UMA MAHESWAR TEMPLE
KWALKHU TOL, PATAN

HISTORIC STRUCTURES REPORT
MARCH, 1992

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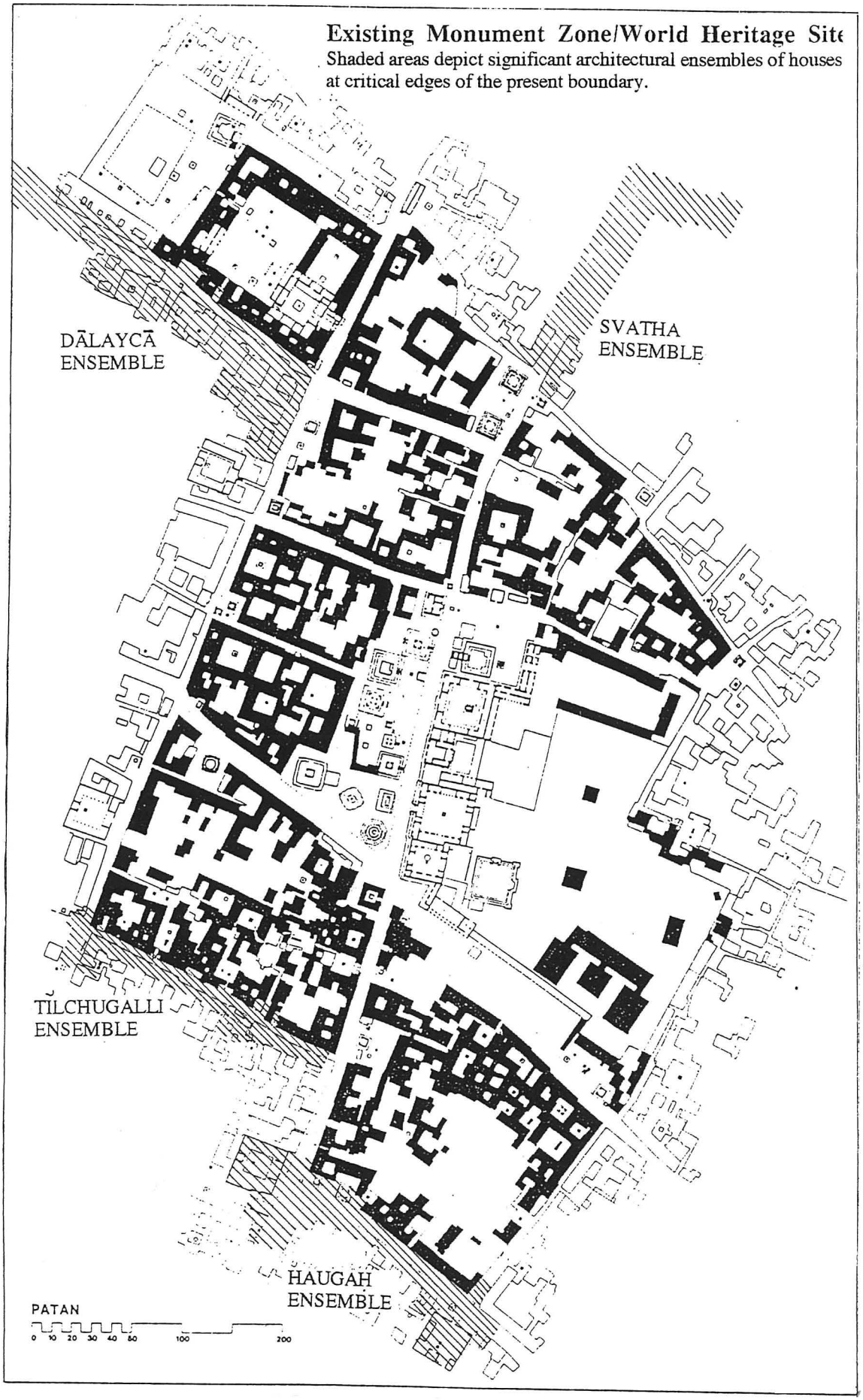

PATAN DARBAR WORLD HERITAGE SITE WITH UMA MAHESWAR TEMPLE SHOWN IN RED.

1.0 Introduction

The temple dedicated to Uma Maheswar, a two-tiered Newar pagoda temple in Patan, was proposed as a pilot restoration project to the British Ambassador to Nepal for possible funding by the British Ambassador's Small Projects' Scheme for the following reasons:

(1) The temple, the focus of the historically intact square at Kwalkhu Tol, is an important urban element in the Patan Darbar Square Monument Zone, a UNESCO World Heritage Site.

(2) In 1989 the Working Group for the UNESCO Campaign to Safeguard the Cultural Heritage of the Kathmandu Valley identified Patan Darbar as first priority for preservation and restoration efforts among the Valley's seven World Heritage Sites. The restoration of Uma Maheswar temple will enhance and be complemented by nearby restoration projects currently in progress including Biswanath Temple, Keshav Narayan Chowk, and Ibaha Bahi implemented in cooperation with UNESCO, the Austrian Government, and the Japanese Nippon Institute of Technology, respectively.

These projects in combination with a forthcoming German-aided Patan Conservation Masterplan and the Canadian funded restoration of Radha Krishna temple (implemented by KVPT) will focus local and international attention on the urgency of preservation efforts in Patan.

(3) As a temple which is still the center of active daily worship, its restoration also contributes to the social and religious life of the urban quarter. There is local support for the project: the responsible *guthi* has pledged to contribute approximately 20% of the construction/restoration costs. Such local/international collaborative efforts provide a new model for Nepal's preservation movement.

(4) The repair of this temple in its early stages of deterioration provides an excellent model for timely and cost-efficient preservation work in the Kathmandu Valley. One side of the upper roof collapsed during the monsoon of 1991, while minor roof damage is apparent in many locations on both the upper and lower roofs. No further damage related to the poor condition of the roof is apparent, although the cycle of deterioration in Nepal's monsoon climate is so rapid, that if repairs are not undertaken before the next monsoon, significant damage could result.

This report is made after a detailed examination of the building December 1991--March 1992 during which time bamboo scaffolding was erected and the damaged tile, mud, and planking cover of the upper and lower roofs was removed to allow inspection of the timber roof and masonry core structures. Inspections were carried out by Constance Stromberg, objects conservator; Manohar Rajbhandari and Prayag Raj Joshi, seismic engineers; Nutan Sharma, epigraphist and iconographer; Surya Sangache, architect, B. S. Thapa, Deputy Chief of the Patan Conservation Lab; Niels Gutschow, architect; and Erich Theophile, KVPT project officer. Photographic documentation and measured drawings were prepared by architects Deepak Pant and Rohit Ranjitkar under the supervision of Erich Theophile. Drawings were prepared in feet and inches according to the working convention of local craftsmen.

2.0 Brief history

Local tradition assigns a late-sixteenth century date to this small temple just blocks from Patan's Royal Square. The sturdy proportions of the building, which give the appearance of the temple's sitting quite solidly on the for the most part historically square at Kwalkhu, are in keeping with the seventeenth century date. Later Malla buildings, such as the nearby 17th century Radha Krishna Temple at Svatha Tol, are contrastingly more vertical and attenuated in appearance, emphasized by multi-level plinths. The 1975 publication, Kathmandu Valley--The Preservation of Physical Environment and Cultural Heritage attributes a sixteenth century provenance, although relevant documents are not mentioned[1].

Inspection of the building fabric, however, does not confirm 300 year old age of the monument. At our request, the local *guthi* responsible for the temple was able to locate the original donation letter of the temple (*dhaana patra*) which fixes the construction date in 1802. In this year, according to a translation of the document by local historian Nutan Sharma, the icon of Uma Maheswar was established and a "two story building of brick" erected, donated by the Kayestha clan. The curious mention of older relevant documents, "which should be added [to the present *dhaana patra*] if they be found, suggests that the structure might have been a rebuilding of an older temple or perhaps the elaboration in a *building* of a former *open shrine.*

Such evolutions of religious sites continues to this day. If the temple is a reconstruction of an older structure, it would account for the proportions of the building.

Most of the Kayestha clan has since left Patan, but the temple remains under the control of the closely-related Amatya clan who live in the residential enclave directly opposite and west of the temple. Many Amatyas may indeed be Kayesthas who have changed their name. This residential enclave, a series of seven connecting courtyards, has also assimilated the Rajbhandari clan, who came to Patan in the middle of the 19th century as key advisors to Prime Minister Jang Bahadur.

At this shrine to Siva (Maheswar) and his consort Uma, blood sacrifices are not offered except on the occasion of the anniversary *puja* of the temple in late June. Every five years in March the temple and square are enlivened by the exhibition of Buddhist *Dipankara* images, en route to the nearby and most important Buddhist quadrangle of Kvabaha.

Uma Maheswar is the name of the representation of the great Hindu god Siva (Maheswar) with his wife Parvati (Uma, Durga) with children, Ganesh and Kumar. Historically this combination has enjoyed great popularity in the Kathmandu Valley. perhaps attributable in part to the economy of the constellation--one is able to worship all of the important gods in one go. There are numerous shrines of all periods to Uma Maheswar in the blocks surrounding Patan Darbar Square, the most ancient of which is a Licchavi image at the eastern end of town in Tyagah, whose iconographical composition is identical to that at Kwalkhu Tol. This representation of a loving pair or couple known as *mithuna* is, according to Pratpaditya Pal, one of the "most ancient and abiding images in Indian art".[2]

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[1] Kathmandu Valley: A Protective Inventory, p.

[2] Pal, Pratapaditya, "The Divine Couple in Himalayan Art", Arts of Asia, Jan-Feb 1992

The stone icon of the temple depicts a domestic scene with Uma on the lap of Maheswar. Vishnu is also at the great God's side as well as attendants and the prosperity-bringing and ever popular child gods of Ganesh and Kumar. Roof strut and door frame carvings depict the terrific manifestations of Uma and Maheswar as Bhairav and the Eight Mothergoddesses (*Asta Matrika*) respectively. In the torana above the temples entrance, Siva is found in his dancing form.

The undated image of this temple is in the finest dark black stone typical of the Malla and earlier period, although stylistically the piece does not appear to be earlier than the temple. A complex and rich composition, what it lacks in refinement, it makes up for in robustness.

THE ICON OF UMA MAHESWAR. SALT STAINS RESULT FROM THE 1979 INTRODUCTION OF CEMENT PLASTER ON THE STONE PEDESTAL AND ANTI-THEFT MASONRY FILL BEHIND THE SCULPTURE.

3.0 Construction history

The 1802 dating of the structure is consistent with the extant historical fabric with a few notable exceptions. These exceptions raise more questions than they provide answers. Consistent with the 1802 dating, for example, are all but one of the timber-carved elements including struts, windows, cornices, *torana*, etc. which are clearly nineteenth century--although it would be difficult to assign them an early or late date in that century given conservative artistic conventions. The laying of the masonry wall with visible 1/4" joints (instead of the traditional flush joints) seems unusual for 1802 unless it was hastily done or related to a reconstruction after one of the several earthquakes which hit Nepal in the early 19th century in the years 1810, 1823, and 1833[3].

The presence of one upper roof strut (west elevation, upper roof, left) which by its size and layout appears to be original to the building, but which stylistically appears to pre-date all other carvings on the temple is problematic. Is this one element a survivor of the lost pre-1802 construction? Is it indeed from another 17th century temple of identical size? This strut is extremely fine in its detail, with its slender energetic main fugure stylistically similar to the struts of the nearby Radha Krishna Temple, dated 1668. The wind and rain-worn surfaces of this strut also resemble the Radha Krishna's 17th century examples; other upper roof struts on the Uma Maheswar are less worn.

There are no other indications of a later re-building. From local elders' reports we know that the temple did not suffer any major damage in the great earthquake which ravaged the Kathmandu Valley in 1934. Present studies suggest that the tilt of the ground floor are the result of seismic forces.

All of the timber carved elements were painted for the coronation of King Mahendra in 1956, the struts and torana with brightly colored enamel paint, the cornices and windows with red mud wash. Careful examination by the Patan Conservation Lab confirmed locals' reports that the struts were unpainted before this date.

Much of the brick walls were also redwashed at that time and in subsequent maintenance efforts. The oversized terracotta pinnacle (Newari-*gajura*) is difficult to date (1934 earthquake or older?): its crude proportions and size suggest that it may come from another building.

More recent repairs include the replacement of 14 lower roof rafters done in the 1970's by the temple *guthi*. These repairs were accomplished with the roof *in situ*. The new members are recognizable by their slightly smaller section (4"x3"), machine sawn marks, and consistent use of sal. The older rafters are consistently pine, adze-hewn and average 5"x 4" in section.

At the same time as the rafter repairs, the entire plinth was sloppily pointed with cement mortar. Patches employed common bricks (Newari-ma apa) and cement-concrete plaster.

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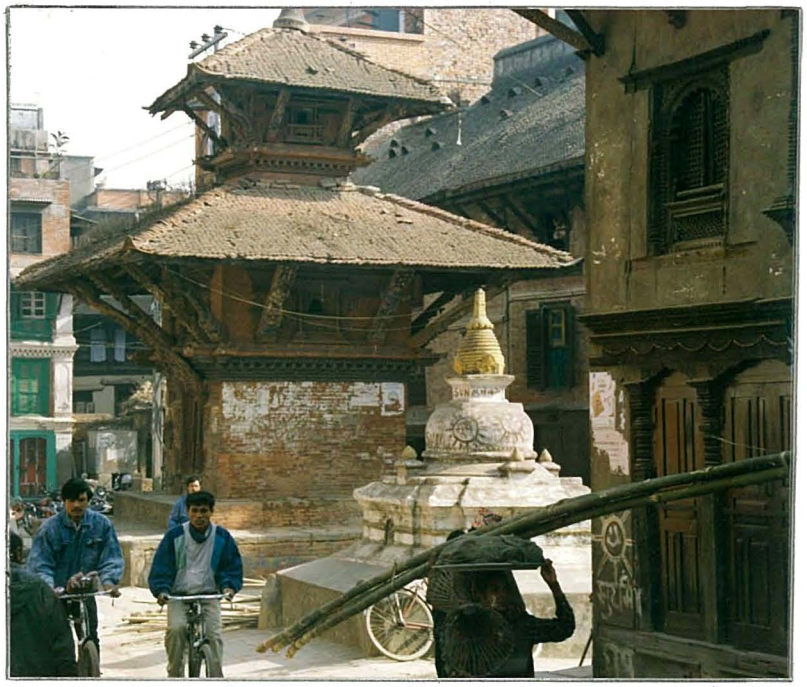
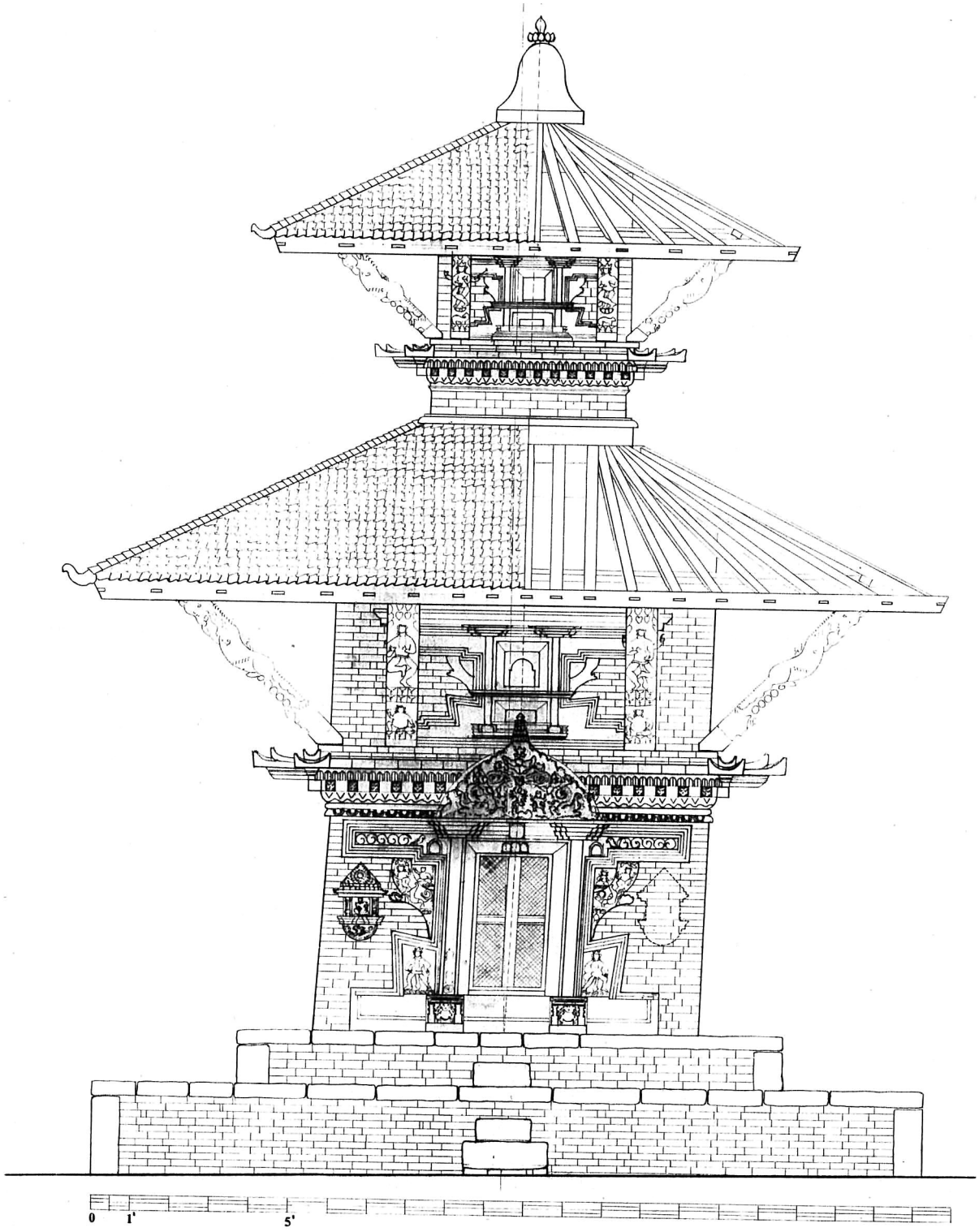
[3]Wright, pp 265, 267, 269. The greatest of which appears to be that of 1833 whose account includes the number of houses and temples damaged or destroyed in the three cities of the Valley including 17 temples in Patan (p 269).



UMA MAHESWAR, JANUARY 1992. ABOVE: VIEW FROM SOUTH. BELOW LEFT: UNDERSIDE OF LOWER ROOF AT SW CORNER. BELOW RIGHT: BASE STORY ENTRANCE, WEST ELEVATION, SEEN FROM THE NEIGHBORING HOUSE.



UMA MAHESWAR TEMPLE

KWALKHU TOL, PATAN
UNESCO WORLD HERITAGE SITE MONUMENT ZONE

PRINCIPAL EAST ELEVATION: EXISTING CONDITIONS
KATHMANDU VALLEY PRESERVATION TRUST, MARCH 1992

4.0 Architectural description

General description

The ground plan of the temple consists of a perfectly symmetrical square brick masonry cella (9'10"x 9'10") punctuated by one timber-framed door opening on the eastern elevation. The cella, the sanctuary of the temple housing its religious icons, sits atop a two-tiered brick and stone-faced plinth. The principal religious icon rests on a large stone pedestal within the sanctuary facing the eastern door.

Above the ground floor, which is demarcated by a continuous composite timber and brick cornice, is found a superstory below the lower of two roofs. This superstory is articulated with a single window opening centered on each side. Ten massive roof struts support the deeply overhanging roof, typical of the Nepalese pagoda temple. An upper floor is found within the superstory, accessible by an opening in the timber joists above the sanctuary. There are no interior levels above this.

