - SIGN
Correction to read "Kingdom of Cambodia" in place of what is written.

JOHN SANDAY
PROJECT DIRECTOR
PREAH KHAN CONSERVATION PROJECT

Cc: - Preah Khan Conservation Project - Site Office (2 Copies)
- World Monuments Fund, New York
- Conservation d'Angkor, Siem Reap
- The Ministry of Culture & Fine Arts, Phnom Penh (2 Copies)
GENERAL
The following is a list of activities have been discussed at Preah Khan with the Chef de Chantier, Ouk Samon and the Administrative Assistant Kussom Sarun.

EAST GOPURA IV - CENTRAL TOWER
The lintel end has shattered and will require a new piece of stone to be spliced onto it following the former technique. This procedure has been delayed until October to ensure proper adhesion of epoxy. The stone is very damp at the moment. So far no stone is available at the Kulen Quarry. Further investigations are to be made. Engineer Predrag will return to Preah Khan in October. The scaffolding should be reerected to provide easy access to the Lintel for work to recommence in October.

EPOXY JOINTING FOR STONE REPAIRS
Please ensure that all joints which are jointed with epoxy resins are kept clean. No epoxy should be visible. No joints should be smeared. If joints are open, they can be closed using a mixture of epoxy and stone dust but this should be kept back from the edges. The edge of joints can be protected if necessary with an adhesive tape.

EAST GOPURA IV - CENTRAL TOWER - STONE IDENTIFICATION
The Chet Koy Stoneworkers Group should continue identifying stones that may have fallen from the central tower collapse and reconstruct them at ground level. A decision on the extent of structural consolidation appropriate for the central tower will be made based on the number of stones from the tower that can be identified.

HALL OF DANCERS - SOUTH EAST SECTOR
Work has progressed well on this section of the Hall of Dancers. The process of epoxy gluing has been postponed until October as the stones are too damp. Otherwise all other work set out in previous work plans has now been completed.

MAINTENANCE - GENERAL
The East and West Processional Way, The North West and East Causeways and all paths on the East/West and the North axial routes should continue to be swept and maintained as required, but a minimum of at once a week during the rainy season. Proper drainage along the paths should be maintained. Clear grass on East Causeway and around Jetty and maintain these areas as the others used by visitors.

HERBICIDE TREATMENT
No further treatment should be undertaken to the East Processional Way. Grasses continue to grow back and are best controlled by hand weeding. Using Herbicide is not a suitable treatment in this case. The chemical is best used on small trees.
and shrubs where it has proven very effective.

Further specific spot retreatment should be undertaken to areas of new greenery on shrubs only. Grasses will die out during the dry season.

The following areas should be rechecked.

1. Roofs of East Gopura IV
2. North East Pavilion
3. Roofs of East Gopura III
4. Wall tops of Enclosure Wall III commencing NW Corner going East
4. Wall tops of Enclosure Wall IV from West Gopura going North

CLEARANCE AROUND ENCLOSURE WALL IV
Ensure that the pathway around both sides of Enclosure Wall IV are kept clear throughout the monsoon. We plan to start work on some of the Garudases in the October mission.

TEMPORARY EMERGENCY SHORING
Continue to check out all shoring on a regular basis. Change defective props and replace those that do not have folding wedges.

CLEARANCE OF DEBRIS ALONG INTERNAL WALL BASES
Continue as before by clearing all dirt and debris from the interiors and ensure there is no standing water against wall bases as well.

MOAT CLEARANCE
It is urgent that work on the clearance of the moats by removing all tree stumps, stones that are visible and other rubbish that may have accumulated in the moats is undertaken immediately on both sides of the North Causeway as discussed again on site. Stones with remnants of decoration should be carefully stack in view on the west part of the platform near the Gopura and all other unidentifiable stone should be stacked behind.

SIGNS ON SITE
Put up new Danger Signs on the scaffolding where work is in progress. On both sides of scaffolding at East Gopura IV. Put a "No Entry" sign just beyond South Gopura I and block access.