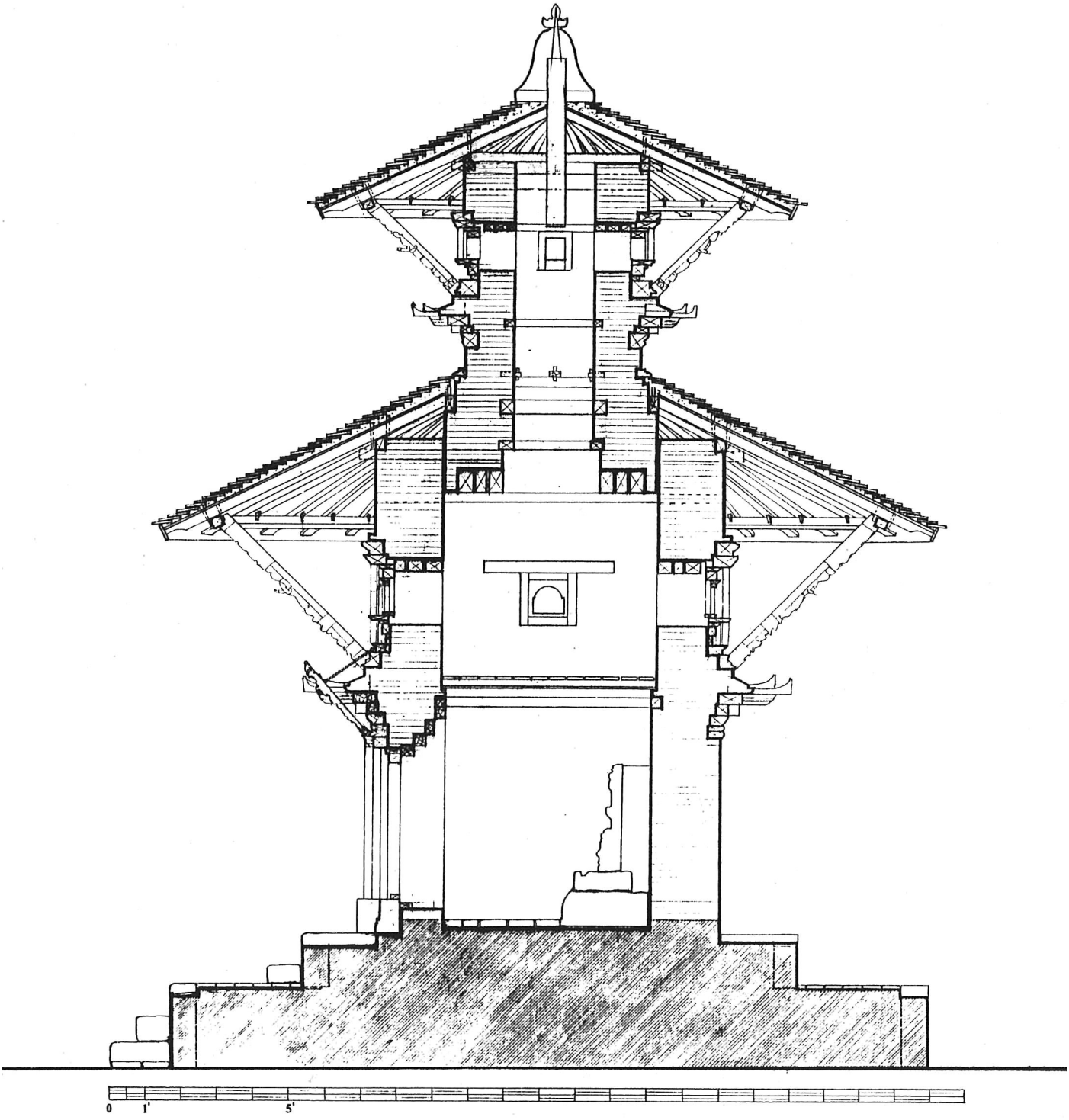
The cella forms a masonry structural core of walls 24" thick which is contained by the lower roof rafters. The upper temple level then continues upward, resting on timber beams within the base cella. The masonry walls of this smaller upper level form 5'2-1/2" square, outside dimensions, whose outer surfaces abut the inside of the lower walls.

The visually dominant timber framed roof consists of four-sided pent roofs at two levels with considerable overhangs (6'0" and 4'4") supported by purlins, which are in turn supported by inclined timber struts. The timber struts rest on continuous timber and carved brick cornices which protrude from the wall structure. The entire roof structure is surmounted by a pinnacle (Nepali:*gajura*), in this case an oversized terracotta piece of late date, perhaps placed after the 1934 earthquake. The massive lower roof (outer dimensions at eavesboard 21'9"x 21'11") overhangs, but does not extend beyond the bottom level of the plinth.

At base level, the single eastern door is surmounted by a carved timber tympanum (Newari-*torana*) and flanked by two diminuative timber carved blind niches. Other elevations at this level are blank. At superstory and upper levels, the configuration of timber framed openings is identical on four sides, with axially symmetrical windows one per side. Openings diminish in size as one goes up the temple. The roof struts read as flanking elements around the focal doors and windows.

The brick wall surfaces are punctuated by the continuous cornices of composite timber and brick construction which support the roof struts, creating strong horizontal registers. The timber door and window frames and inset panels, cornices, niches, and roof struts provide the field for intricate carvings of iconographic and decorative forms.

The height and breadth of the two plinth levels increase as they descend from the sanctuary to create a stepping effect: this echoes that of the graduated roofs above, and raises the temple structure 3'6" above the street level. The plinth, faced in brick veneer and paved with brick tile and stone, is most likely a solid fill construction. The depth and configuration of foundations within the plinth are not known.



UMA MAHESWAR TEMPLE

KWALKHU TOL, PATAN
UNESCO WORLD HERITAGE SITE MONUMENT ZONE

SECTION WEST-EAST : EXISTING CONDITIONS

KATHMANDU VALLEY PRESERVATION TRUST, MARCH 1992

4.1 Traditional construction techniques

The traditional construction of Uma Maheswar employs bearing brick walls laid in yellow clay mortar (Newari-*mhasuca*) together with a secondary timber frame construction in which wall plates, beams, tie members, and rafters are connected by timber pegs and lapped joinery.

The brick wall construction consists of three layers with very few cross bonds: an outer facade brick (Newari-*daciapa*), one course thick; an inner bearing wall of common fired brick (Newari-*ma apa*) two layers thick; and middle fill of brick fragments (Newari-*dutha apa*). This facade veneer brick (*daci apa*) tapers in section away from the facade to allow hairline joints on the face with additional mortar behind, although the walls of the temple consistently reveal 1/4" to 3/8" wide mortar lines.

The 19th century *daciapa* is an extremely well-fired and dense brick with a finished smooth surface on only one side, excepting corner pieces, which are finished on two sides. The finishing is achieved through the application of a red clay slurry (Newari-*laca*) applied after sundrying and before firing. Laid tightly, the lustrous brown crimson *daci apa* provides a fine and smooth background for the sculptural effects of the woodcarvings.

The foundation structure of Uma Maheswar has not been excavated. One can imagine that it is comparable to other buildings of the period constructed in stone laid again in yellow clay. The plinth is probably built up in fill defined by the temple foundation walls and outer brick walls faced with *daci apa* and stone aprons.

The timber structure of Uma Maheswar conforms to the traditional formula of the Newar pagoda temples. Closely spaced rafters (varying center-to-center dimensions 9" to 16") laid on the flat and are tied to wall plates and purlins with timber pegs to form the "hanging eaves" (Newari-*kvachupakha*) of the pagoda's lower roofs.

Sal timber (*shorea robusta*) a local species related to Malaysian teaks, is traditionally employed for most structural and virtually all decorative timbers. Pine was used in many 19th and early 20th century reconstructions, but may also have been employed in the Malla period. The older rafters of the Uma Maheswar are consistently pine. Inner structural timbers are largely pine with some sal.

The integrity of the timber roof structure of the temple, like many examples in Nepal, has suffered in the course of repairs over the years. We do not know how precise the joinery of the original construction was, but later work on the Uma Maheswar has been characterized by ill-fitting mortise and tenon joints, over-cut lap joints, and improper placement of timber pegs.

The design and joinery of the elaborate facade openings is, in contrast to extant structural joinery, sophisticated and well executed. Stepping timber lintels in the wall thickness expand door and window openings toward the interior, while four interlocking layers of timber frames, both structural and decorative, define the door and window openings in elevation.[5]

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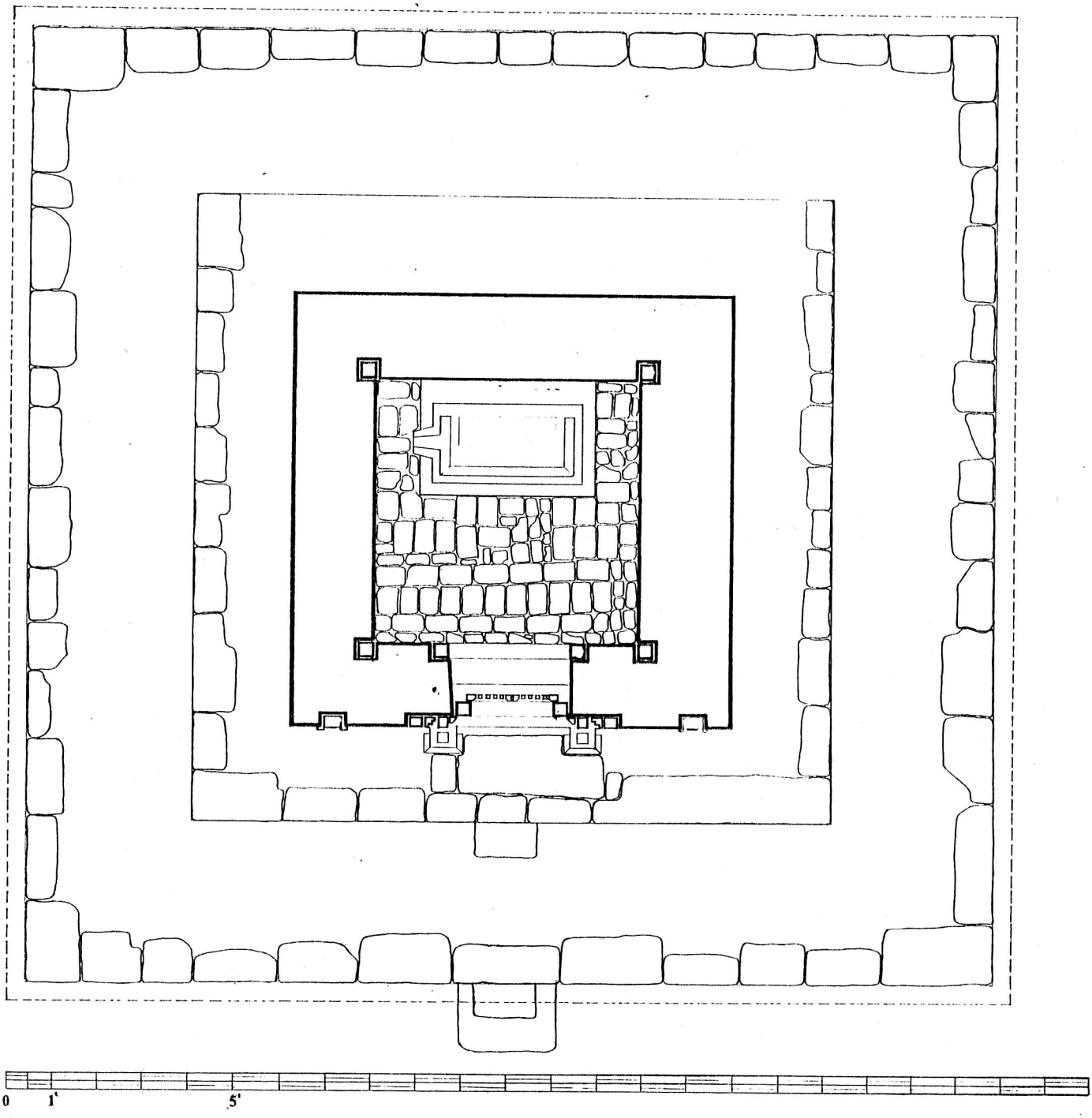
[5]Discussed at length pp 10-11, 17-18; Gutschow (1985).



UMA MAHESWAR TEMPLE

KWALKHU TOL, PATAN
UNESCO WORLD HERITAGE SITE MONUMENT ZONE

GROUND PLAN: EXISTING CONDITIONS
KATHMANDU VALLEY PRESERVATION TRUST, MARCH 1992

The central window of the upper base story, for example, consists of (1) an inner largely concealed structural frame with greatly extending sill (Newari-*kvakhalu*) and lintel (Newari-*mutagah*); (2) a secondary trabeate frame set in front of the first, (3) a forward standing trabeate frame supporting a tympanum (Newari-*torana*) above (now missing); and (4) stylized curving and stepping non-structural frames which wrap the extend the surface of the primary frame, flush with the wall.

4.2 Iconography-general description

One of the richest and most characteristic expressions of Newar art is found in the conception and execution of woodcarvings which adorn the pagoda temple[6]. On those temples of royal donation, hundreds of images--many of them unique and not repeated in other comparable locations on the building--contribute to a complex perhaps inscrutable iconographical program. On the Uma Maheswar Temple, one finds a reduced program of such carvings typical of neighborhood temples built by local donors.

This iconographic program is fundamental to the conception and religiosity of the Hindu temple: the constellation of religious symbols and deities reconstructs a cosmological diagram, a *mandala*, and is integral to the architectural structure, itself holy in Hindu thought.

Among the Newar pagoda temples, one finds some variation in the iconographic programs, even of temples dedicated to the same god or goddess. These variations may be understood as reflections of local sacred geography, mythology concerning the particular deity to be housed, the artistic inventiveness of individual carvers, wishes of the donor, or certain programmatic or stylistic conventions, which can be observed by city or period in the Kathmandu Valley. [7]

The temple is fortunate to have preserved all of its 19th century carvings (and earlier strut?) except for one niche at the entrance. The principal figurative carvings of the Uma Maheswar's's architecture include:

(1) Roof struts on two levels.
(2) Entrance ensemble (door, flanking niches, and torana)

In addition there are more architectural and formulaic carvings described below.

Roof struts

Excepting the single full-height horse designs of corner struts (Newari-*kunsal*), repeated at both levels, other struts are articulated in two registers at the upper level and three in the lower. A principal figure dominates the largest middle portion of the strut atop a symbolic mount at both levels.

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[6]Very few comprehensive iconographic or stylistic studies have been made on the woodcarved art of Nepal (Rau 1985). Work by Gail on nearby Vaisnavit and Saivite temples in Patan focuses only on ground floor elements (Gail 1984). Mary Slusser's work on Panauti's Indresvara Mahadeva deals primarily with roof struts (Slusser 1979). Gutschow's "dictionary" describes the complex construction and symbolic elements of windows, doors, columns, pillars, cornices (Gutschow, 1987). Koelver's work puts forth a holistic analysis of iconographic elements related to architectural form, etc., nut for a Buddhist monument, the stupa at Svayambunath (Koelver, 1992).

[7] Niels Gutchow's documentation and analysis of the 1500 year evolution of the Buddhist *caityas* of the Kathmandu Valley provides the most comprehensive illustration of these points. Unpublished manuscript, 1992.

ICONOGRAPHIC PROGRAM

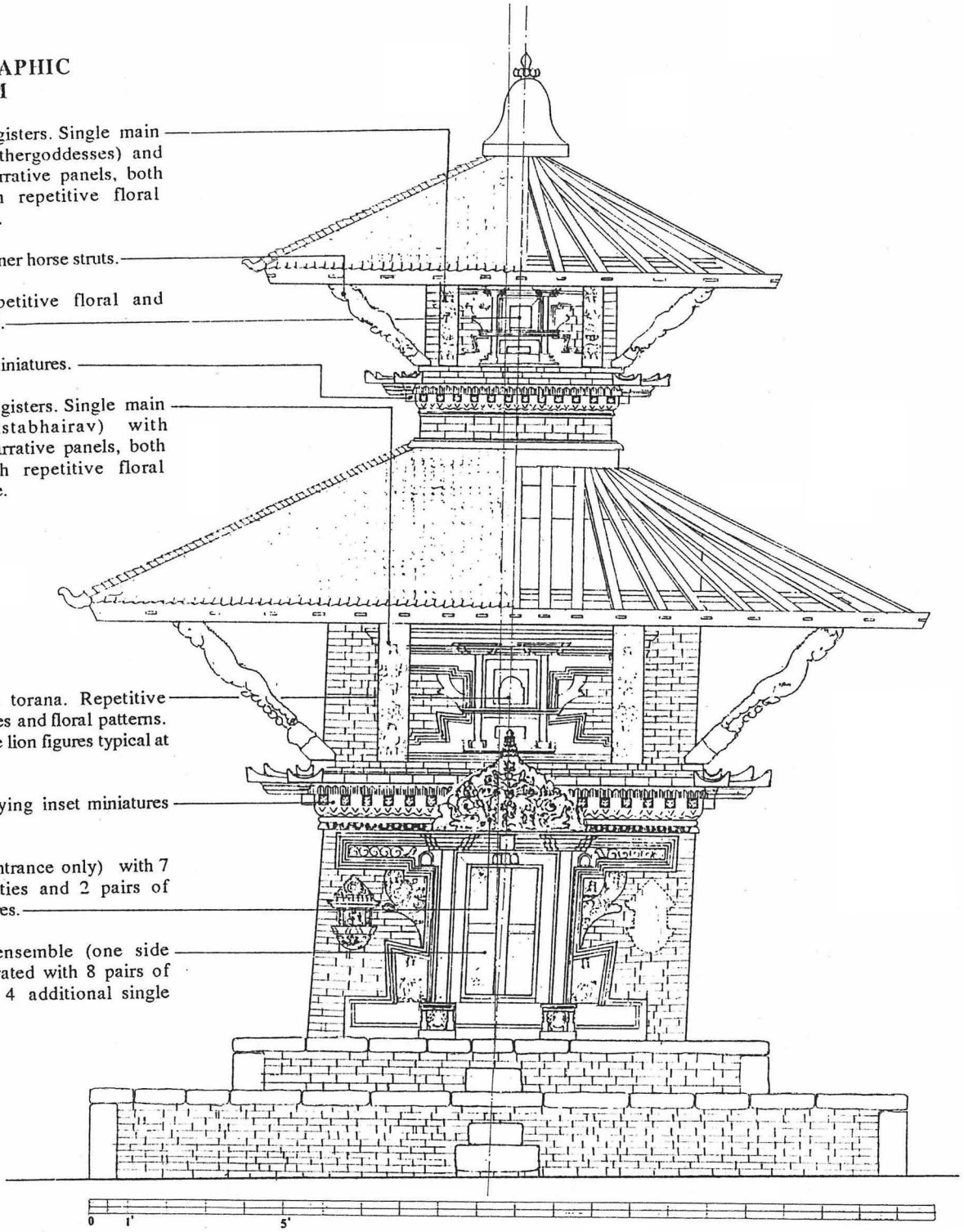
8 struts: 3 registers. Single main figures (Mothergoddesses) and subsidiary narrative panels, both varying, with repetitive floral patterns above.

4 identical corner horse struts.

Window: repetitive floral and animal figures.

Cornice: no miniatures.

8 struts. 3 registers. Single main figures (Astabhairav) with sudsidiary narrative panels, both varying, with repetitive floral patterns above.



Window: no torana. Repetitive animal figures and floral patterns. Repeated base lion figures typical at all openings.

Cornice: varying inset miniatures on all sides.

Torana (at entrance only) with 7 different deities and 2 pairs of guardian figures.

Door/niche ensemble (one side only): elaborated with 8 pairs of deities and 4 additional single deities.

UMA MAHESWAR TEMPLE

KWALKHU TOL, PATAN
UNESCO WORLD HERITAGE SITE MONUMENT ZONE

PRINCIPAL EAST ELEVATION: EXISTING CONDITIONS

KATHMANDU VALLEY PRESERVATION TRUST, MARCH 1992

Lower struts:
The principal figures render the eight Bhairav (Newari-*Astabhairav*) upon symbolic mounts. Lower registers depict varying individual gods. The Bhairav figures are surmounted by an upper panel of foliage, a 4x4 grid of leaf elements. Incised lines which suggest rocks are cut into the plain base areas of the struts. There are no inscriptions.

Corner horses. On this and the upper level, virtually identical struts at corner locations are elaborated as massive flying horse figures (Newari-*kunsal*). These animal figures are typical of all pagoda temples and are found with minor variations. The erect genitalia of these struts suggest Tantric themes. Historically appended arms and symbolic weapons have been lost.

Upper struts
These eight struts depict as the principal figures each of the eight Mothergoddesses or *Asta Matrika.* As on the lower struts, the principal figures stand atop symbolic mounts. There is no susidiary scene below. Above foliage patterns of 3x3, 4x4, and 4x3 grids of leaves are found.

Entrance ensemble:
(Extended door frame, flanking niches, and *torana*)
Figurative carvings are elaborated in the following locations :

(a) Extended door frames just above sill level (Newari-*bhailahkva*)
house Bhairav figures, identical yet in mirror image.

(b) Curvilinear panels (suggesting inset brackets, Newari-*gvagahkva*) flank the door, carved to depict female figures--*Salabhanjika*-- atop a crocodile (*makara*). The two figures are identical, but in mirror image. The ancient and archaic *Salabhanjika* type, consists of a maiden standing beneath a tree, with one arm above the head grasping the foliage[8].

(c) Quarter-round panels (Newari-*debikva*) within the curve of the *gvagahkva* are mirror images of Visnu. According to Gutschow, this medallion is also used to depict Surya, Candra, or flower designs[9].

(d) Projecting door lintels include one pair of miniature panels depicting Visnu.

(e) Forward standing columns
In the base areas of these columns are a pair of niches depicting Bhairav.

(f) Door surrounds include two pairs of carved deities set in miniature niches, Siva below and Visnu above.

(h) Tympanum (*torana*): an image of Visnu atop Garuda surmounts the dancing form of Siva (Newari-*Nasadyah*) atop his bull, Nandi. Other subsidiary gods flank the central composition (Visnu, Brahma, Kumar, Ganesh, and Siva in several additional emanations). Lower corners are defined by mythical crocodiles, *makara.*

(i) Niches (in the shape of miniature blind windows; Newari- *gahjhyah*) flank the ground floor door (right side lost). The architectural setting houses a guardian figure Dvarpal; below an additional unidentified figure is found. The temple priest

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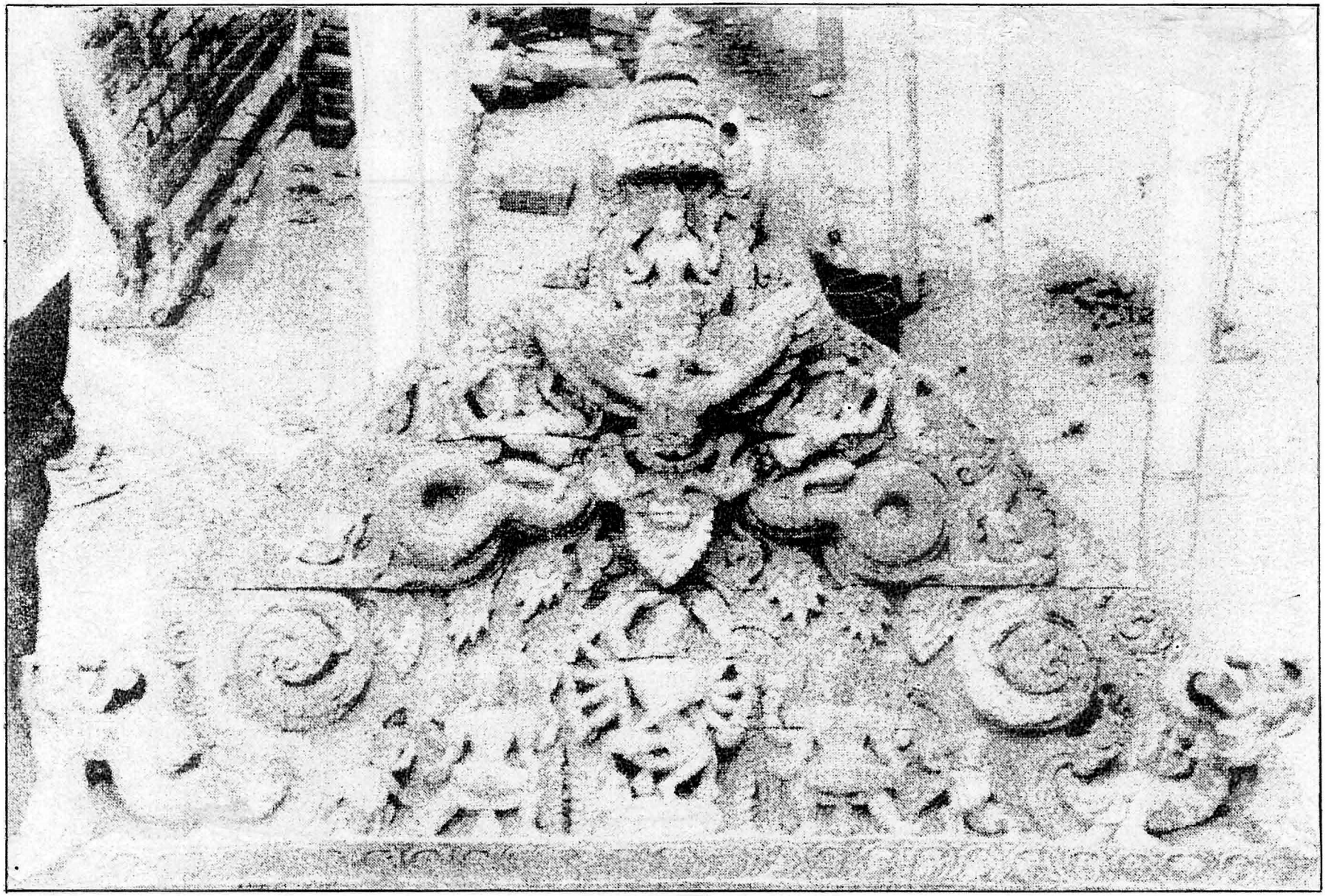
[8] Rau (1985: 143) discusses the Salabhanjika motif, "as ancient as the tradition of art in Southeast Asia". The Salabhanjika's juxtaposition of a figure in nature is clearly echoed in the general rendering of virtually all woodcarved struts in Nepal which include foliage above and suggestion of rock cut earth imagery below.
[9] Gutschow, 1987:259)



THE ENTRANCE TORANA WITH POLYCHROME PAINT CA. 1956. FEBRUARY, 1992.

has reported that the lost right niche was identical to the surviving niche, in mirror image. This convention, i.e. identical pairs in mirror image, describes the majority of carvings in the door-*torana*-niche ensemble.

Architectural carvings

Additional more architectural carvings are found which although formulaic have some symbolic content[10] and are typical of the local architectural canon. These include:

(1) Upper story windows, one per side on two levels
(2) Timber cornices at two levels

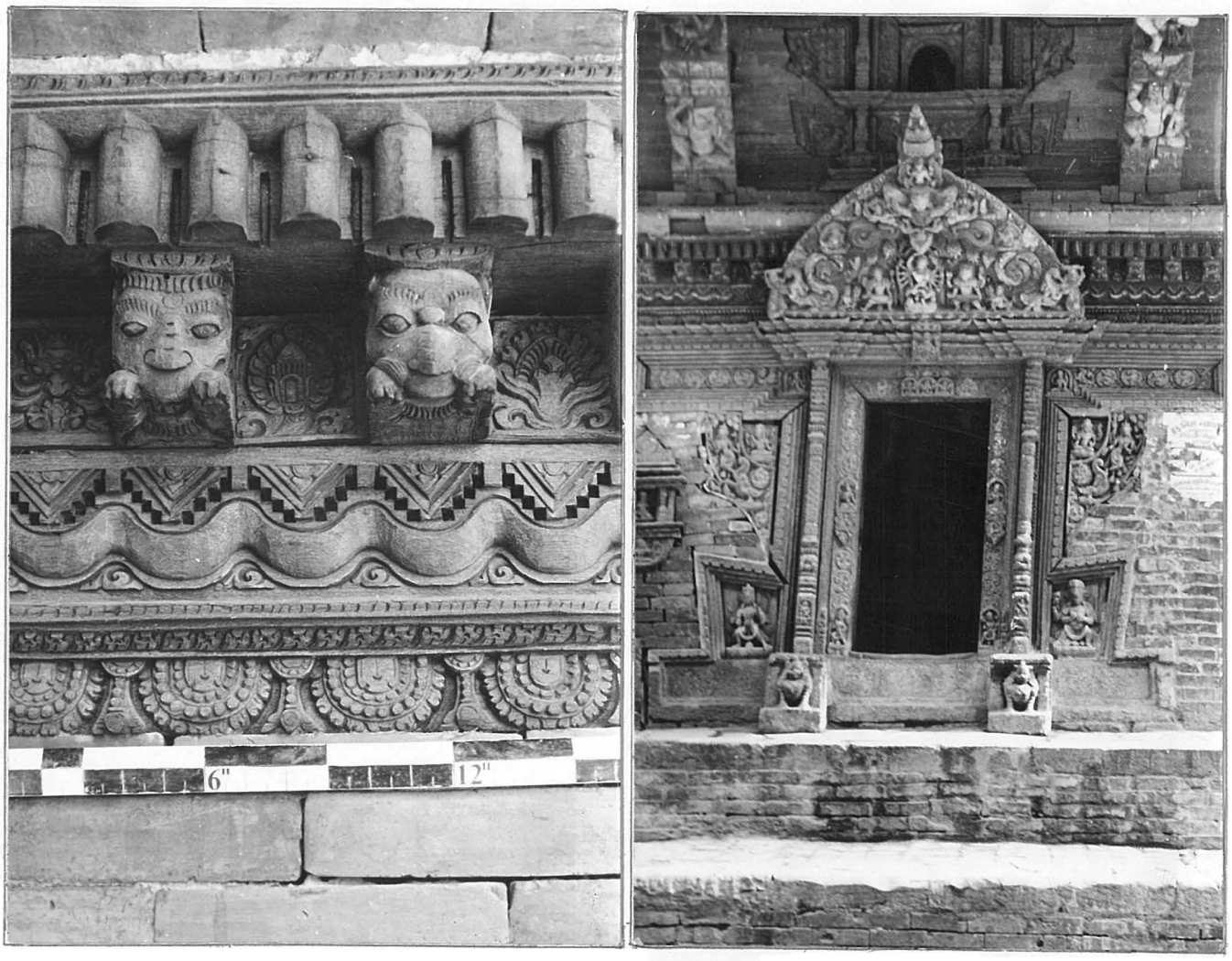
(1) Upper windows (*gahjhyah*) are constructed in the form of openings with panels below (Newari-*kvasvahjhyah*). They are rendered identically on four sides with animal and floral motifs elaborated in locations where the entrance door houses deities.

(2) Cornice miniatures

Miniatures between the carved lion heads in the base story cornice just above the ambulatory depict floral motifs, and the eight auspicious symbols (Newari-*Astamangal*).

UPPER BASE STORY WINDOW ABOVE ENTRANCE, WEST ELEVATION. FEBRUARY, 1992. SEE DISCUSSION OF FRAME ELEMENTS PAGE 13.

[10]Gutschow's dictionary (1987) identifies the names and symbolic content of hundreds of mouldings, motifs, and profiles.



LEFT: PORTION OF BASE STORY CORNICE AFTER TEST CLEANING, MARCH 1992.
RIGHT: ENTRANCE ENSEMBLE WITH RIGHT NICHE MISSING, JANUARY, 1992.

5.0 Existing conditions

5.01 Foundations/walls structural
5.02 Walls: fabric
5.03 Walls: openings, decorative elements
5.04 Roof structure
5.05 Roof cover
5.06 Roof decorative elements
5.07 Interior
5.08 Plinth

5.01 Foundations/walls structural

The only structural damage to the masonry wall consists of a tilt to the building's base story wall at the northwest corner. The displacement has been measured on the exterior as 5" out of plumb towards the south, 1" to the west. Maximum displacement is at the top of this 5'8" high lower story wall (measured to bottom of cornice) and tapers to the intersection of wall and plinth below. All other wall corners are within 1" of plumb. The displacement at the same northeast corner on the inside is 2-1/2", that is, less than that of the exterior corner, suggesting that the three-layered wall--especially the middle rubble fill--has taken up the difference. Extensive cracking in the north facade veneer layer appears to have resulted from this displacement. Additionally, the corner joints of the west elevation's door frame have been spread by this displacement, leaving less than one inch of structural interlock at the upper corners.

Checking of the levels of the lower roof wall plates and eavesboards with water levels confirms that this damage has not resulted from settling, but rather from the lateral forces of seismic activity.

As there is no settling of the structure, excavation of the foundations was not undertaken.

The interior timber beams of pine and sal which support the upper wall structure as well as other timber tie members found at upper level locations are in excellent condition showing no signs of deflection, threatening insect infestation, or fungal growth.

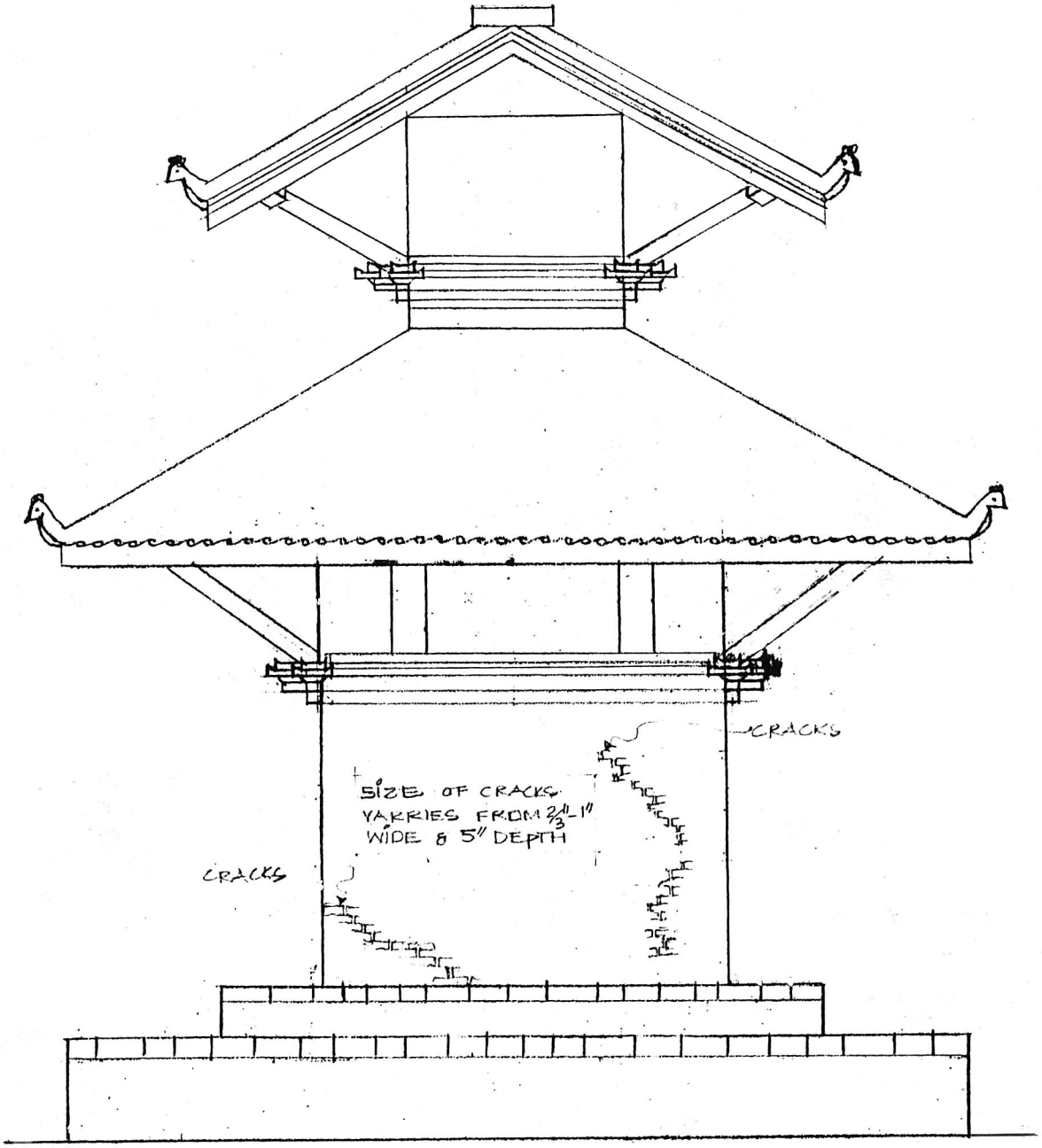
All of the pine timbers show some signs of past insect infestation, namely the very tiny flight holes (1-2mm) flight holes of the furniture or powder post beetle, Anobium Punctatum or Lyctus, respectively. The flight holes are widely spaced and show no signs of recent infestation. The structural integrity of the pine members is not threatened by this past infestation.

5.02 Walls-fabric

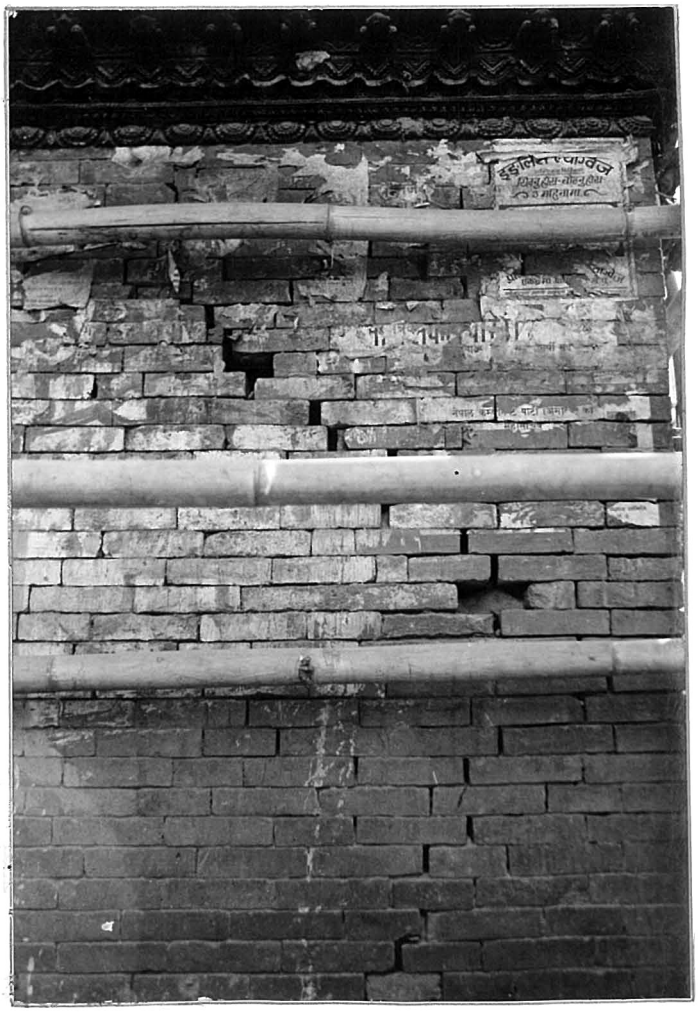
Plinth pavement

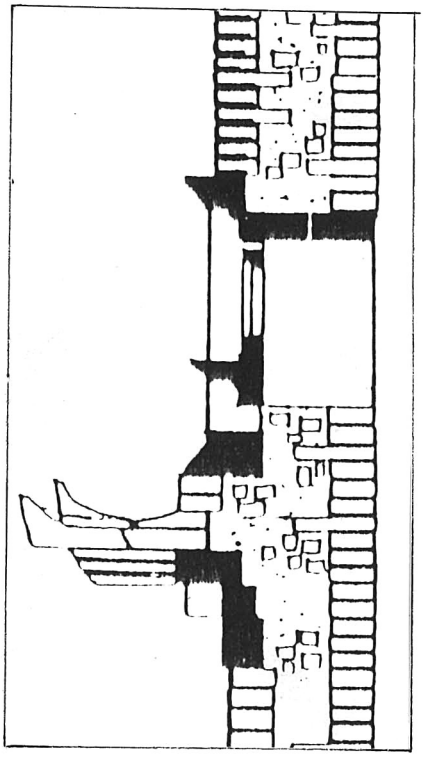
The two-stepped plinth retains very little of its traditional pavement. Only some 20% of the traditional brick tiles, *cika apa,* survive, almost all of them cracked. In all other locations, common bricks, brick fragments, and cement-concrete plaster have been substituted during "improvements" of the last 20 years. The eastern upper plinth pavement (tiles and edge stones) has notably been completely replaced by cement-concrete plaster.

All of the edge stones along the two levels of plinth have been pointed with cement mortar. In cracked and broken stones (80% of all stones), cement mortar has been used as fill. Lost upper eastern plinth edge stones and four other stones on the southern lower plinth have been replaced by cement mortar.



ABOVE: NORTH ELEVATION: DOCUMENTATION OF CRACKS, MAXIMUM 1" WIDE AND ONE BRICK DEEP. FEBRUARY, 1992.





LEFT: THE RIGHT CRACK OF THE NORTH ELEVATION, BASE STORY. (REFER DRAWING OPPOSITE PAGE.RIGHT: SECTION THROUGH WALL AT UPPER BASE STORY WINDOW. THE TYPICAL CONSTRUCTION EMPLOYS INNER AND OUTER LAYERS WITH FEW HEADERS AND A RUBLLE FILL IN THE MIDDLE.

ABOVE: INTACT WALL SURFACE OF UPPER STORY AT NORTHEAST CORNER.
BELOW: UPPER BASE STORY WINDOW, SOUTH ELEVATION. JANUARY, 1992.

Plinth walls
Historical brick survives on all sides, although with sloppily applied cement mortar pointing in all locations. Numerous small areas (2-4 bricks/area) of the plinth's vertical surfaces of veneer brick have been patched with common brick laid in cement mortar. The eastern lower plinth wall is the only area with serious spalling of the brick surfaces-- only a handful of bricks retain their smooth surface in this area.

Graffiti in enamel paint has been applied on the northern and southern elevations. All vertical brick surfaces have been red-washed several times with a mixture of red mud and water.

Base story
The *dacia apa* veneer brick is uncharacteristically laid with visible joints consistently of between 1/8" and 1/4" at both horizontal and vertical joints in all locations at this and other levels. At these joints, the yellow mud mortar is visible; there are no signs of recent or historical pointing. A major patch (15-20 sq.ft./50 sq.ft. of base story elevation) is present on south elevation. In this location, bricks have been laid in cement mortar with cement pointing. In addition there is significant spalling (80%) of the brick surface on both the interior and exterior of the north base story wall. As such spalling is not present in other locations, the filling up of the area behind the sanctuary's icon with mud and rubble to a height of two feet above interior floor level appears to be the conduit for this rising ground dampness. (This fill was added with iron bars connected to the sanctuary's icon by the temple *guthi* to prevent theft. This mass was then covered with cement plaster.)

On the principal west elevation, a small patch in common brick and cement mortar has been made where the right side timber niche has been lost. Other historical bricks in mud mortar are intact.

The historical brick varies in tone from deep crimson to warm red to yellow-brown. New common brick is more pink.