NEW STONE
continue to find out the possibility for ordering new stone from the Kulen stone quarries as soon as possible. Check average sizes of stones required for minimum sizes otherwise acquire a small truck load of the largest stones available. Talk with the Indonesian Pimeneakas Project as requested previously.

REARRANGEMENT OF STONES AT EAST AND WEST GOPURAS
Stones that have fallen at the East and West Gopuras should be re-arranged and grouped, at ground level, to form the original architectural elements.
DISENGAGEMENT OF PLATFORM SOUTH OF HALL OF DANCERS
Commence the careful removal and disengagement of vegetation only from the platform. No earth should be removed from on the platform or around it until there is an archaeologist at the site. All stones should be left in "as found" position.

DEAD TREE REMOVAL
Work should commence on the removal of dead trees that are threatening the Enclosure Walls and other structures. The trees presently identified are two overhanging Enclosure Wall III north east Sector; one close to the laterite platform north west corner, near the Two Storey Pavilion and the large dead tree overhanging the south side of the Hall of Dancers. The dead tree recently blown down in a storm on the north west sector of Enclosure Wall III should be removed. Do not disturb the collapsed stone blocks.

SOUTH PORTICO - EAST GOPURA III
The pieces of broken lion sculpture should be identified, cleaned and placed on the portico to dry ready for their repair as a demonstration in October.

GARUDA NORTH OF WEST GOPURA IV
Prepare this Garuda for repair by cleaning all joints of clay, termite nest etc ready for consolidation in October.

NEAK PEAN - SUPPORT TO STUDENT DIPLOMA INVESTIGATION
Once the Archaeologists are on site check with Phally and Soma to obtain approval from the Conservation d'Angkor Directorate, Spot excavations to verify original water levels under the direction of the archaeologists at selected spots.

NEAK PEAN - SIGN
Following instructions from H.E. Vann Molyvann the sign should be modifies to conform with the standard signs. The same sign board can be used; just the lettering should be changed.

JOHN SANDAY
PROJECT DIRECTOR
PREAH KHAN CONSERVATION PROJECT

Cc: - Preah Khan Conservation Project - Site Office (2 Copies)  
- World Monuments Fund, New York  
- Conservation d'Angkor, Siem Reap  
- The Ministry of Culture & Fine Arts, Phnom Penh (2 Copies)
APPENDIX E

WORK PLAN & BUDGET - 1995/96
<table>
<thead>
<tr>
<th>PROJECT ACTIVITY</th>
<th>JUN/95</th>
<th>JUL/95</th>
<th>AUG/95</th>
<th>SEP/95</th>
<th>OCT/95</th>
<th>NOV/95</th>
<th>DEC/95</th>
<th>JAN/96</th>
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<th>MAY/96</th>
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<tbody>
<tr>
<td>1.00 Specific Site Projects</td>
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<td>1.02 East Gopura - South Gate</td>
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<td>1.03 Enclosure Wall IV - North Reconstruction</td>
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<td>1.04 Hall of Dancers - S.E. Sector (Ongoing)</td>
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<td>1.08 West Gopura III - West Portico</td>
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<td>1.09 Consolidation of Emergency Propping</td>
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<td>3.02 Site Training - Engineers</td>
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# Preah Khan Conservation Project

## Workplan for Field Campaign IV June 1995 - May 1996

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APPENDIX F

HALL OF DANCERS CRACK INVENTORY & PLANS
### HALL OF DANCERS - PREAH KHAN, ANGKOR

#### SEPARATED STRUCTURES (CRACKS)

**DOCUMENT TREATMENT**

April 1995

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* URGENCY

A = SEVERE
B = MODERATE
C = NOT SEVERE
### HALL OF DANCERS - PREAH KHAN, ANGKOR

#### SEPARATED STRUCTURES (CRACKS)

**DOCUMENT TREATMENT**

April 1995

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- **NOTE:** Refer to Plans for all crack locations

- **URGENCY**
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  - B = MODERATE
  - C = NOT SEVERE