Upper base story and upper story
In excellent condition, these walls retain their *daci apa* laid in visible yellow mud mortar and show no signs of cracking or spalling except for the uppermost 4 courses below the damaged upper roof on the north elevation. In this location water penetration has weakened the mud mortar, caused the veneer brick to bulge out some two inches, and led to the falling off of a handful of bricks.

5.03 Wall openings and decorative elements

The only structural damage, as discussed above consists of the threatened structural interlock of the base story door frame.

All timber windows, doors, and cornices have been red-washed with a mixture of red mud and water.

There are no signs of fungus, insect infestation, or deterioration on these timber elements.

The base story niche to the right of the door (west elevation) was stolen some 14 years ago according to the temple priest (*pujari*).

5.04 Roof structure

Summary
Roof repairs in the 1970's was limited to the replacement of 14 rafters on the lower roof. It is not known when previous roof repairs were made.

All 14 new rafters are machine sawn sal timbers, average size 4"x 3" laid on flat. (Traditional construction methods consistently employ timber beams and joists in their structurally inefficient orientation on flat in Nepal.) The remaining older rafters of unknown date are all pine, adze hewn, and of average size 5" x 4". Older wall plates and purlins are all adze-hewn in pine.

All of the pine timbers show some signs of past insect infestation, namely the very tiny flight holes (1-2mm) flight holes of the furniture or powder post beetle, Anobium Punctatum or Lyctus, respectively. The flight holes are widely spaced and show no signs of recent infestation. The weakened structural integrity of almost all the pine members results from water damage and development of wet rot rather than insect infestation.

In general the sal timber (*shorea robusta*) retains its structural integrity even in locations where damaged roof cover has allowed water penetration over the last two years, while all unprotected pine timbers have deteriorated rapidly due to wet rot, losing all structural integrity in the same time period. This damage is often only detectable from the top side of the rafter---inspection from below (before dismantling of the roof cover) is often misleading, as even when the bottom three surface appear sound, a pen knife from above will penetrate 2 inches.

The traditional connection between rafter and wall plate and between rafter and purlin consists of two timber pegs inserted to brace the rafter against the horizontal member. At approximately 80% of these peg locations, water penetration had caused deterioration of the peg, enlargement of the peg hole, and deterioration of the surrounding area on the rafter of 3" square on average.

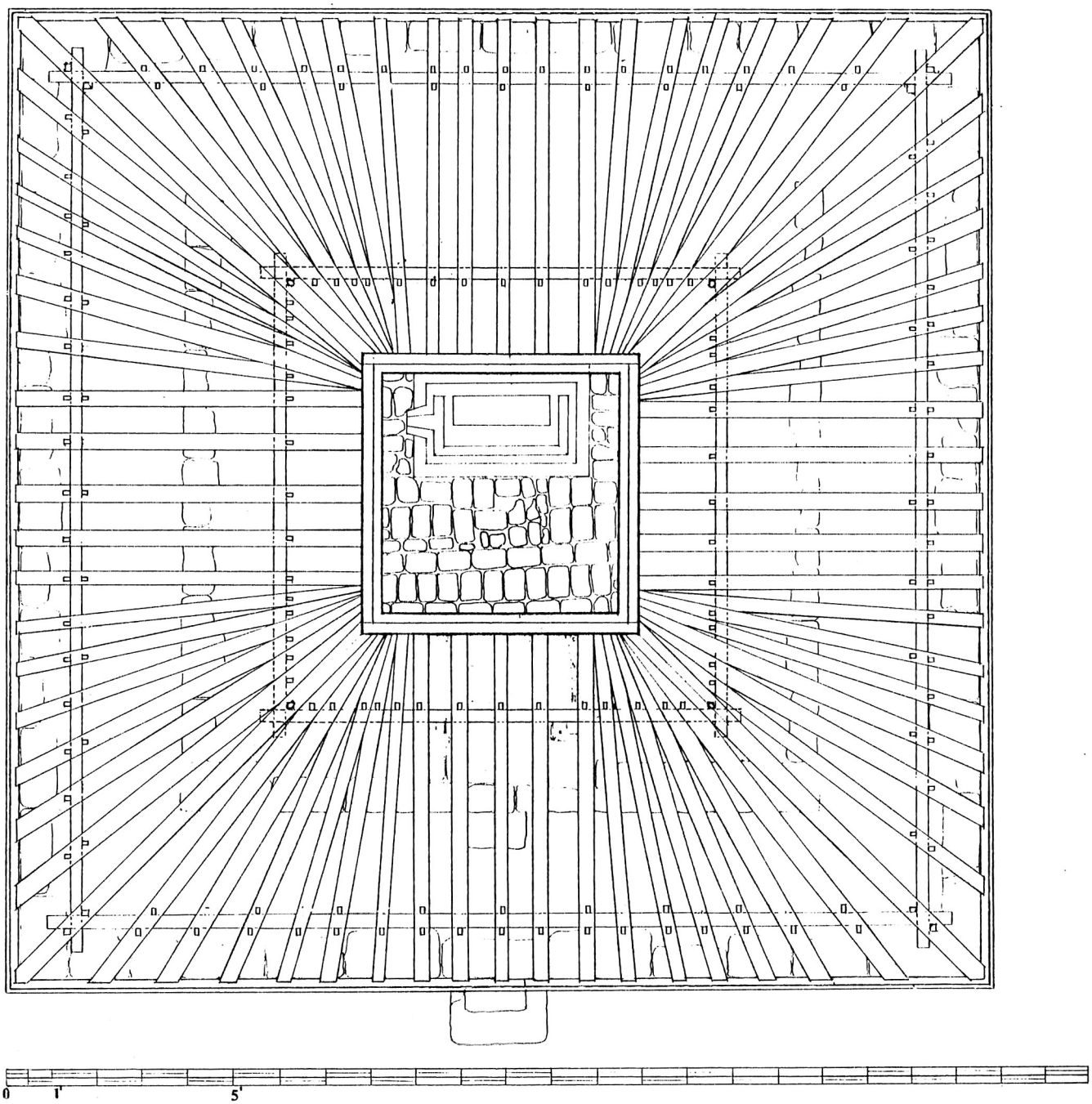
The most important conclusion of the detailed study of the roof structure is that the traditional wooden peg (Nepali-*cuku* , Newari-*chukul*) inserted as a key at the wall plate and purlin is the principal entry point for water into the structural timbers. The traditional detail uses the peg as a key in the mud layer above the planking, especially at more exposed locations above the purlins. Thus any damage to or movement of the rather loose roof tile (*jhingati*) allows water to reach the mud and then penetrate to the cross grain of the rafter through this wooden peg. Moreover, when the small timber peg deteriorates, there is nothing to prevent the heavy rafters from sliding off the masonry core structure. This scenario describes the majority of roof failures in Newar buildings.

Lower roof

With the exception of the newer sal members, all rafters show some signs of structural damage, either from the *chukul* or from general dampness from the damaged planking and mud cover above. A careful survey of all members has been made to identify all re-usable timbers. Eavesboards on all sides are completely deteriorated by wet rot. Purlins on four sides are of pine and in poor condition. Wall plates, both inner and outer, are of pine and in good condition.

Upper roof

The much smaller upper roof structure has collapsed on the north side. This damage was brought on by water penetration at *chukul* locations which allowed the rafters to slide off.

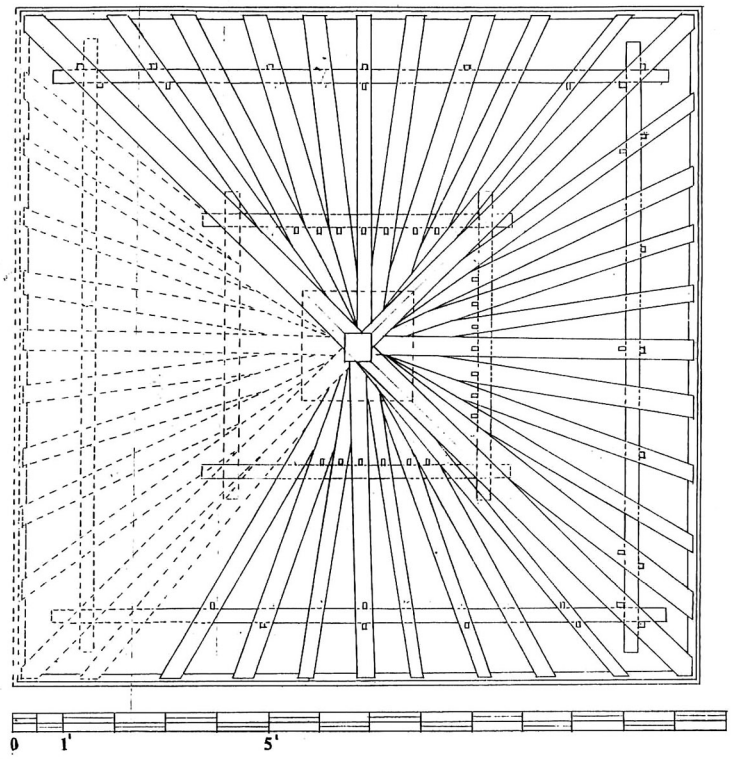


UMA MAHESWAR TEMPLE

KWALKHU TOL, PATAN
UNESCO WORLD HERITAGE SITE MONUMENT ZONE

LOWER ROOF PLAN: EXISTING CONDITIONS

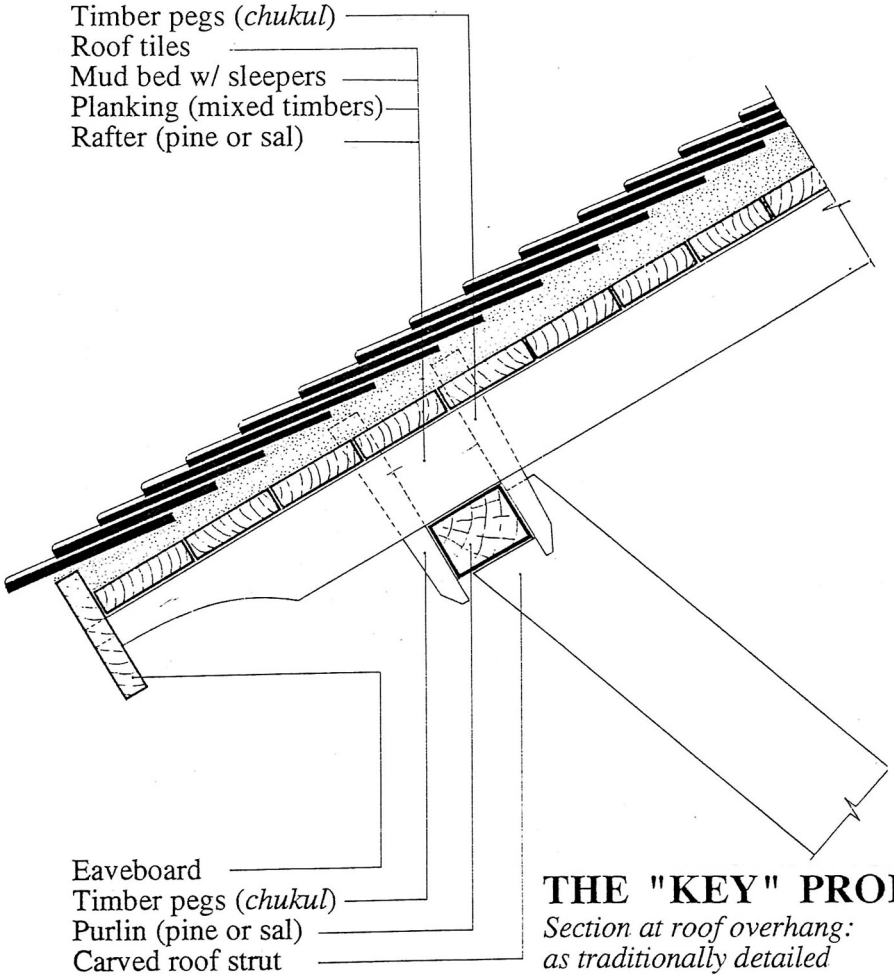
KATHMANDU VALLEY PRESERVATION TRUST, MARCH 1992



UMA MAHESWAR TEMPLE

KWALKHU TOL, PATAN
UNESCO WORLD HERITAGE SITE MONUMENT ZONE

UPPER ROOF PLAN: EXISTING CONDITIONS
KATHMANDU VALLEY PRESERVATION TRUST, MARCH 1992



THE "KEY" PROBLEM

Section at roof overhang:
as traditionally detailed

On the other three extant roofs, sal eavesboards and pine purlins are severely water damaged. Rafters are damaged at *chukul* locations. A careful survey is being made to identify all rafters able to be conserved. The three sides of surviving pine wall plates are severely damaged by water penetration brought on by the missing north roof.

5.05 Roof cover

The roof cover consists of mixed planking and packing box scraps--all pine-- in random widths over rafters with a clay bed above to receive the tiles.

Planking

80% of the pine planking on the upper and lower roofs is structurally denatured from exposure to water and wet rot. Much of the planking is wood from packing boxes, 1/2" to 3/4" thick.

Roof tiles *jhingati*

The roof tile cover laid in clay is largely intact on the south, east, and west sides of the upper and lower roofs, although many indivdual tiles have been displaced by vegetal growth. The lower northern roof is completely covered by grasses and weeds. Moss is evident on all tiles, except those portions of the lower roof which are beneath the intact upper roof overhangs.

Only 25% of the traditional ridge tiles which are stacked vertically along the hips of the roofs remain. The lost tiles have been knocked off --traditionally they are not attached--and the remaining tiles have been laid flat.

Six of eight corner aviform tiles remain. The northeast and northwest corner tiles of the upper roof are those lost.

5.06 Roof decorative elements

Metalwork

One inch wide metal straps with triangular points are found with nails connecting all rafter heads at their penetration of the eaveboards of bottom and top roofs. Their 1 mm thickness has allowed them to rust through in all locations.

Roof struts

All struts are in place and date from at least the 19th century. All struts were painted in 1956 in polychrome enamel paint. There is no evidence of earlier paint layers, confirmed by inspection at the Department of Archaeology conservation lab and by locals' reports.

All but the strut at the upper roof southeast corner location are structurally sound, showing no damage from fungus or insects. At the corner horse strut of the upper southeast a crack through the narrowest portion of the horse's neck goes through all but one inch of the section.

All original appended arms to the main strut figures have been lost. No replacements have been added.

The two struts under the collapsed upper roof area have been stored by the *guthi*.

Pinnacle (gajura)
The clay pinnacle of unknown date sits unfixed and tilted atop a vertical post. The base bell-shaped component is cracked, although not separated. Traditional assembly of the *gajura* is from stacked components linked by a penetrating central post. The extant gajura is missing several components between the lower bell shape and the upper knob. The sal timber kingpost supporting the *gajura* is intact with superficial wet rot, 1/2" deep.

5.07 Interior

There are no signs of structural or superficial damage except for significant salt staining and spalling on the interior northern base wall. As discussed above (under 5.02) this appears to result from ground dampness transmitted by later masonry works around the temple's icon.

The brick floor tile (8"x8") (Newari-*cika apa*), laid only in earth, is cracked in almost all individual tiles. Some 30% of tiles are missing, leaving bare earth.

The upper floor joists, planking, and mud cover are in excellent condition.

6.0 Recommendations for repair and restoration

6.01 Foundations/walls structural

General-seismic reinforcement issues

Given the seismic activity of Nepal, any restoration project must consider both the reinforcement of existing structure and the introduction of new structural members to withstand earthquakes.

The challenge of restoration of such a monument is to arrive at a thoughtful compromise between full structural consolidation and preservation of historical appearance and fabric. Concealed horizontal tie members are relatively easy to insert at wall plate levels, a technique developed by the UNESCO project at Hanuman Dhoka in Nepal, but to tie the structure together vertically is much more challenging as sophisticated drilling technology is not available. Thus, as a first step, insertion of reinforced concrete ring beams was considered above both wall plate levels.

Design of seismic reinforcements of the temple was undertaken simultaneously with that of the nearby Radha Krishna Temple, also under restoration by the Trust. Comparative analysis of the two structures' seismic performance characteristics led to the following conclusions.

*The Uma Maheswar was comparatively less at risk because (a) its overall proportions are more compact (lower plinth, two-tiered) (b) no soft ground floor, in fact, a very low percentage of openings/wall area and (c) the critical discontinuity between lower and upper level walls was much reduced by the location of the upper walls in plan butting those of the lower structural core (at Radha Krishna there is a 2' gap between inner and outer walls).

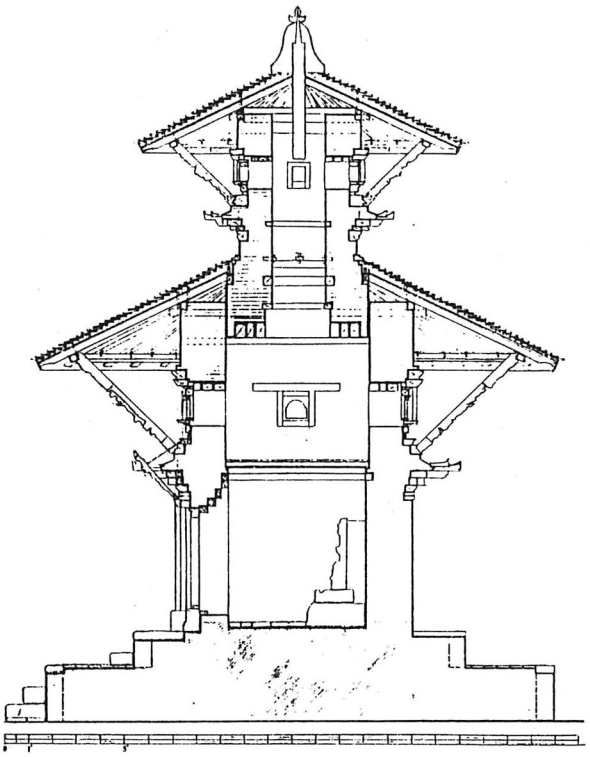
*The very small size of the upper temple level (interior shaft: 2'3" x 2'2") did not merit insertion of a reinforced concrete ring beam. In fact, the historical configuration of timber wall plates and crossing tie members was judged quite adequate to resist seismic forces if damaged members were replaced with improved joinery (adding lapped joints where formerly only timber peg connections had been made). Additionally a rust-resistant and concealed steel collar could easily be inserted atop the rafters to resist the outward thrust of the pagoda roof loads.

*Existing continuous exterior timber cornices at two levels (5"x5" in section) were inspected at critical corner joints for their ability to act as a wrapping tie member. In excellent condition, their location in section also corresponded with the individual centers of gravity of the upper and lower temple levels, increasing their utility to resist lateral seismic forces.

* In general, the relatively compact and intact masonry core structure was judged not as critical to reinforce as the spreading timber roof structure, which through repair and rebuilding (incorporating concealed bolting and angles and improving joinery in rebuilt locations) could be tied together and linked to the masonry core.

*These conditions and configuration characteristics of the building presented the opportunity to develop a less invasive seismic reinforcement intervention at the lower roof wall plate level. Thus, a timber reinforced ring beam was developed, not only as an appropriate reinforcement measure, but as a model for less invasive and less costly seismic reinforcement. This ring beam incorporates the intact and structurally sound historical pine wall plates found in all locations at this level.

SEISMIC CHARACTERISTICS
Radha-Krsna &Uma Mahevara Temples



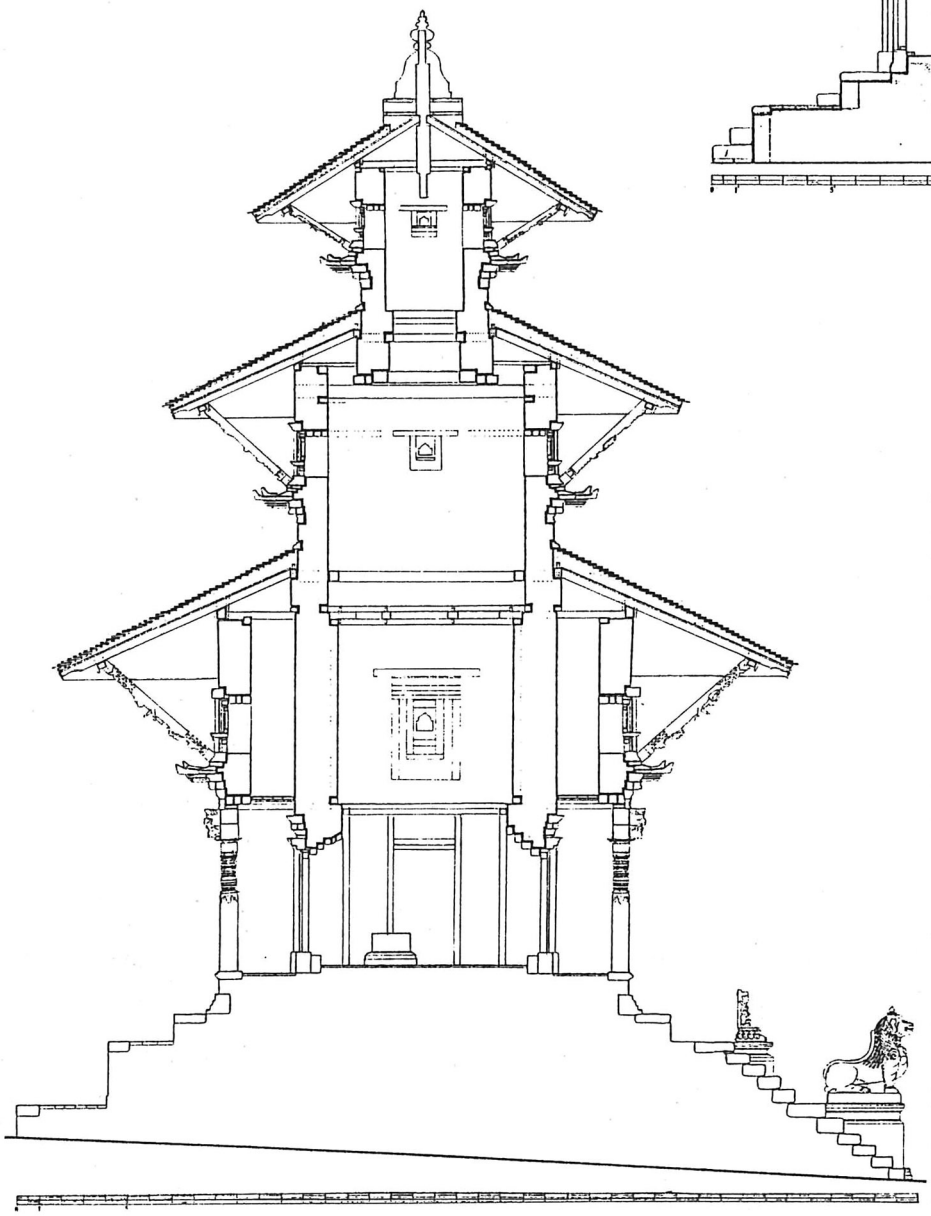
Uma Mahevara Temple (1802)

Overall proportions more compact.