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NOTE: Refer to Plans for all crack locations

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B = MODERATE
C = NOT SEVERE
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* URGENCY
- A = SEVERE
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- C = NOT SEVERE

NOTE: Refer to Plans for all crack locations
APPENDIX G

EXCERPTS FROM PREAH KHAN STUDENT THESES
THE PREAH KHAN STUDENTS THESES
A SUMMARY OF INTENTIONS

The two theses - one completed in August 1995 and the other planned for completion and presentation in December 1995 are the first theses to be presented from the Faculty of Architecture of the University of Fine Arts, Phnom Penh since it was reopened in 1989.

The two student groups have undertaken a common study on the geography and history of Cambodia and a study of the evolution of urbanism and temple architecture. The latter takes into consideration a fairly detailed analysis of the evolution of Angkor, its styles of architecture, site selection and orientation as well as typical style plans and elevations. There are also sections describing the typical building materials. Most of this information has been derived from studies the students have made at Preah Khan and occupies the first three chapters of the thesis.

Following this general introduction the students have selected specific projects in or associated with Preah Khan and the northern group of temple complexes.

John Sanday acted as Director of Studies - Conservation and Presentation for both groups and both groups consulted WMF Consultants about the general topic of conserving and presenting historic sites as well as their specific projects.

WMF is pleased to have been associated with the work of the students and hopes that their theses will create an interest and awareness amongst other students and may encourage similar studies to be undertaken in the future.
ACKNOWLEDGEMENTS

The Preah Khan Conservation has been developed with and is fully supported by the Ministry of Culture and Fine Arts with His Excellency Nouth Narang's backing as it meets his interest to promote a social advancement in an understanding of culture and tradition.

We are grateful to the World Monuments Fund (WMF) which has provided us training as a component of WMF's overall programme for the Preah Khan Conservation Project, under the leadership of John Sanday WMF's Field Director. John Sanday is also the Director of the Conservation and Protection Studies for this thesis.

Our Proposal to undertake this thesis has been fully supported by Mr Phoueng Sophean, the Dean of the Faculty of Architecture, University of Fine Arts, Phnom Penh and our Director of Studies, who has helped us greatly with the structure and format of the thesis and suggestions on the best way of presenting our proposals. Other advisers who have greatly assisted us are Professor Predrag Gavrilovic, of the Center for Seismic Engineering, Skopje, who is consultant engineer to the WMF Project; Mr Pich Keo Director of the National Museum Phnom Penh and archaeologist; and H.E. Cheng Phoun former Minister of Culture and Fine Arts and historian. We wish to thank all these people for their invaluable advice, and the support we have received from the Ministry of Culture and fine Arts, the Faculty of Architecture and the World Monuments Fund.

We would like also to thank personally all the professors of the Faculty of Architecture who have dedicated their time and energy during the last six years to teaching us so fruitfully. Finally we would like to thank our families, our friends and our fellow students and all those who have supported us during our period of studies - we are indebted to their great kindness and patience.

(NOTE: The following pages outline the topics of the chapter headings of the thesis. It is hoped that the thesis will be translated in the coming year and be presented as an Annex to the 1995/96 Preah Khan Field Report)
THESIS ON THE CONSERVATION AND PRESENTATION
OF THE BUDDHIST MONASTIC COMPLEX OF
PREAH KHAN

Prepared by
LEK SARETH
&
VAR MAURIN

(The following pages contain a translation of the Preface, Acknowledgements and Contents of the thesis prepared under the guidance of John Sanday and the World Monuments Fund Team)

Students at the Department of Architecture
University of Fine Arts,
Phnom Penh, Cambodia

August 1995
PREFACE

The heritage of a country includes things of the past and continues up to the present. The international character of Heritage brings the past to the present in order to give people a better understanding of life.

In the past Heritage belonged to a person, to a group, or to a religion. Today that past belongs to the general public, the original artifacts being important evidence of the glorious past civilisations of every nation.

With this in mind United Nations Educational, Scientific and Cultural Organisation (UNESCO) was created following the Second World War with the intention of protecting the cultural heritage of mankind. As a result, the protection of Cultural Heritage became an international concern, but it still remains an important responsibility for each nation to care for its heritage. The Conservation and protection of man's cultural heritage is not only an immediate concern but a responsibility of future generations. It is therefore important to not only understand and develop suitable technology, but also to have full knowledge of the history and geography of the region or country.

Cambodia is one of the oldest nations following some of those such as Tanzania in Asia. In its past Cambodia reach great heights in its civilisation and culture and today these can be seen in some of the magnificent Khmer temple structures throughout the region.

Today the world is becoming increasingly interested in the protection and preservation of temples and other historic structures, because these buildings clearly show the culture and civilisation of every region.

Cambodia has also begun to conserve its temples, but with over 1080 temples in the country, the scale of conservation it is undertaking at present is very small. This is due to a shortage of trained specialists, a lack of funds and a lack of security. Cambodia has a great problem
with artifacts being stolen from the temples. For example, the Angkor Conservation Office in Siem Reap records that during the 1992/93 objects were being stolen from the angkor temples every day. This is a truly regrettable situation.

Corresponding to the directives of the Ministry of Culture and Fine Arts: "Save and protect cultural heritage and preserve tradition by relating to the past", we have selected Prasat Preah Khan in Angkor Cambodia as the subject of our thesis on architectural conservation.

During our study of Preah Khan we hope to show you the causes of deterioration of the temple and to provide recommendations to halt deterioration in the present time as well as the future. In order for this project to be successful we need to compare Preah Khan with other temples and projects in Angkor.
ローマ文字表記

図"アーガミート"の図版

図"アーガミート"の図版

0 1 2 3 4 5 dm.
THESIS ON THE CONSERVATION AND PRESENTATION OF PRASAT NEAK PEAN AND ITS WATER TANKS

Under Preparation by

Ms CHEAM PHALLY
&
CHHUN SOMA

Students at the Department of Architecture
University of Fine Arts,
Phnom Penh, Cambodia

(Chhuñ Soma and Cheam Phally plan to complete their thesis at the end of October for presentation to their Jury in December 1995)
PRASAT NEAK PEAN - THESIS SUMMARY

WMF has been responsible for a program of disengagement and maintenance at Neak Pean for the last year. The site is now partially disentangled from the surrounding jungle and it is possible to begin to appreciate the unique qualities of this unusual temple complex. Following WMF's interest in Neak Pean and the temple's close association with Preah Khan - it is linked by the North or Preah Khan Baray, the second group of students decided to make this temple complex the centre of their conservation study. Although much smaller than Preah Khan, the temple complex has a unique association with the large Baray surrounding it and which originally provided an hydrological system to fill the central tank of Neak Pean plus provide water to the four smaller tanks at the cardinal points of the main tank. There was an ingenious system for raising the water from the surrounding Baray and this is one of the main topics for their thesis.

An extensive set of drawings have been prepared of the whole site. In particular, sections linking the complex to the North Baray and even to Preah Khan have been prepared. Detailed plans and elevations of the site have also been drawn up and comparative studies undertaken.

The thesis covers an analysis of not only the layout, hydrology and method of construction of the site but also a careful study of the present condition of the site and its environment. Recommendations cover proposals for reinstating the hydrological system for Neak Pean, as well as the temple complex's careful repair, conservation and presentation. There are also general recommendations for considerate servicing of the complex with suitable tourist facilities such as parking, souvenir shops, toilet facilities and soft drink stalls which will be designed and located to minimize their impact on the historic environment.

This study will provide an excellent basis for the studies being planned for the rehabilitation of the irrigation system for the North Baray at present under investigation as part of an overall plan of the International Coordinating Committee for Safeguarding Angkor.
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(NOTE: It is hoped that this thesis will be translated in the coming year and be presented as an Annex to the 1995/96 Preah Khan Field Report.)
CHAPELLE EAST OF NEAK POUN

SCALE: 1:25
APPENDIX H

PROMOTIONAL POSTERS
ADOPT A GARUDA!