Top-heavy due to great roof overhangs and heavy mud/tile cover.

Vertical discontinuity is lessened because upper walls abut lower walls. Historical timber tie structure adequate to reinforce.

Foundations?



Radha-Krsna Temple (1668)

Top-heavy due to great roof overhangs and heavy mud/tile cover.

Taller overall proportions increase risk.

Vertical discontinuity. Historical timber tie structure inadequate to reinforce.

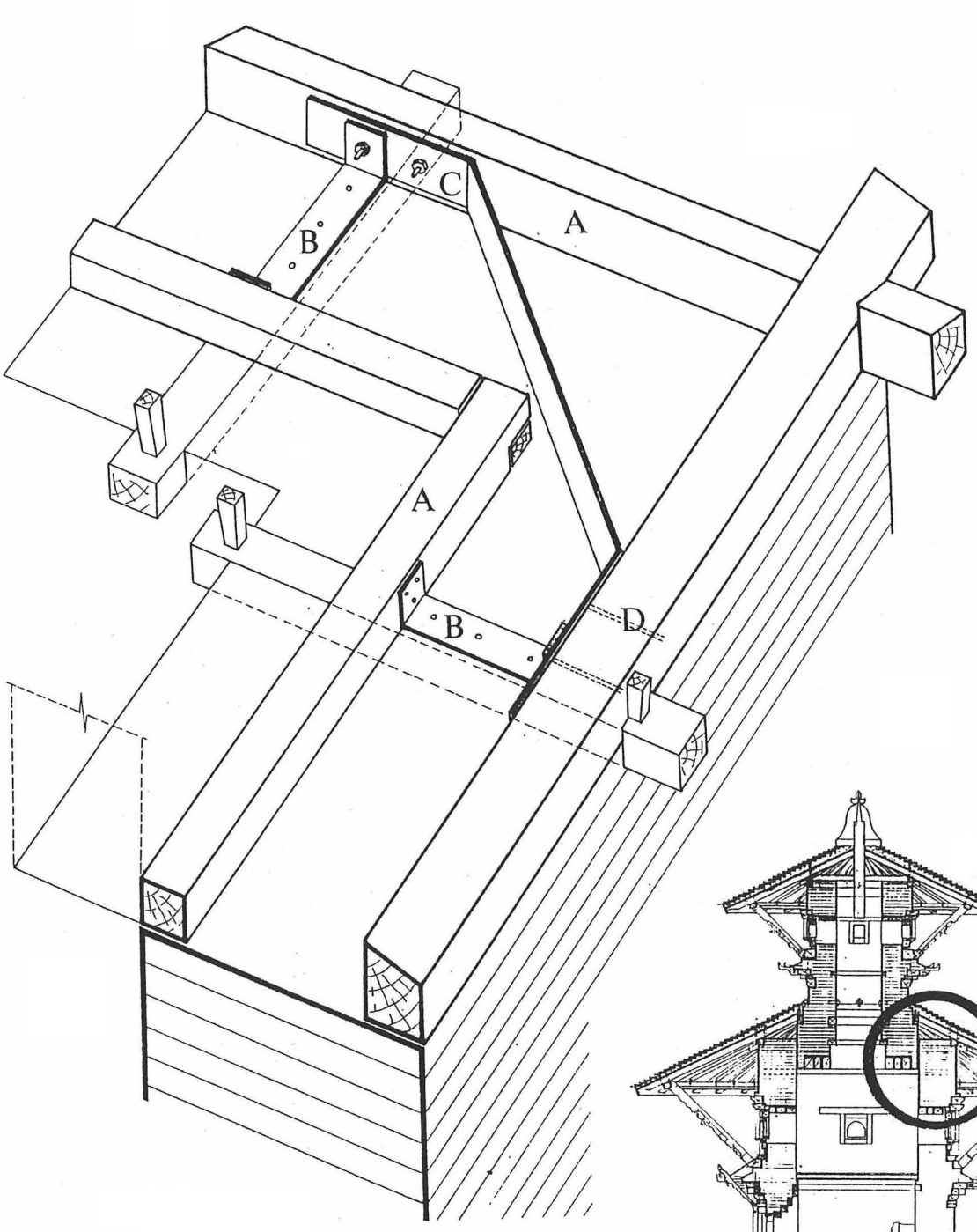
Lack of bracing between inner and outer walls. Historical timber tie structure inadequate to reinforce.

Symmetrical placement (in plan) and small size of openings are more resistant.

Lack of bracing between two wall layers

Soft ground floor: continuous timber arcade.
Plinth: massive shock absorber?

Foundations?



A Existing inner and outer wall plates
B Steel collar tying joists,and inner and outer wall plates together
C Steel collars tying timber wall plates
D Concealed bolting at timber joints

UMA MAHESVARA TEMPLE:
STEEL-REINFORCED TIMBER RING BEAM
Axonometric view at wall plate level below the lower roof rafters.
Drawing: R. Ranjitkar, June 1992.

SEISMIC IMPROVEMENTS

IMPROVED JOINERY AND CONNECTIONS IN THE ROOF STRUCTURE/DEVELPMENT OF TIMBER RING BEAM AT LOWER WALL PLATE LEVEL

(1) INSERTION OF A CONCEALED COLLAR 3' FROM THE TOP OF THE ROOF, CONTINUOUS ON ALL SIDES.

(2) INTRODUCTION OF LAPPED JOINTS INTO THE REBUILT UPPER WALL PLATE/TIE BEAM ASSEMBLY.

(3) IMPROVED JOINERY AT THE UPPERMOST WALL PLATE CONNECTION

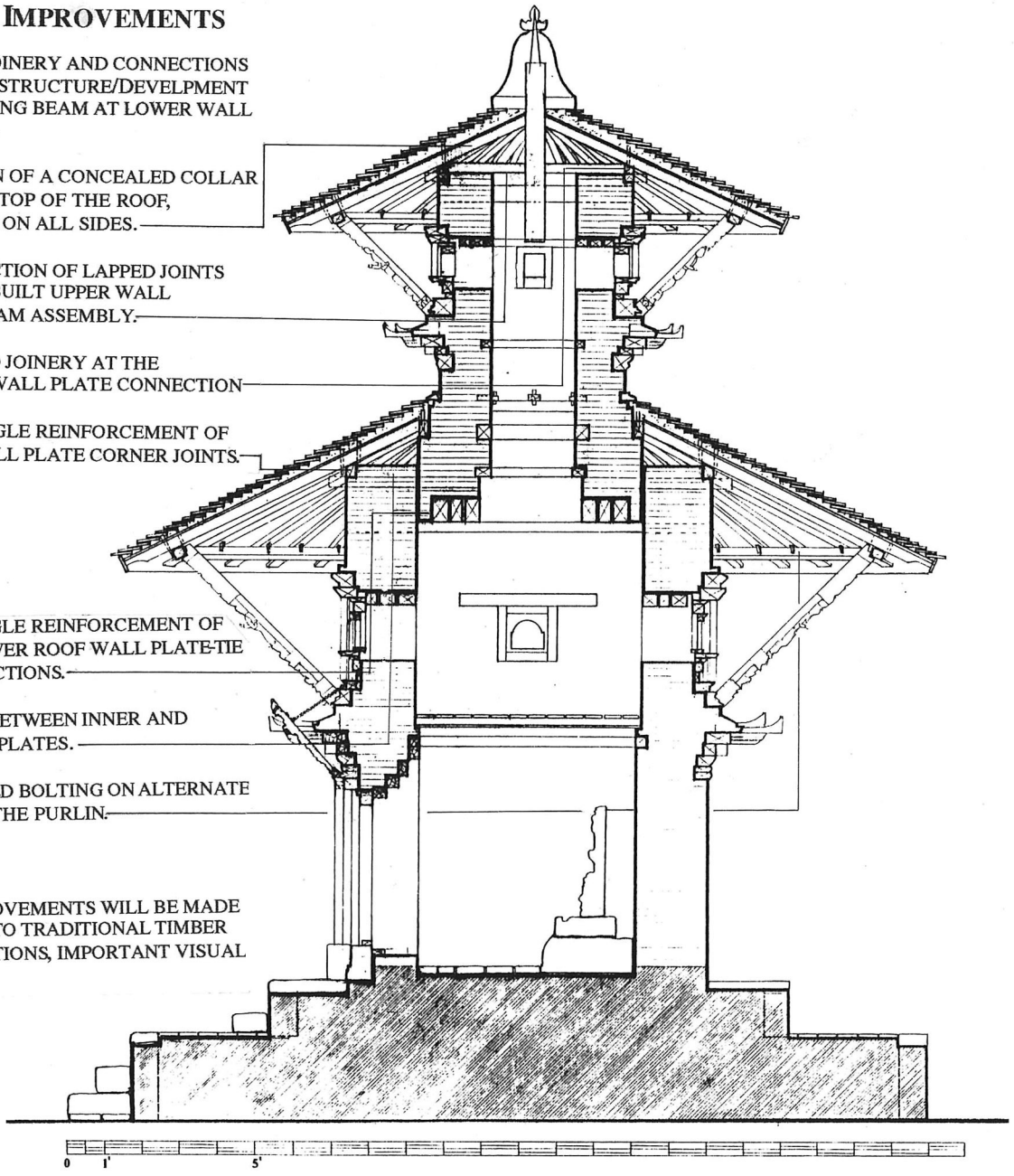
(4) STEEL ANGLE REINFORCEMENT OF EXISTING WALL PLATE CORNER JOINTS.

(5) STEEL ANGLE REINFORCEMENT OF EXISTING LOWER ROOF WALL PLATE-TIE BEAM CONNECTIONS.

(6) BRACING BETWEEN INNER AND OUTER WALL PLATES.

(7) CONCEALED BOLTING ON ALTERNATE RAFTERS TO THE PURLIN.

(THESE IMPROVEMENTS WILL BE MADE IN ADDITION TO TRADITIONAL TIMBER PEG CONNECTIONS, IMPORTANT VISUAL ELEMENTS.)



UMA MAHESWAR TEMPLE

KWALKHU TOL, PATAN
UNESCO WORLD HERITAGE SITE MONUMENT ZONE

SECTION WEST-EAST : EXISTING CONDITIONS
KATHMANDU VALLEY PRESERVATION TRUST, MARCH 1992

* The challenging and, at this time technically unfeasible task of inserting vertically continuous reinforcements was not judged necessary. (See discussion in appended article.) Concealed bolting and steel angles were used not only to strengthen the tie beams and wall plates, but also to *extend* structural connections through linkage, in this case, between the timber ring beam, rafters, and purlins.

* An axonometric and section drawing document the timber ring beam and other improved connections (improved joinery, concealed bolting and angles) designed by Rohit Ranjitkar with Engineer Prayag Joshi.

Plinth
No structural work necessary.

Base story
The deformation at the northeast corner will be approached in the following manner. Partial dismantling of the wall area surrounding the spread timber frame of the base story door will allow the structural interlock of that door frame to be re-established. All bricks will be carefully removed to allow precise reconstruction.

All other wall repairs at this level are discussed below under wall fabric.

6.02 Wall fabric

Base story
Inappropriate patches with common brick and cement mortar will be replaced with veneer brick, *daci apa*, matching historical size and color as closely as possible. These bricks will be custom ordered. Fabrication will be losely supervised by the project team to assure high quality firing, a deficiency in most modern brick. Wherever patches are made, through-wall iron ties or butterflies, as discussed below, will be inserted to consolidate the three-layered wall.

On the north elevation, the extensive separations of the veneer brick layer can only be corrected through rebuilding as piecing in of small pieces would be visually distracting and structurally insufficient. This rebuilding will incorporate all historical bricks, while eliminating later patches of common brick. The historical bricks, nevertheless, are very difficult to remove without breaking where cement mortar or pointing is present. Similarly, the spalling of the east elevation merits rebuilding as 80% of the historical bricks are damaged up to the cornice level.

The eccentricity of the northwest corner, which could be exacerbated by seismic forces, will be able to be somewhat reduced during this rebuilding of the north elevation veneer layer through reduction of the middle fill layer. At the same time critical through-wall iron ties or butterflies can be incorporated to consolidate the three-layered wall. These butterflies will be spaced on 2' centers, staggered on every fourth brick course. They will be packed in a lean cement mortar to prevent corrosion. All other masonry work will employ the traditional yellow mud mortar with no pointing. The damping effect of this traditional mortar is judged critical in the conservation of these buildings. The 19th century brick pattern of the veneer layer, with its uncharacteristic 1/4" visible joints will be matched to integrate visually old and new areas of wall surface.

Before this patching and rebuilding work, the walls will be cleaned of the applied mud wash. This mud wash is water soluble and can be removed with soft brushes and dilute soap water.

Upper story
No work necessary except cleaning (as described above) and the rebuilding of four uppermost courses of damaged brick wall below the collapsed north roof wall plate.

6.03 Walls: openings and decorative elements

The timber cornices and openings require cleaning with water and brushes to remove the red mud wash. Structural work on the door is discussed above. The lost niche (right side of door) will be remade according to the original design, a mirror image of the left niche.

6.04 Roof Structure

All roof repairs and rebuilding will be accomplished *in situ*, that is, without complete dismantling of the wall plate/rafter/purlin/strut assembly. Elements will be repaired and replaced on a piece by piece basis to allow the existing roof position and height to be preserved.

All existing timbers--both sal rafters and older pine members--will be reused and in existing locations wherever possible. In some cases, removal of damaged areas from lower roof rafters will allow them to be used on the shorter upper roof. (The pine timbers do not present a threat to the structure if they are protected from water by the new roof cover.)

The improved joinery and connections in the roof structure (discussed under seismic improvements above) include (1) concealed bolting on alternate rafters to the purlin; (2) improved joinery at the uppermost wall plate connection (3) angle reinforcements of existing wall plate corner joints; (4) bracing between inner and outer wall plates; (5) steel angle reinforcement of existing lower roof wall plate-tie beam connections; (6) introduction of lapped joints into the rebuilt upper wall plate/tie beam assembly; and (7) insertion of a concealed collar 3' from the top of the roof, continuous on all sides. These improvements will be made in addition to traditional timber peg connections, important visual elements.

Consulting engineers suggested optional steel reinforcement of strut-purlin and strut base-cornice joints, but as these reinforcements could not be concealed, they were not implemented. Futher study will investigate solutions which could be fully concealed.

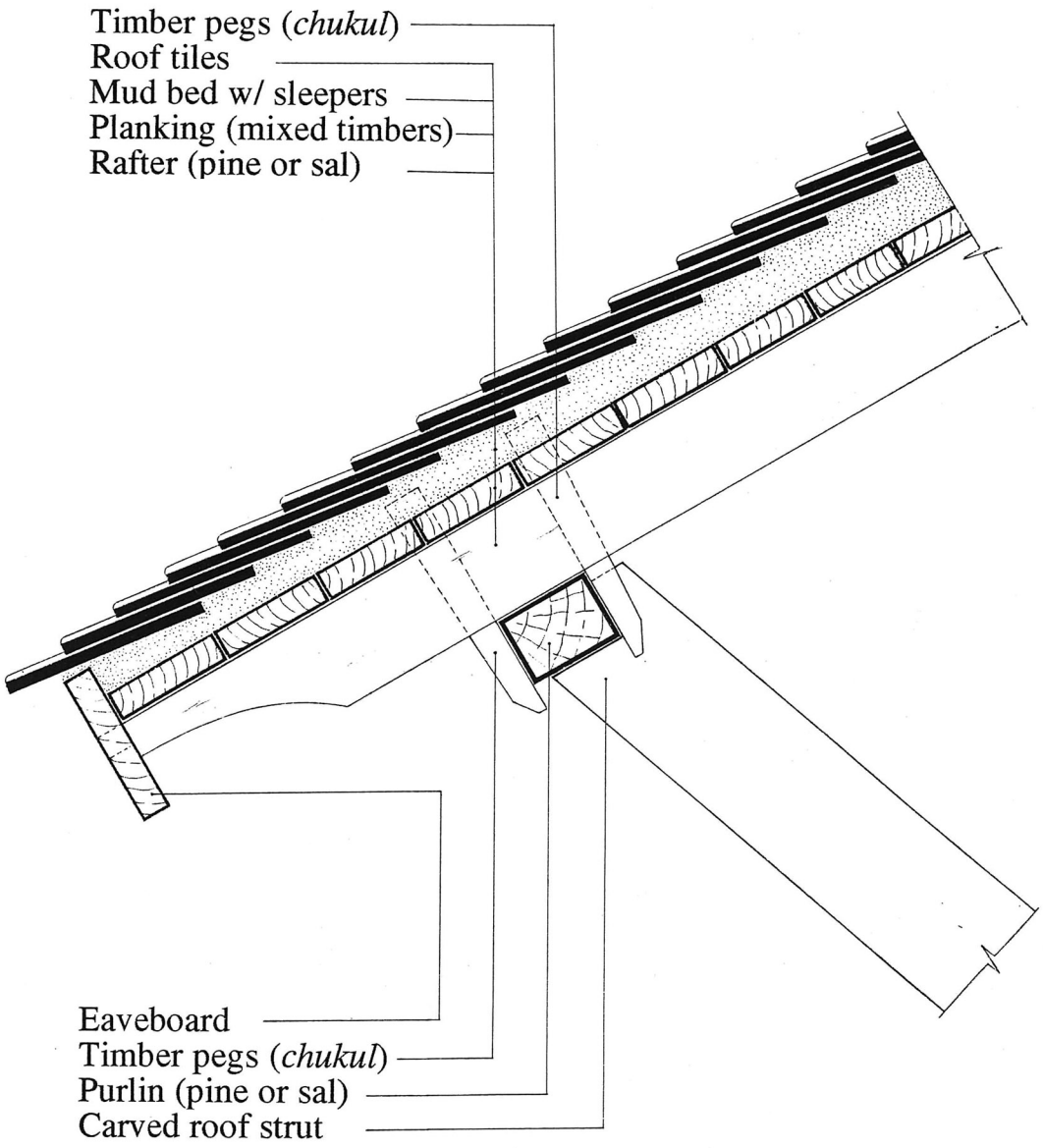
Repairs/rebuilding will be accomplished from the top down to prevent completed repairs from being damaged by subsequent work.

New and old structural timber will not be treated with preservative /insecticide as the new and historical sal timbers are naturally resistant and the older pine members are only susceptible to insects when green. See discussion in appended article.

6.05 Roof cover

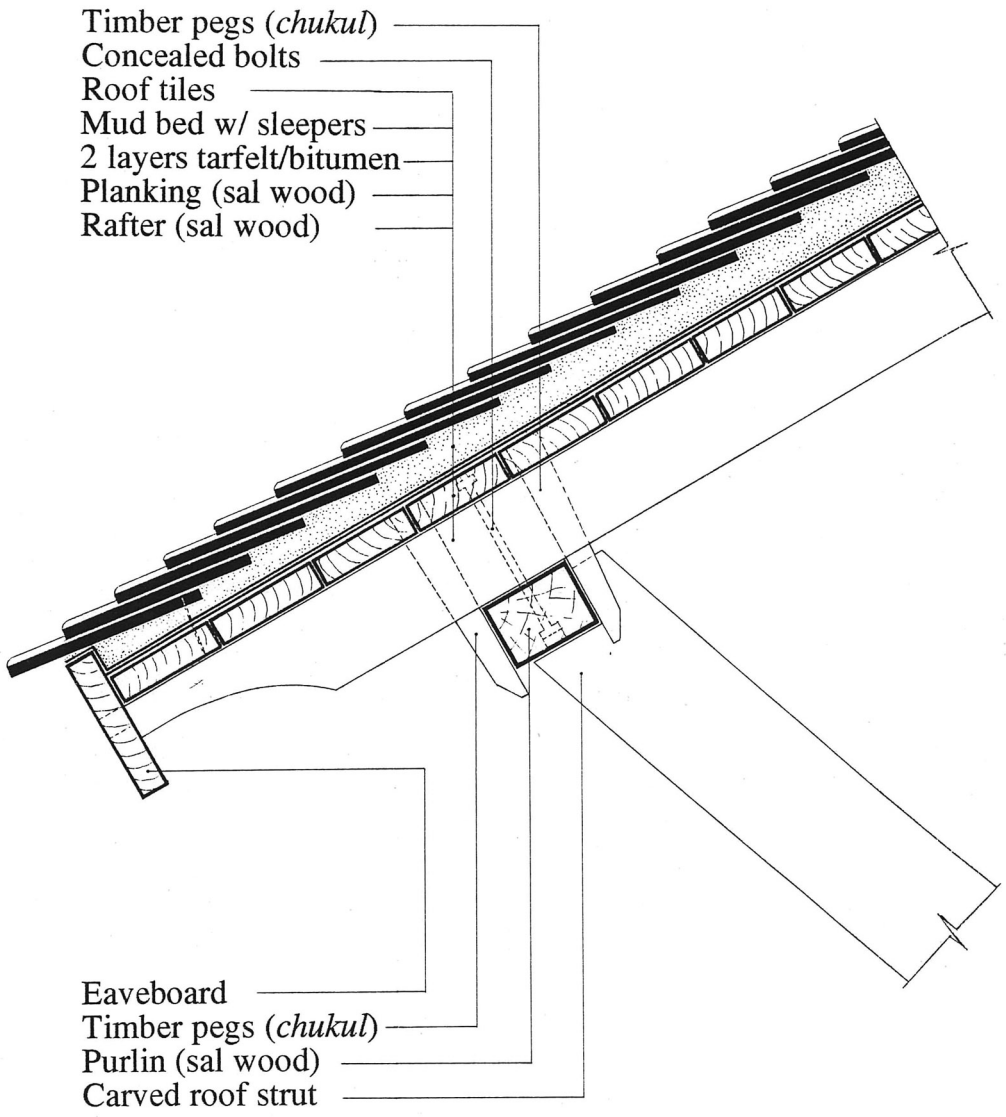
The same roof cover details as developed by the Hanuman Dhoka and Bhaktapur Development Projects will be employed with several additional refinements discussed below.

Planking
All planking/timber scraps must be replaced with new 1" thick sal planks, in random widths, butt jointed, and nailed to the rafters with galvanized nails.
Moisture barrier
As at Hanuman Dhoka, two layers of highest quality (Indian standard III grade 1) layers of tarfelt will be introduced above the planking layer. Heated bitumen (Indian standard 85/25 meaning at 85 degrees, 25 drops/minute) will be coated on the planking, between tar felt layers, and as a final coat above the bitumen. Small



THE "KEY" PROBLEM

Section at roof overhang:
as traditionally detailed



THE "KEY" PROBLEM

Section at roof overhang:
Improved detailed

sal wood timber battens in angled positions (to allow water to run down their length as horizontal orientation would not allow) will be nailed into the tar felt with rubber washers to prevent water penetration. Such battens are necessary to prevent slippage of the mud.

Mud bed
The traditional mud bed into which the jhingati are laid must use the more cohesive black mud available in the valley and must be dug from depths greater than one meter to minimize organic material content. The mud will then be mixed with a herbicide per manufacturer's directions.

The herbicide Karmex has been used extensively in the valley over the last years with mixed results. Our discussions with project personnel at various sites suggests that the American-manufactured product performs better than an Indian product of the same name. Moreover, the care taken in the mixing of the herbicide with the mud appears to be critical. At Hanuman Dhoka, the chemical has not proven fullproof, but has certainly inhibited vegetal growth for at least 15 years according to supervising engineer Hari Ratna Ranjitkar. The American Karmex will be used for proposed work, which will be closely supervised.

Jhingati
As newly produced *jhingati* are of inferior color, strength, and porosity, the project will procure old jhingati for replacement tiles (approximately 40%). These older more durable tiles are not difficult to find given the present rate of destruction of historical structures in the Kathmandu Valley. The old tiles will be scrubbed with mild detergent and water.

Tiles will then be soaked in siltrate solution per manufacturer's directions to reduce their absorbency. The effectiveness of this treatment is clearly illustrated on the recently rebuilt Cyasilin Mandap in Bhaktapur, where samples of treated and untreated tiles (new tiles) have weathered very differently. In just two years, the untreated tiles have become covered with moss, while treated bricks are moss-free. The poor performance of the new untreated tiles contrasts greatly with those of ten years ago, installed by the Bhaktapur Development Project. Those tiles were also not treated, but remain moss free to date because of their more highly-fired and moisture-resistant composition.

As at Hanuman Dhoka, the bottom roof tiles (above the eavesboard) will be drilled and nailed in place as they are highly susceptible to being knocked off. They will be attached with headless nails, however, as the Hanuman Dhoka installation with regular nails necessitated removal of one square feet of adjacent tiles to replace one bottom *jhingati*. The top tiles will also be drilled and nailed into the mud bed, as this layer of tiles is vulnerable to dislocation by pigeons.

As it is difficult to find old ridge tiles (Newari-*nyakuca*) or corner aviform tiles, the project will custom order necessary new tiles (75%) to match historical size and shape. Project personnel will monitor production of these tiles to assure the best possible quality. They will be soaked in siltrate solution per manufacturer's directions.

The stacked lower ridge tiles will be held from slipping by the introduction of a steel angle beneath the lowest 16 tiles as introduced by the Hanuman Dhoka Project. The "L" form literally hooks the bottom-most tile and is held in place by the weight of the upper tiles. It is concealed by the tile traditional placed at the bottom tilted in the opposite direction.

6.06 Roof decorative elements

Metalwork
Replacement iron straps will be manufactured to match historical pieces in a slightly increased thickness to increase their life.

Roof struts
All struts will be conserved *in situ* except for one structurally damaged strut at the upper roof southeast corner and the two struts removede from the temple after collapse of the upper northern roof.

Based on advice from the Department of Archaeology Conservation Lab and successful test samples, their treatment will include:

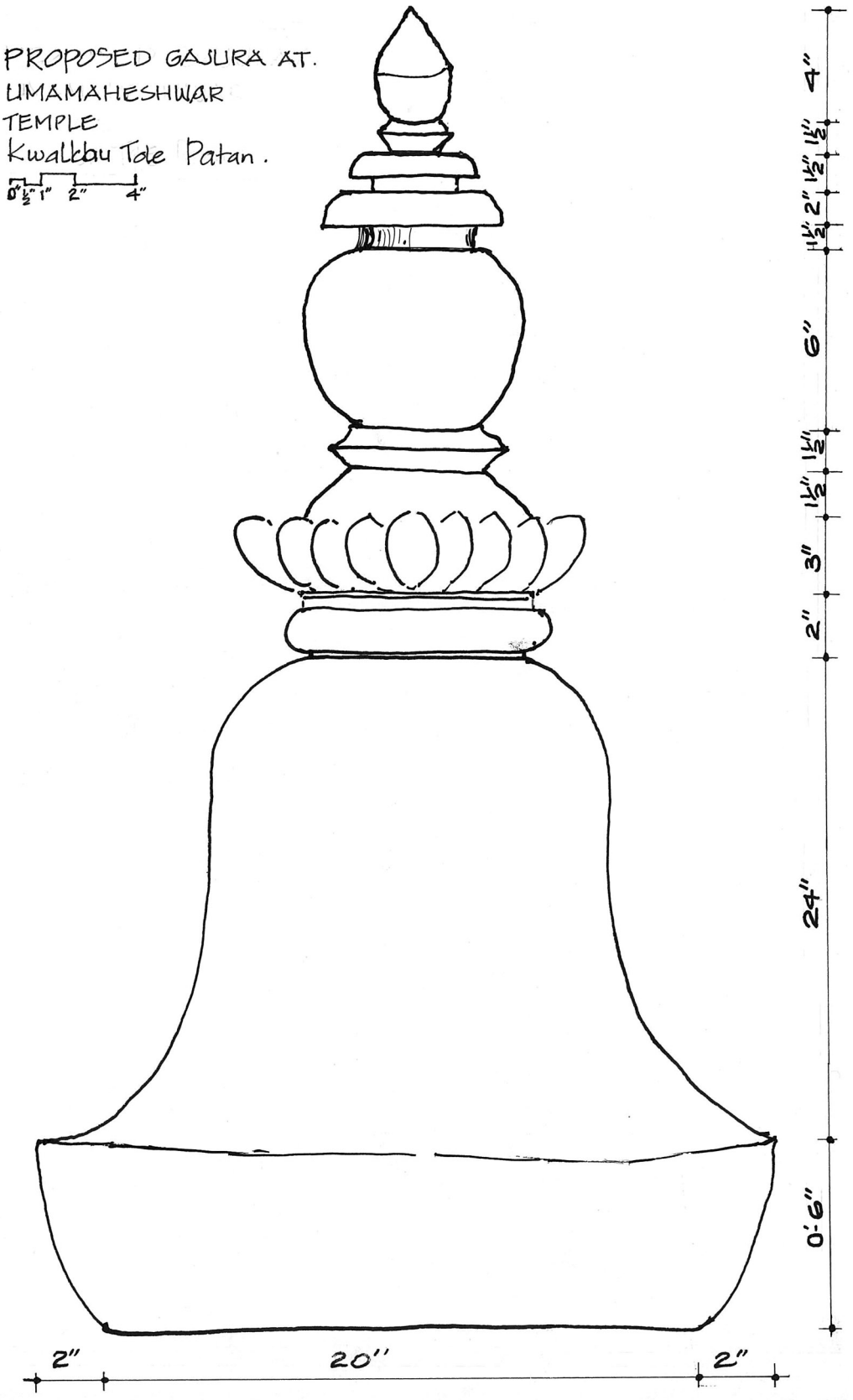
* Dry removal of dirt with soft jute brushes. These brushes will have no iron reinforcements at bristle attachments.
* Rinsing of struts with clean water.
* Cleaning with soft jute brushes and dilute soap solution (Extrann).
* Careful removal of enamel paint with surgical scalpels.
* Washing with dilute ammonia solution.
* Final rinsing with clean water.
* Application of Xylamon/Xylophene, a preservative/insecticide used at Hanuman Dhoka and Ibaha Bahi projects with successful results. The chemical is diluted with kerosene per manufacturer's instructions, included in appendix.

The upper southeast corner strut will be consolidated by the addition of a steel section treated for rust-resistance. Necessary through-bolting will be inserted only in uncarved areas and then filled with a timber plug. Investigation of alternative rust-proofing techniques will include local galvanizing plants, application of imported products such as the German Gussolit; locally available nickel plating, and multiple coats of anti-rust paint. To date, only the anti-rust paint has been employed on similar applications. The same treatment will be applied to the steel roof reinforcements.

Gajura
Conservation of the existing clay gajura is not advised because of its inappropriate size and damaged condition. As discussed above, the element may have come from another building: it appears oversized in comparison with other historically intact *gajura.* The design and installation of a new gajura in gilt copper will continue the ongoing tradition of votive donations to temples in the context of Nepal's living culture. It will employ traditional details, size, and proportions based on study of extant historical *gajura.*

6.07 Interior
Improvement of the security arrangements for the temple icon will eliminate the rising ground dampness. Negotiations with the temple guthi are ongoing as they are more concerned with security than damage from ground dampness. The existing spalling on the interior north wall is not structurally threatening and not terribly visible in the dim light of the interior. Thus, the interior walls will be cleaned, but not patched or rebuilt, maximizing preservation of historical fabric.

New brick tiles (Newari-*cika apa*) will be fabricate to match existing historical size and laid in sand to replace the damaged floor. All existing undamaged tiles will be reused.


PROPOSED GAJURA AT.
UMAMAHESHWAR
TEMPLE
Kwalkbu Tole Patan.
0" ½" 1" 2" 4"
4"
1½"
2"
1½"
1½"
6"
1½"
1½"
3"
2"
24"
0'-6"
2"
20"
2"

7.00 Recommended maintenance program

Maintenance in Nepal is a challenging question with no easy answers. Theoretically any future work on this temple will have to be approved by the Department of Archaeology, although in practice government authorities are not even able to control demolition of historic structures in the World Heritage Site, let alone specify maintenance practices. Thus, the first job of the conservation architect in Nepal is to build not only the Department's technical resources, but also the public awareness that old buildings need care and professional expertise.

The contribution of the Uma Maheswar Guthi to the project has been negotiated by the Department of Archaeology to include an additional provision of 100,000. NRps. to be put in trust for future maintenance. The trust will be monitored by the Department of Archaeology.

The following outlines recommendations the Department must issue to control well-intentioned efforts that generally lead to destruction of the historical fabric.

(1) Roof maintenance.
Roof damage must be corrected as soon as possible to prevent related timber and structural damage. During repairs of the traditional tile roofs, great care must be taken not to damage other tiles. We recommend that only tilelayers (Newari-*awale*) be used for *any* work on the roof--even removal of vegetation--as only they have the sensitivity to realize when a tile has been broken when stepped on. And they can repair it on the spot.

(2) Timber carved elements.
No paint, varnish, or treatments other than the traditional linseed oil. Current fashion is to paint everything black.

(3) Wall repairs.
NO cement mortar anywhere. As demonstrated in the study of proposed restoration work, the problem with cement and *surkhi* mortars is that they are largely irreversable, i.e. while removing them the bricks or stones are generally broken. The salt content of cement mortar reduces the life of these traditional building materials.
No paint, mud wash, or lime wash. Clean with soft bristled brushes.

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APPENDIX A

ENGINEER'S REPORT

Structural report by Engineer Prayag Joshi

STRUCTURAL REPORT OF UMA MAHESVAR TEMPLE

It is observed that the construction of Uma Mahesvar Temple was made in such a way that the whole temple is less vulnerable to horizontal loads. The following reasons gave conclusions for not putting concrete ring beams at the wall plate levels:

- The height of upper roof portion is less than the lower height (from ground level to the lower roof level). The lower level firm vertical load bearing walls with the same center of gravity throughout.
- The upper roof has number of timber ties.
- The wall plates in both the directions also serve as the ring beam.
- The clear dimensions of the upper roof (2' x 2') are very small.
- The three timber beams holding the upper wall has also tie element to prevent horizonal movements at this joint.
- The cornices both in upper and lower levels are extended in all directions, which also serve as ties.

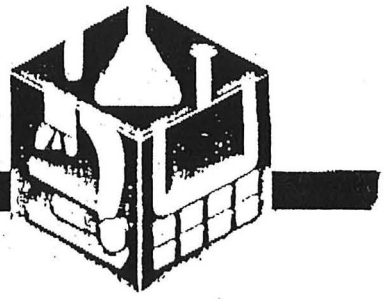
The moments and shear forces from horizonal loads in structures like Uma Mahesvar come to be minimum. Hence, the temple with necessary timber elements in places is concluded to be safe.

Prayag Raj Joshi
ARA Engineering Consultants (P) Ltd.

APPENDIX B
PRODUCT INFORMATION

TAKEDA

TECHNICAL DATA



Xylamon EX

Application

Residence, plant, school, sports facility, shrine, temple, bridge, timber post, sheet pile, pillar, bench, door, looper, bamboo blind, fence, cattle house, fruit tree support, fishing boat, yacht, train vehicle, container, bus, truck, organ, piano, carving, arts item, household Buddhist alter, wire cable drum, straw roof, plywood, particle board.

Features

(1) Xylamon EX shows long term effects since it has the outstanding permeability and sticking property to the wood.
(2) It has the outstanding effect against fungi, wood insect and termite.
(3) It shows the quick effect to kill the termite and has high anti-termite performance.
(4) It is low in odour. After drying, it is almost odourless.
(5) Overcoating of paint can be made (In about 1 week after Xylamon coating application).
(6) Bonding by the adhesive agent can be effected. (In about 1 week after Xylamon coating application)
(7) It is not regulated by the Poisnous and Toxic Substance Control Act in Japan.

Use Method

(1) The standard dosage is 4 ~ 5 m^2 per liter.
(2) Use the bush and make the coating application twice amply to the following sections.
  [1] Ground sill, horizontal brace sill, sleeper, floor joist, ledger strip, floor cluster, and floor post.
  [2] As to the pillar, stud, diagonal bracing, furring strips and window sill the part below one meter in height from the upper edge of ground sill (excluding the portion which can be seen from the room inside).
  [3] As to the mortar finish on metal lathing bed plates, the portion below one meter in height from the upper edge of ground sill.
  [4] The frame members and ceiling bed plates of the bathroom.
(3) Make the coating with particular care to such portions as are in contact with the concrete or stone, and also to the wood cut faces, joints, cracked parts, etc.

Takeda Yakuhin Kougyo Kabushiki Kai
2-12-10 Nihonbashi
Chuoku, Tokyo
Tel : 03-278-2555

武田薬品工業株式会社・環境資材本部
東京本社 東京都中央区日本橋2丁目12番10号 電話03-278-2555 FAX.03-278-2749
本 社 大阪市中央区道修町2丁目3番8号 電話06-204-2803 FAX.06-204-2405

Handling Cautions

Please peruse the following instructions to keep the product handled in safe and correct manner.

(1) If this agent contacts the skin, rash may be occurred. Therefore, do not fail to wear the protective hand gloves and protective working wear.
In case this agent contacted the skin, wash it away immediately with the soap and a plenty of clean water.

(2) This agent may irritate eye or respiratory mucous membrane. Therefore, be sure to wear the protection glasses and protection (gas) mask.
If it contacts the eye, wash well immediately with a large amount of clean running water and consult a doctor.

(3) Following person should not handle this agent.
* The person himself or the blood relatives who are inclined to suffer from nettle rash, rash, bronchial asthma, migrain, allergy.
* The person who in the past experienced in allergic symptoms (eruption, itching etc.) resulting from the paint, detergent, drug.
* The person who is in bad health, suffer from insomnia, or fever.

(4) Since this agent contains the organic solvent, headache, dizziness or nausea may be caused when it is inhaled for a long time. Therefore, arrange a good ventilation during the coating application and for some time even after the work.
In particular, if it is used indoors, never fail to provide the local ventilation facility.

(5) Be careful and avoid the application to the garden tree or flowers. Also do not put it into the pound, where gold fish or carp lives. Do not apply to the wooden bird cage or kennel or indoor wooden member of green house.

(6) Do not use this agent to the place where foodstuffs or tablewares are placed.

(7) Be careful and avoid the contact of this agent with PVC pipe which is used as the water service pipe. If contacted, wash it away immediately with the detergent.

(8) Do not apply this agent at a place where fire is used.

(9) Do not throw this agent away into the sewage, river, sea or pond.

(10) Make the sufficient hand washing and gargling after the finish of handling. Store the working cloth only after washing carefully away the attached agent.

(11) Separate from the foodstuffs, and keep away from the reach of children. Set the plug tightly and keep the good custody.
In order to maintain the quality, store it at the place, avoiding the rain water or direct sunshine.

(12) Do not discharge the waste water used for washing the machines and tools contaminated with this agent, or the used containers of this agent into the river, lake, marsh, sewage, public water area or into the ground, which may pollute the underground water.
Do not throw away the used containers of this agent but assign the disposal to the qualified agents. Handle this agent with responsibility and do not use it for any other purpose.

(13) Pay sufficient attention to prevent such accidents as theft, loss, outflow, etc.

(14) Should this agent be swallowed, do not try to make it vomit but carry the patient immediately to the hospital to receive the treatment like the stomach washing.
On such an occasion, tell the doctor that the swallowed agent contains the organophosphorous carbamate and petroleum solvent.

When this agent is used in indoor working place, observe the following caution items in order to prevent the health hazards from the workers.

(1) Provide the local exhaust device or ventilation equipment at the handling work place.

(2) Never fail to make the operators to wear the protection devices.

(3) Those who are always engaged in the handling of this agent, should receive the health check once every 6 months regularly for the purpose of better health control.
- In line with the check items for the organic solvent special health diagnosis and the special health check items for those who are engaged in the work handling the organo-phosphorous agent, the health inspection should be effected, including the regular check of serum chorine esterase activity value.

DU PONT AGRICHEMICALS

PRODUCT INFORMATION DATA

KARMEX* WEEDKILLER

A wettable powder containing 80% diuron for long-term control of weeds in non-crop areas. Approved by Agricultural Chemicals Approval Scheme under Approval No. 1793.

Toxicological Data

Acute LD_{50} for rats 3400 mg/kg body weight

Karmex can be irritating to eyes, skin and respiratory system.

Product Properties

Karmex is a residual herbicide which will control a wide range of annual grasses and shallow rooted broad leaved weeds. Rain soon after application is essential to carry Karmex into the root-zone of germinating weeds. The product is absorbed through the roots and inhibits photosynthesis within the plant. Karmex may be applied to most soil types but length of residual weed control may be reduced on heavy soils or soils high in organic matter.

Karmex is non-corrosive to equipment, non-flammable and non-volatile.