HELP CONSERVE A GARUDA AND CONTRIBUTE TO PREAH KHAN CONSERVATION PROJECT. CONTRIBUTIONS ARE BEING ACCEPTED FOR THE SEVENTY-TWO 3 M X 4 M SANDSTONE SCULPTURES ASSURING THEIR PROTECTIVE VIGILANCE FOR FUTURE GENERATIONS GUARDING THE MOAT WALLS OF THE TEMPLE CITY OF THE SACRED SWORD IN ANCIENT ANGKOR.

EACH GARUDA RESTORATION COST RANGES FROM $5,000 TO $18,000(USD). SUGGESTED DONATIONS OF $30,000 INCLUDES CONTRIBUTIONS TO TOTAL CAMPAIGN—SAVING OTHER SIGNIFICANT ARCHITECTURE AND SCULPTURE.

WORLD MONUMENTS FUND
174 EAST 80TH STREET
NEW YORK, NEW YORK 10021
TEL (212) 517-9367
FAX (212) 628-3146

CONTACT THE STAFF AT PREAH KHAN VISITOR CENTRE
(SIEM REAP, CAMBODIA)
CLASSICAL DANCE
AT
PREAH KHAN
in the
HALL OF DANCERS

Next Performance
Date: ____________.
Time: ____________.
Entrance Donation: ________

All Proceeds go to the Preah Khan Project & The "Apsara Paradis" Troupe
APPENDIX I

SITE DISPLAY BROCHURES
Continuing in an easterly direction you pass through the impressive East gopura. Walk along the grandson platform and look back at the fine architectural composition of the gopura modified in various towers and doorways which is flanked by similar but smaller doorways. Most of the gopura's external wall surfaces are adorned with finely sculptured reliefs, moldings, pillars of jungle, and false windows, all of which were carved in situ.

A short walk West into the forest will bring you to an unusual single building thought to be the Pavilions of the Sacred Flame. This structure emerged from the forest and has had little work done to it. This single building demonstrates all of the problems of structural collapse.

Returning through the northern (right hand) door of the East gopura you will enter an open space in which an unusual two story pavilion, strangely reminiscent of classical western architecture, is located. Little is known of its former use, but there is speculation that the pavilion originally housed a Sacred Sword from whence Preah Khan gets its name.

Follow the path to the north (left) between the enclosure wall and the northern Smilie Temple complex, taking particular note of the beautifully carved frontons over many temple doorways depicting episodes of the divinities' lives. By exiting the temple complex through the North gopura it is possible to return to the East entrance by following the path through the forest to the left or continue to the North entrance.

The World Monuments Fund Program

An important component of the WMF program is the "on-site" training of the Cambodian students of architecture and archaeology from the University of the Arts in Phnom Penh seven of whom are working under the WMF team's supervision. The project also provides a training ground in construction crafts, where experienced workers are passing their skills onto a new generation. This program has made Preah Khan once again a teaching center where the skills acquired through practical conservation work will renew the vitality of Angkor and contribute to its future preservation.

The World Monuments Fund is a not-for-profit private foundation based in New York, USA, whose aim is to assist in the preservation of man's most significant artistic and architectural heritage through the planning, orchestration, and funding of major conservation projects worldwide. WMF sent its first team to Angkor in 1983 and since then has organized and supported several missions to Angkor which have concentrated on research and preliminary conservation activities at Preah Khan. In November 1992, WMF began the conservation and presentation project at Preah Khan and has commissioned consultants from eight different nations to assist in WMF's efforts to conserve and present Preah Khan as a pedal ruin.

The work plan for the 1992/93 season concentrates on the continued research to enable visitors to have a better understanding of the site, and the inception of various conservation and consolidation activities with a view to developing appropriate conservation technology for this and other sites in the Historic City of Angkor.

Please Help.

World Monuments Fund is seeking donors to help continue the training and conservation project at Preah Khan. If you wish to contribute, please contact one of the team members on-site or send donations by check to:

World Monuments Fund
Preah Khon Project
147 East 60th Street
New York, NY 10022, USA
Tel: (212) 517 9657
Fax: (212) 626 3146

OR
34 Avenue de Ne York
75016 Paris FRANCE
Tel: 33 47 20 71 89
Fax: 33 47 20 71 27

WORLD MONUMENTS FUND

The Preah Khan Project

Welcome to the Preah Khan Conservation Project - a contribution to the Kingdom of Cambodia's International campaign to safeguard the historic monuments of Angkor, managed and funded by the World Monuments Fund.

History of Preah Khan

Preah Khan is an extensive monastic complex covering over 55 hectares which was built by the Khmer king Jayavarman VII as a monastery and teaching center. It is located to the North East of Angkor Thom, a short distance beyond the North Gate of the palace complex. Preah Khan is one of a group of temple complexes situated on a small basin or water tank which includes, among others, the temples of Neak Pean and the monastic complex of Ta Som. Together these structures constitute one of Angkor's major axial complexes.

The central sanctuary of Preah Khan was dedicated in 975, the date carved in the stupa, (stone inscription) a commonly used date for buildings of the time. It was the culmination of Jayavarman VII's reign. From this point you can look along both axes of Preah Khan towards the centre.

Today Preah Khan can best be described as a partial ruin set deep in jungle which, over the years, has taken its toll of the structures. As in Ta Prohm, there are many magnificent trees that have assumed an active function in the destruction and/or support of these structures. The coexistence of these manmade remains in a natural setting has given Preah Khan a special character as compared with the original spirit it must have possessed.

The Entrance to Central Tower

The principal entrance to Preah Khan is from the East, not along the western approach which you are presently using. Both East and West entrances are heralded by imposing processional ways defined by rows of lanterns borne by standing sentries. Each lead onto a wide stone paved causeway lined on either side by divinities (left) and demons (right) wearing the protective headdress and nagas which direct the visitor to a gateway or gopura. From the entrance, an axial route passes through dense jungle where, according to the Preah Khan stele, (stone inscription) a community of 97,940 dwell, and leads up a raised platform in front of a second majestic composite gopura. Beyond this gopura leading into the religious compound a series of smaller gopuras and shrines are linked by covered galleries which converge along the central axis towards the central shrine. Passing through the doorways you may notice inscriptions on the decorated doors which describe divinities that formerly occupied the shrines and the shrines' donors. Notice the remarkable gopura wall of stone which was originally hidden by panelled timber ceilings laid directly upon the decorated consoles. These walls were designed and constructed to be fire tight and, the other masonry at Angkor, use no mortar.

Two enclosur4 walls, one in laterite supporting a circular-like roof vault, outline the central Buddhist complex and a high tower over the principal shrine denotes the intersection of the

axis routes. Within this shrine is a 6th Century stupa which has replaced the famed image of Lokeshvara (Lord of the World) carved in the Benares of King Jayavarman VII's time. From this point you can look along both axes of Preah Khan to where you will notice the ground masons towards the central.

In two enclosed courtyards on the west side of the central tower there are several shrines which were added at the time of the 'Indivatization' of the Monastery in the 13th Century. The determined effort to transform the Buddhist complex to a Hindu one resulted in the removal or defacement of many of the Buddhist images at Preah Khan. You can also see examples where the Buddhicas have been cleverly turned into andesites (holy men) by adding beards and by altering the lotus position normally adopted by the seated Buddhas.

The interior of the Central Tower is poetically inscribed, decorated with glazed tiles, presumably firing points for metal panels which may have been glazed and inscribed. Notice also that many of the interior wall faces close to the central shrine are beautifully inscribed with religious figures and floral decoration which at a later date were hidden by stucco - an occurrence likely when sections of Preah Khan were adapted as individual shrines centuries after Preah Khan's loss of royal patronage in the mid 15th Century.