Weed Control Properties

Karmex may be used pre-emergence or shortly before weed growth begins, at any time of the year except when ground is frozen, provided adequate moisture is available by rainfall to activate the herbicide

Rate of Use

The [illegible] absorbed or adsorbed [illegible] soil [illegible] high [illegible] are [illegible]

[illegible]

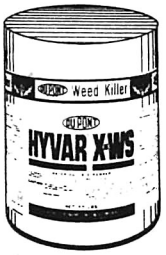
IMPORTANT FACTS ABOUT DU PONT WEED AND BRUSH KILLERS

A. SOIL STERILANTS

1. **HYVAR® X** bromacil weed killer . . . is especially suited for control of hard-to-kill perennial weeds and grasses on industrial sites. It is a wettable powder containing 80% bromacil (5-bromo-3-sec-butyl-6-methyluracil). It is highly active against a broad spectrum of broadleaf weeds and grasses. "Hyvar" X may be mixed in either water or a herbicidal oil and sprayed to the surface of the ground where it is carried by rainfall into the soil and is taken up by the roots of weeds. Depending upon the rate applied, "Hyvar" X persists in the soil for an extented period of time and gives long-lasting control of weeds.

   "Hyvar" X is non-flammable, non-volatile, non-corrosive and low in toxicity to man and animals when used as directed. "Hyvar" X has two particular advantages as a soil sterilant. First, it is activated with a very small amount of rainfall—as little as 1/2 inch. Second, its breakdown by heat and light is negligible so that it will persist on the soil surface and become active when rainfall occurs.

2. **HYVAR® X-WS** bromacil weed killer . . . is a 50% active bromacil water soluble formulation which performs identically to "Hyvar" X on a pound-for-pound active ingredient basis. It dissolves completely in water with slight agitation.



3. **KARMEX®** diuron weed killer . . . is a substituted urea compound formulated as a wettable powder containing 80% diuron, 3-(3,4-dichlorophenyl)-1,1-dimethylurea. It is applied as a spray to the surface of the ground for weed and grass control. It is a versatile and effective weed killer giving weed control at low rates of use, and, because it is only slightly soluble in water, it persists in the soil to give long-term weed control, particularly under conditions of high rainfall. The product is non-flammable, non-volatile, non-corrosive and is low in toxicity to humans and animals under recommended conditions of use.

4. **TELVAR®** monuron weed killer . . . another member of the family of substituted urea herbicides is formulated as wettable powder containing 80% monuron, 3-(p-chlorophenyl)-1,1-dimethylurea. Its weed and grass control activity is much the same as that of "Karmex", but the product is more soluble. Because of this, it is preferred primarily in areas of lower rainfall or for late season use. It, too, is non-flammable, non-volatile, non-corrosive and is low in toxicity to humans and animals under recommended conditions of use.

B. PERENNIAL VINE CONTROL CHEMICALS

1. **ZOBAR® WEED KILLER** — A solution containing 4 lbs. of chlorinated benzoic acids per gal. to be diluted in water for use as a spray for non-select selective control of certain undesirable broadleaf weeds and certain species of woody plants. It is absorbed by foliage and leaches into the soil to be taken up by the roots. It controls perennial vines such as bindweed, smilax, and trumpet vine and perennial weeds such as Canada thistle, leafy spurge, blueweed, and Russian knapweed.

2. **TRYSBEN®** 200 weed killer . . . a water solution of the dimethylamine salts of trichlorobenzoic acids, "Trysben" 200 is intended to be diluted further with water and applied as a spray to the weeds and surface of the ground where it is both absorbed by foliage and leaches into the soil to be taken up by roots. "Trysben" 200 is especially useful for control of many deep-rooted perennial broadleaved weeds, such as bindweed, and woody vines such as smilax and trumpet vine. It will persist in the soil for extended periods of time depending on the amount applied.

C. BRUSH KILLERS

1. **Foliage Spray**

AMMATE® X weed and brush killer . . . is soluble in water and is non-flammable, non-volatile, and low in toxicity to man and animals under recommended conditions of use. Because of its lack of volatility, it is the preferred foliage-applied brush killer for use along rights-of-way adjacent to agricultural crop areas. When applied as a foliage spray, it is recognized as one of the most effective compounds for the control of woody brush. It may also be used to treat stumps following cutting, and can be applied in frills, notches, and cups to control unwanted trees. "Ammate" X may be applied easily with spray equipment. It may be applied in solution with water plus Du Pont Surfactant WK or Du Pont Spreader Sticker, or in an oil-water emulsion.

"Ammate" Weed and Brush Killer Solution, a concentrated solution of ammonium sulfamate in water, is available in tank car quantities from Du Pont.

2. **Soil applied**

DYBAR® fenuron weed and brush killer . . . is formulated as a dry pellet containing 25% fenuron (3-phenyl-1,1-dimethylurea). The 1/8 inch cylindrical pellets are applied just as they come from the container to the surface of the ground beneath the brush. With no sprayer or heavy equipment needed, application is extremely easy. "Dybar" is non-volatile, non-corrosive, non-flammable, and low in toxicity to humans and animals.

D. ADDITIVES THAT IMPROVE PERFORMANCE OF CERTAIN WEED AND BRUSH KILLERS

1. **DU PONT SURFACTANT WK** . . . improves weed and brush control results when used with "Hyvar" X, "Hyvar" X-WS, "Karmex", "Telvar", "Ammate" X, Sodium TCA, and Sodium Chlorate. It increases the solubility of some chemicals that are low in solubility and gives better kill on some tough-to-kill species. Surfactants improve wetting and spreading of chemicals for better control on vegetation, especially when temperatures are above 85°F and soil is dry and humidity low.

2. **DU PONT EMULSIFYING AGENT A** . . . an emulsifying agent that is used in preparing oil-water emulsions of "Ammate". The use of this mixture in general enhances performance of "Ammate" and minimizes corrosion on metal surfaces.

FACTORS WHICH MAY AFFECT RESULTS OF WEED CONTROL APPLICATIONS

A. INTRODUCTION

Weed control in non-crop areas of industry often means controlling all vegetation for an extended period, (a growing season or longer). The needs of the industry usually determines the degree of control desired. But weeds should be controlled before becoming too well established in the spring so that the dead plants will not remain as a fire hazard.

There are many variables in nature and with the chemicals which are factors in obtaining these different degrees of vegetation control. The most important are discussed below.

B. TYPE OF CHEMICAL

Chemicals are usually classified as follows:

1. **Contact types** — Detrimental to plant tissues and destroy the plant shortly after application. They produce plant kill within a few hours, are favored by good plant conditions and leave no residual action.

   Contact chemicals are often added to soil sterilants to enhance results.

2. **Foliage Translocated Chemicals**
   These materials are absorbed by foliage and other green plant tissues, are transported throughout the plant, and interfere with plant growing processes. They usually require several days for toxic effects to show, generally have a short residual action in the soil, and are specific in that they will control certain types or species of plants. Their application results in short term control and repeat applications are necessary for continued control. Also, their specificity requires that mixtures of chemicals be used if broad spectrum control is desired.

3. **Root Absorbed Chemicals**
   These chemicals are of the soil sterilant or residual type ("Hyvar" X, "Hyvar" X-WS, "Karmex" or "Telvar"). When applied at high rates, complete control of all vegetation is obtained. One application usually lasts a growing season.

   These materials should be applied to the surface of the soil. Water is required to dissolve and activate the material. The chemical is picked up by the roots of vegetation and translocated throughout the plant where toxic symptoms begin to show. Plant control is a matter of time. They should be applied just prior to or shortly after emergence of vegetation in the spring. In late spring and summer applications, they should be combined with contact or foliage translocated type chemicals to speed up results.

C. TYPES OF CHEMICAL VEGETATION CONTROL

1. **Soil Sterilization (Where Bare Ground is Desired)**
   The application of residual type herbicides gives complete control of all vegetation. This is desired in areas where weed and grass growth creates serious risks such as fire hazards, decreased maintenance efficiency, or where maintaining bare ground economically is desired. Initially high rates are required but retreatments at 1/2 to 1/3 of the initial rate is usually recommended.

2. **Abatement Vegetation Control**
   This term denotes the use of a chemical (or combination of chemicals) at rates which result in knockdown of existing vegetation and retarda-

tion of regrowth. One to three applications may be necessary depending on the length of the growing season and the chemical combination used. It is designed for areas where bare ground is not necessary.

3 **Selective Weeding**

Selective weeding means selectively controlling certain plants without injury to a stand of desired vegetation with a chemical or combination of chemicals. These chemicals may be applied either as pre or post-emergence treatments.

4. **Chemical Trimming & Pruning**

Denotes the use of contact chemicals to knockdown vegetation in close proximity to valuable plants. Weeds and grasses under fences, along the base of buildings, under shrubbery, etc. may be controlled by treating the foliage of the undesired plants.

Limbs of trees that overhang on a right-of-way may be controlled by directing the spray to those limbs. This is accomplished without material damage to the tree.

5. **Brush Control**

a. **Summer Foliage Treatment** (applicable to medium or dense stands of brush) — The application of chemicals to leaves and stems of brush during the active growing season. Complete wetting of the plant to the point of runoff is necessary for effective control.

b. **Basal Applications** (to light or scattered stands of brush) — Dry pelleted products such as "Dybar" may be applied to the soil at the base of individual stems or clumps of brush in late winter to early summer to clean up these infestations. Also, 2,4-D — 2,4,5-T or 2,4,5-T LV Esters in diesel fuel may be applied to the lower 18 inches of a plant anytime during the year.

c. **Stump Treatments** — The application of "Ammate" or 2,4-D — 2,4,5-T to the freshly cut surface (within 24 hours) of a stump to prevent it from resprouting.

d. **Dormant Cane Treatment** — The application of 2,4-D — 2,4,5-T or 2,4,5-T in diesel fuel to dormant vegetation in the winter for its control. Eight to 16 lbs. active ingredient in 100 - 200 gallons of diesel fuel per acre is usually used.

e. **Aerial application** — The use of fixed wing aircraft or helicopter to apply weed and brush control chemicals.

D. TYPE OF PLANT

The type or species of vegetation influences the selection of the chemical or treatment. **Annual and biannual type** weeds and grass originate from seeds in the surface of the soil and can be controlled with low rates of residual type herbicides applied prior to emergence or with combinations of soil sterilants and contact materials after emergence.

Perennial type vegetation have root systems which live from year to year. They require specific translocated herbicides or soil sterilant type chemicals at high dosages for their control.

In general, a broad spectrum soil sterilant such as "Hyvar" X or "Hyvar" X-WS, and "Karmex" is capable of controlling most vegetation for a year or more. Resistant weeds or grasses should be spot treated with a specific material or retreated at initial rates.

E. THE SOIL

Soil type affects the dosage required to control plants. In light soils, herbicides are more active due to less adsorption so that lower rates are required. Soils which are high in organic matter or clay are adsorptive,

requiring higher rates to kill the weeds and more rainfall to wash the herbicides down into plant root zones. In heavy soils, "Hyvar" X and "Hyvar" X-WS will perform better and faster than "Karmex" or "Telvar".

The organic content of a soil also determines the population of soil micro-organisms such as bacteria or fungi. These micro-organisms may destroy some of the organic herbicides and shorten their duration of activity. The bromacil compounds ("Hyvar" X, "Hyvar"X-WS) are not as effected as "Telvar", "Karmex" and "Dybar".

F. RAINFALL

Water is important in chemical weed control. It acts as a vehicle for application, the soil sterilant type chemicals must be in solution in water before they can enter the root systems of plants, and excessive water can leach the chemicals out of the soil to reduce their effectiveness. Water is also a necessary ingredient for growth of plants, thereby affecting growth rate and performance of contact or foliage translocated herbicides.

The rate of rainfall is an important factor in determining which soil sterilant should be recommended in a given area. In high rainfall areas a lower solubility chemical such as "Karmex" is suggested whereas in the semi-arid to arid areas higher solubility materials such as the "Hyvar" products are recommended.

G. THE APPLICATION

Proper application is the key to success of any herbicide treatment. Soil sterilants should be applied evenly to the surface of the soil at the recommended rate. Contact materials must be distributed evenly to the foliage of vegetation when atmospheric conditions are conducive for good control. And with foliage translocated herbicides, proper timing and good coverage are essential for performance.

H. SURVEYING THE SITUATION

Only through a survey can the problem be critically analyzed and proper steps be taken to get the best possible control (commensurate with the need). In such a survey, the following factors are important:

1. **The Type of Weeds** — It is critical that the various kinds of weeds be identified in order to select the proper weed killer and amount needed for the job.
2. **The Objective** — The selection of the chemical or combinations of chemicals to be used will depend on the results desired.
3. **Soil Type** — Is the soil sandy, heavy clay, or highly organic? Higher rates are needed for the clay and organic soils and more rain necessary.
4. **Climatic Factors** — How much rainfall is expected? Is it evenly distributed over the year or seasonal? Rainfall patterns usually dictate the timing of applications as well as the proper material and quantity.

I. SURFACTANTS

The use of a good surfactant such as Du Pont WK has improved weed control results obtained with such compounds as "Karmex", "Hyvar" X, "Hyvar" X-WS, TCA, Dalapon, MSMA, and DSMA. This is particularly true when spraying established vegetation, which is under-going drought stress or other adverse growing conditions, and temperatures are above 80° F.

APPENDIX C
FUNDING PROPOSAL

THE KATHMANDU VALLEY PRESERVATION TRUST
24 QUINCY STREET CAMBRIDGE, MASSACHUSETTS 02138 USA
TEL: 617-659-1883 FAX: 617-659-2409
BHAKTAPUR DARBAR SQUARE, BHAKTAPUR, NEPAL
TEL: 610957 FAX: 9771-610957

Project costs

1.	Site office and store	7,500.
2.	Photo documentation	2,500.
3.	Measured survey of monument including full documentation of existing conditions, restoration construction drawings, iconographic program	7,500.
4.	Conservation consultant (local expert)	15,000.
5.	Nepali staff architect, engineer, and overseers Team calculated @ 10% of project	49,300.
6.	Administraton and local fees	6,400.
7.	Materials control, bookkeeping, financial statement	3,000.
Project costs subtotal:		**91,200.**

Total project and construction costs:
from previous page **584,796**

Detailed Estimate

Site:- UMA MAHESWAR PAGE 1 OF 6. Date:- DECEMBER 20.91

No.	Description of work	Quantity	Unit	Material		Labour	
				Rate/Unit	Amount	Rate/Unit	Amount
N.B.	NUMBERS REFER TO WORK ITEMS IN ABSTRACT OF CONSTRUCTION COSTS SUMMARY.						
(1)	BAMBOO SCAFFOLDING						
	OVERALL SIZE OF FRAME FOUR SIDES	22'x 25'					
	SPACING OF BAMBOOS 3' ON CENTER NECESSITATES						
	BAMBOO ⟶	120	PC.	100/PC	12,000		
	BAMBOO TWINE AND LABOR FOR ASSEMBLY + DISMANTLING					L.S.	3,000
rent.	TOTAL : 15,000				TOTAL	15,000	
(2)	DISMANTLING OF UPPER AND LOWER ROOFS, STORAGE OF REUSABLE SAL TIMBER + ROOF TILE					L.S.	1,500
(3)	SITE CLEARANCE & CLEAN UP INCL. TRASH REMOVAL BY TRUCK					L.S.	8,000
(4) (A)	REBUILDING OF STRUCTURAL MASONRY MAADA BRICK						
	UPPER LEVEL WALL AREA	2(5'4" x 1'6" x 2'6")	=	44	cu.ft		
	LOWER LEVEL N. FACADE	5'9" x 2'0" x 9'7")	=	110	cu.ft		
	LESS REUSABLE (60%)		−	84	cu.ft.		
				70	cu.ft.		
	70 cu.ft @ 63 Rp/cuft. labor + materials		=	4410.			

L.S. = LUMP SUM.

Prepared by:- Checked by:- Approved by:-

Site:- UMAMAHESWAR P. 2 Date:- DEC 20.91

No.	Description of work	Quantity	Unit	Material Rate/Unit	Material Amount	Labour Rate/Unit	Labour Amount
(4)	(B) REFACING WITH DACHI APA BRICK RESULT WALL AREA + MISC. PATCHING	195	SQ FT	92/SQFT	MAT'L + LABOR →		17,940
	(C) SHORING UP DURING REBUILDING OF LOWER WALL				L.S.		500
	TOTAL # 4 ABV.						22,350
(5)	SEISMIC CONSOLIDATION. REINFORCEMENT OF EXISTING STRUCTURE AT WALL PLATE LEVELS TO RESIST LATERAL FORCES W/ POSSIBLE R.C.C. "RING" BEAM INSERTION						
	ALLOWANCE						5,000
	BASED ON WORSTCASE R.C.C. RING BEAM. CEMENT CONCRETE						
	CEMENT	17.4	CUFT.	80/CUFT	1392		
	REINFORCEMENT	78.4	KG	30/KG	2352		
					4744 ≈		5000
(6)	TIMBER ROOF STRUCTURE						
(A)	SAL RAFTERS						
	LOWER ROOF						
	72 PIECES: 72 X	12'-6"	x 3" x 4" =		75 CU. FT		
	# X	AV. LENGTH	x DIMENSION				

Prepared by:- Checked by:- Approved by:-

Detailed Estimate

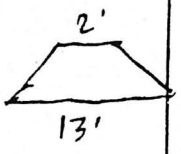
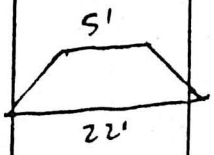
Site:- UMA MAHESWAR P. 3 Date:- DEC. 20. 91

No.	Description of work	Quantity	Unit	Material Rate/Unit	Material Amount	Labour Rate/Unit	Labour Amount
	LOWER ROOF	75 CU. FT					
	UPPER ROOF						
	45 PIECES x	9'0" x 3" x 4" =			34 CU. FT		
	SUBTOTAL RAFTERS	109	CU.FT				
	15% WASTAGE	+ 16	CU FT				
		125	CU FT.				
	(B) WALL PLATES						
	LOWER: 4 PIECES	9'9" x 5" x 4" =			5.28 CU.FT		
	UPPER: 4 PIECES	5'-4" x 5" x 4" =			2.88 CU FT.		
					8.16 CU FT.		
	(C) BEAM ABOVE STRUTS, SUPPORTING RAFTERS.						
	LOWER: 4 PIECES	22'0" x 4" x 6" =			14.52 CU FT.		
	UPPER: 4 x	14'0" x 4" x 6" =			9.24		
					23.76		
	TOTAL STRUCTURAL TIMBER (A, B, C, ABOVE)						
	(A)	125 x 850 =			106250		
	(B)	8.5 x 850 =			7225		
	(C)	24 x 850 =			20,400		
					133875		

Prepared by:- Checked by:- Approved by:-

Detailed Estimate

Site:- UMA MAHESWAR P.4 Date:- DEC.20.1991

No.	Description of work	Quantity	Unit	Material Rate/Unit	Material Amount	Labour Rate/Unit	Labour Amount
(7)	(A) ROOF PLANKING						
	UPPER ROOF						
	4 SIDES x $\frac{13'+2'}{2}$ x 8' =		240 SQ FT				
	LOWER ROOF						
	4 SIDES x						
	$4 \times \frac{22+5}{2} \times 12 =$		648 SQ FT				
	TOTAL ROOF AREA :		888 SQ FT				
	1" SAL PLANKING	888	65/SQFT =		57,720		
	(B) 1" SAL EAVES BOARD						
	$4 \times 22' \times 9" =$		66 SQ.FT				
	$4 \times 14' \times 9" =$		42 SQ FT				
			108 SQ FT.				
	108 x 70/SQFT =		7560				
	SUBTOTAL ITEM 7 =		65280.				
8.	CONCEALED REINFORCEMENT OF DAMAGED CARVED TIMBER STRUTS						
	ALLOWANCE		L.S				10,000.

Eqt.

Prepared by:- Checked by:- Approved by:-

Detailed Estimate

Site:- UMA MAHESWAR P.S Date:- DEC. 20. 91.

No.	Description of work	Quantity	Unit	Material Rate/Unit	Material Amount	Labour Rate/Unit	Labour Amount
(9)	ROOF COVER						
(A)	GALVANIZED METAL MEMBRANE MATERIAL			35 /SQFT			
	TWO SIDED PAINTING W/ BITUMEN 80/100, BOILED @ 180°			5 /SQFT.			
	INSTALLATION					10 /SQFT	
	TOTAL					50 /SQFT	
	ROOF AREA	888	SQFT	50/- =		44,400.	
(10)	JHINGHATI CLAY TILES						
	1. TILES	888	SQFT	30 /SQFT. (LABOR+MAT'L) →		26,640.	
	2. TIMBER BATTENS FOR FIXING MUD		LS			4 500	
	3. RIDGE TILES	85	lin ft.	85 /LIN FT =		7 225	
	4. AVIARY CORNER TILES	8	PC.	120 /PC.		960	
	5. PROV. + INSTALL TERRACOTTA PINNACLE (GAJURA)		L.S.			1,000	
	TOTAL #10					40,325.	

Prepared by:- Checked by:- Approved by:-

Detailed Estimate

Site:- UMA MAHESWAR P.C Date:- DEC. 20.91

No.	Description of work	Quantity	Unit	Material		Labour	
				Rate/Unit	Amount	Rate/Unit	Amount
(11)	CLEANING OF HISTORICAL WOODWORK AND CARVINGS BY HAND.						
	100 MAN DAYS (LABORER)	100	M.D.	@ 60 RP/ M.D	= 6000.		
(12)	CHEMICAL TREATMENT INSECTICIDE + PRESERVATIVE APPLICATION ON NEW + OLD TIMBER		L.S.				15,000,
	NOTE. THIS COST MAY BE SAVED/REDUCED IF THE DEPT. OF ARCHAEOLOGY HAS THE MOST EFFECTIVE CHEMICALS IN STOCK AND AGREES TO SUPPLY US.						
(13)	CLEANING AND REPOINTING - FACADE.						
	- CLEANING COSTS NEGLIGIBLE						
	- POINTING						
	30% OF TOTAL WALL AREA (1268 SQ FT) =				420 SQ FT.		
	420 SQ FT X 10 RP/SQ FT =				4200.		

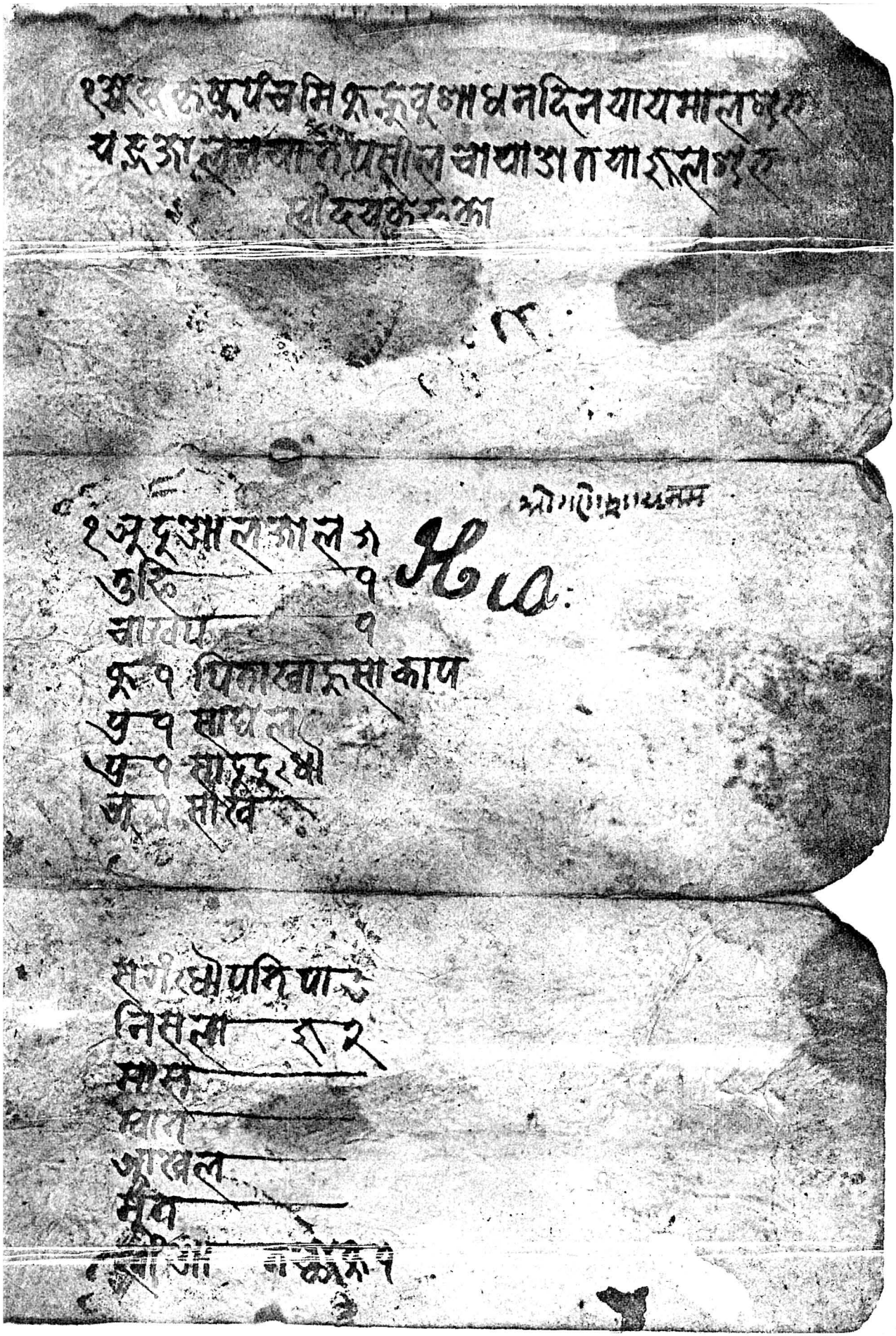
Prepared by:- Checked by:- Approved by:- 697.

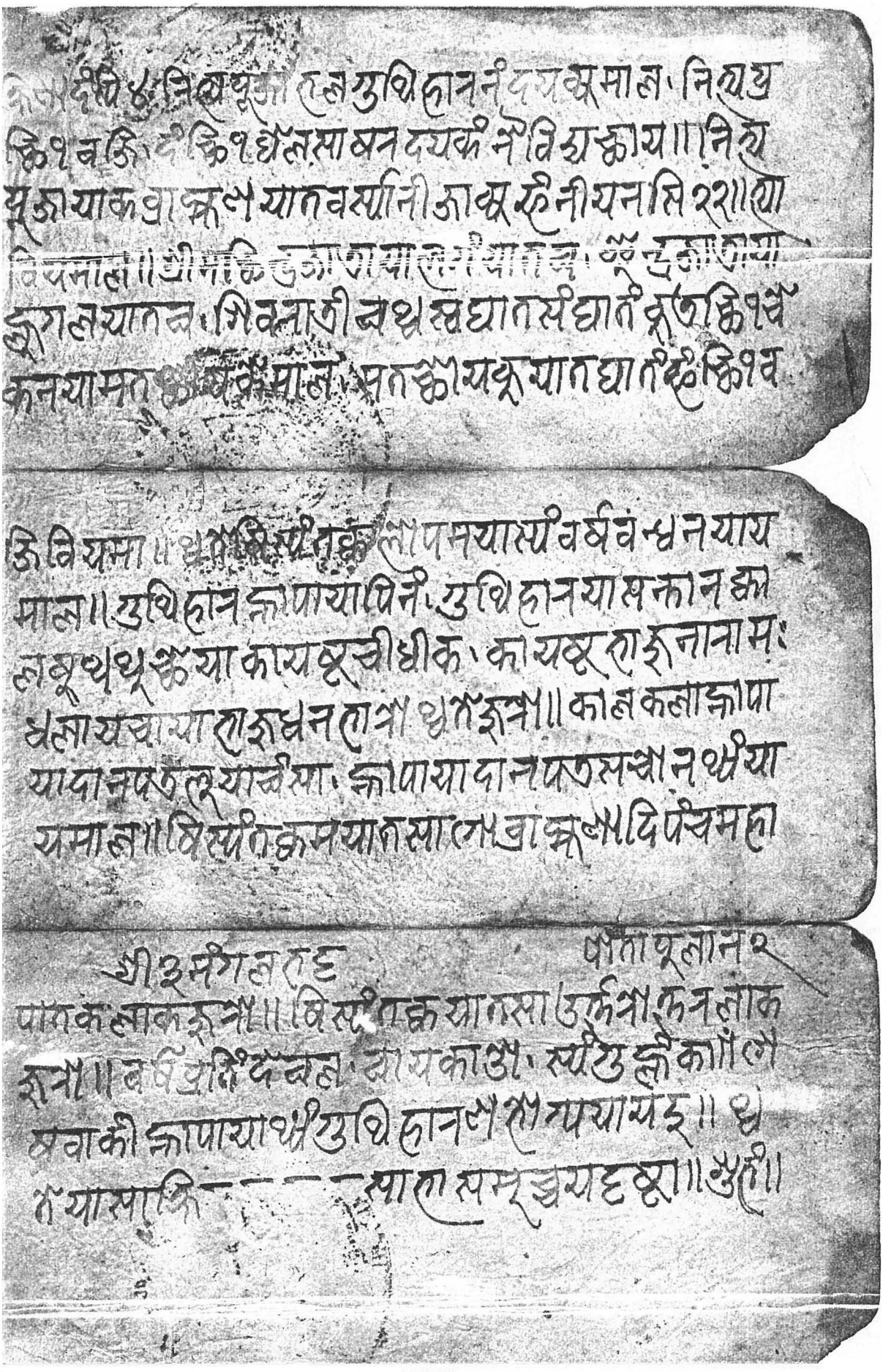
Site:- UMA MAHESWAR P.6 Date:- DEC 20.91.

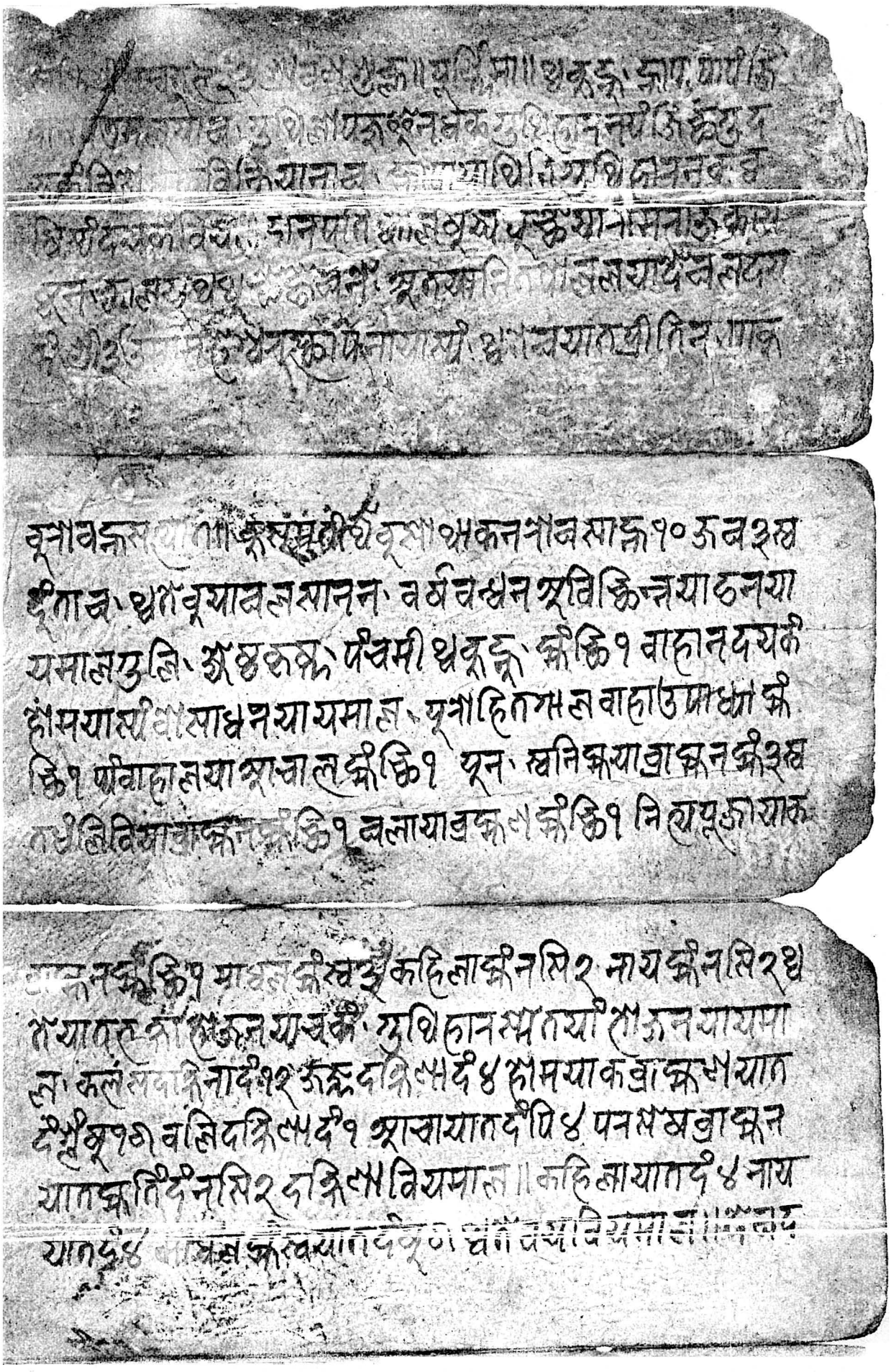
No.	Description of work	Quantity	Unit	Material Rate/Unit	Material Amount	Labour Rate/Unit	Labour Amount
14.	RESTORATION OF PLINTH + INTERIOR PAVING. *						
*	(THIS WORK WAS NOT ORIGINALLY PROPOSED BY THE TRUST AS IT IS NOT CRITICAL TO THE STRUCTURAL HEALTH OF THE MONUMENT. THE LOCAL GUTHI HAS REQUESTED INCLUSION OF THIS WORK TO IMPROVE ITS CHARACTER AS A "LIVING MONUMENT" I.E. EASY TO BE SAT ON, WORSHIPPED IN.)						
	DACHI ADA BRICK FACING 200	200	SQFT	(LABOR + MAT'L) 91 /SQ FT =	18,200		
	STONE APRON	20	SQ FT	(LABOR + MAT'L) 260 /SQFT =	5,200		
	TELIA TILE INTERIOR + PLINTH	275	SQ FT	(LABOR + MAT'L) 60 /SQFT =	16,500		
	TOTAL # 14						39.900,

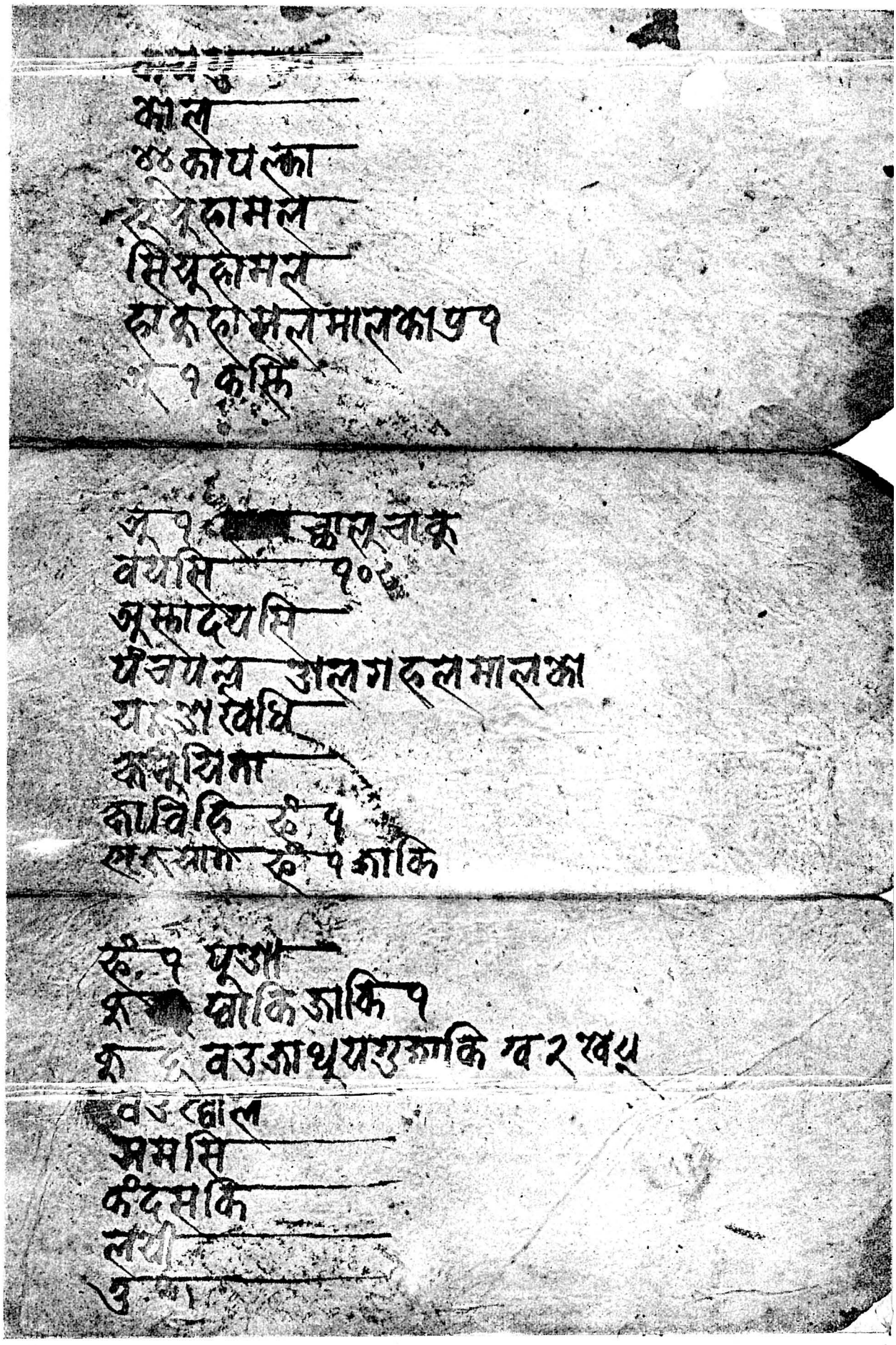
Prepared by:- Checked by:- Approved by:-

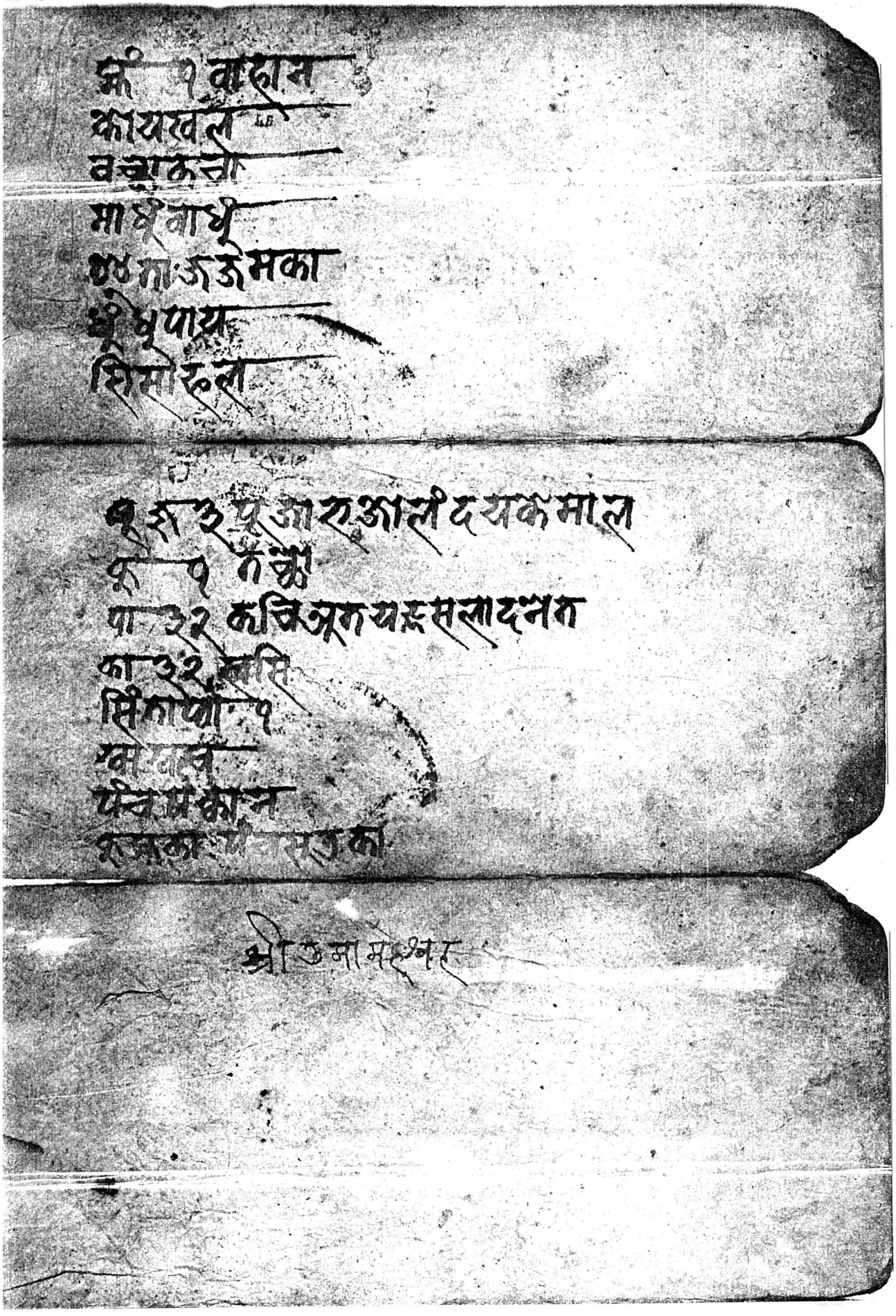
APPENDIX D
HISTORICAL DONATION LETTER











श्री उमामहेश्वर

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