Central Tower to East Entrance

Having reached the central point of the complex it is best to continue eastward to discover the formal entrance to the religious compound. A short distance along the central axis from the main tower, you will find the meter high stone statue solemnly placed in the portal of one of the axial shrines. The inscriptions on all four sides give a precise record of the monastery's dedication, its 515 divinities represented by statues, of the 16 major annual festivals and its mission as a center of learning.

Beyond the shrine adjacent to the east where the walls are finely inscribed, you pass again through the two enclosures walls and has a grandiose space which was formerly vaulted and is now open to the sky. This is the Hall of Dancers, probably named thus because of the many remarkable and finely carved reliefs depicting the dancing figures adorning the magnificently proportioned main doorways. The vault above provide the largest span in Angkor.
**ROM DOUL**
- 4-petalled flowers common motif in Khmer art
- young, straight shoots used for arrow and spear shafts, frames, beams, and fish traps
- culturally significant tree with many ceremonial uses

**KRASANG**
- short, thorny tree
- small, leathery leaves
- green, lemon-sized sour-tasting fruit used in soaps

**ANSAY**
- may green, palm-like shrub
- ceremonial uses in Cambodian weddings

**SBOVE**
- grasses growing up to 1 m
- woven into thatch for roofs
- roots boiled into vitamin-rich tea

**PAH AO**
- palm-like shrub growing in bunches
- leaves used for making sleeping mattresses and for wrapping rice cakes
- lower branches cut like bamboo shoots for soups

**BANDOL PICH**
- light grey, spiky vine 2-3 cm in diameter
- soak in white rice wine for skin complexion medicine, to cool fevers, or after childbirth
- folk belief that medicines toughen skin and make you impervious to bullets

**PADAO**
- curved, shallow leaves
- sharp thorns on stem shafts
- often planted close together to form low fences
- fibers from stem shredded and woven into cordage, ropes, baskets, and whips

**YEANG**
- GUMTREE DIPTEROCARPUS
  - trunk cut into and burned to collect resin
  - resin used to waterproof lumber for houses and boats, or is mixed with charcoal for firestarting
  - strong wood used in construction
  - families retain rights to collect from individual trees for generations
  - fast growing

**CHOM BOK**
- beige, buttressed trunk, often with orchids
- strong wood with a good finish
- yellow-green, egg-sized sour-tasting fruit
- almond-shaped nut tastes like coconut—shell litters the ground
- bark boiled into vitamin-rich tea
- shelter for cavity nesters
- slow growing

**GRA BO**
- long leaves hang down
- often growing near water
- fruit inside small, woody seed rubbed on insect stings to prevent itching
- medicine for leprosy

**SPONG**
- GIANT FIG TREE FICUS
  - smooth, silver, cylindrical trunk
  - destructive root systems grow over and around stone buildings
  - shelter for cavity-nesting wildlife
  - deciduous leaves fall during dry monsoon
  - fast growing

**SRA LAO**
- white, buttressed trunk
- hard wood valued for furniture making
- deciduous leaves fall during dry monsoon

**SLANG**
- round, inedible orange fruit
- poisonous, button-sized beige seeds with shiny dark interiors used as local malaria vaccine in small doses
APPENDIX J

SELECTED ILLUSTRATIONS OF ARCHITECTURAL DETAILS & ARCHAEOLOGICAL FINDS
FEMALE HAND HOLDING BEADS (WHITE SANDSTONE)

FOUND: HALL OF DANCERS COURT B (N.E. COURT)

DATE: APRIL 1995 COURT B (N.E. COURT)

MEASUREMENTS: 160 X 80 X 50

PLACED: DEPOT

No.
MIDDLE HOLE ON ONE SIDE:
2cm x 2cm x 2cm (BIGGER)

DISTANCE FROM CENTER TO CENTER:
16 cm

13.5 cm

CENTER HOLE: 5 cm x 5 cm x 4.5

(length x width x depth)
Head of Apsara


Courtyard A

Measurements: 25 x 126 x 106 cm (Height x Width x Depth)

Placed in Conservation

N°: 38/92