

PATUKVA AGACHE
PATUKVA TOL, PATAN

HISTORIC STRUCTURE REPORT
JUNE, 1994

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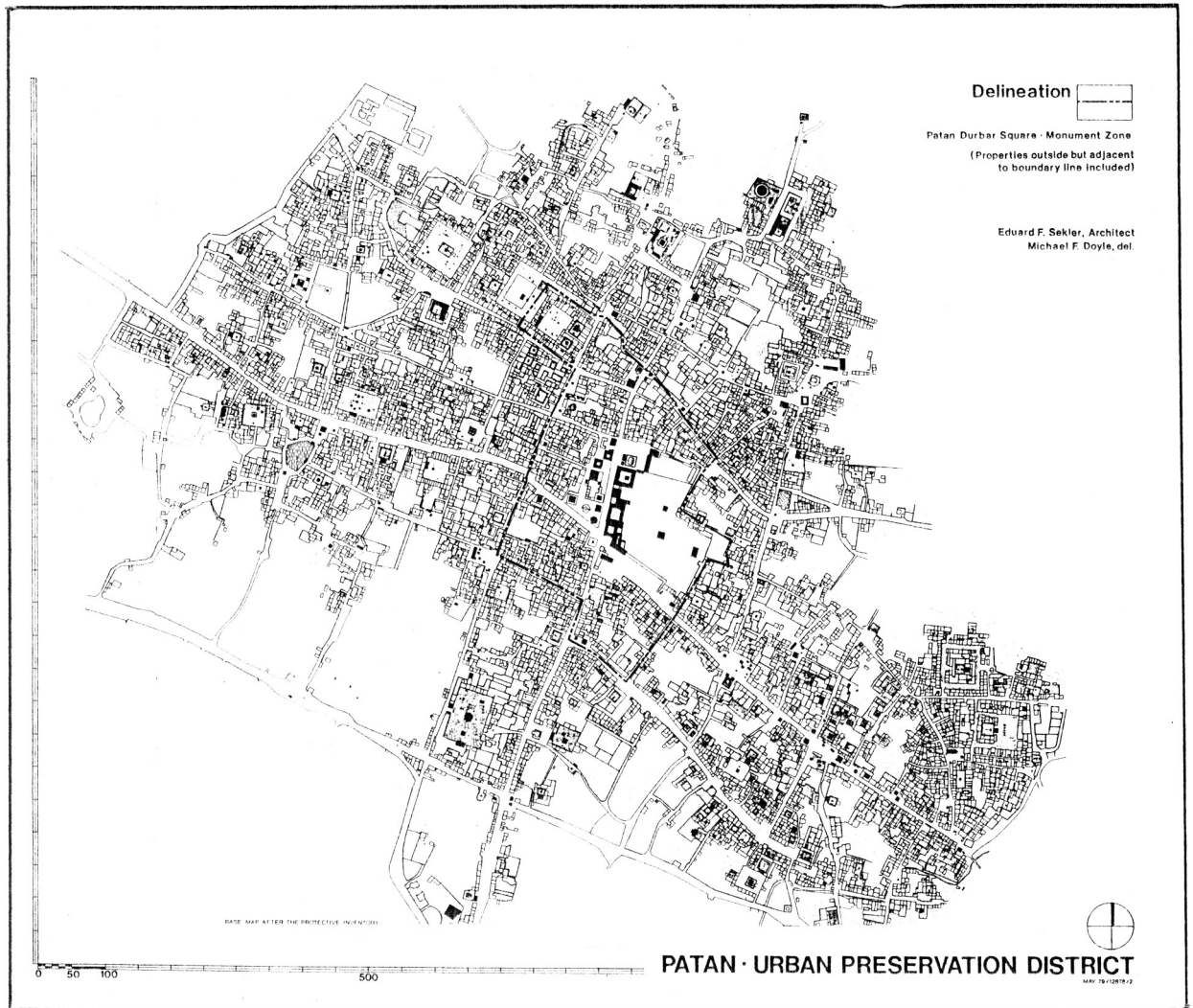
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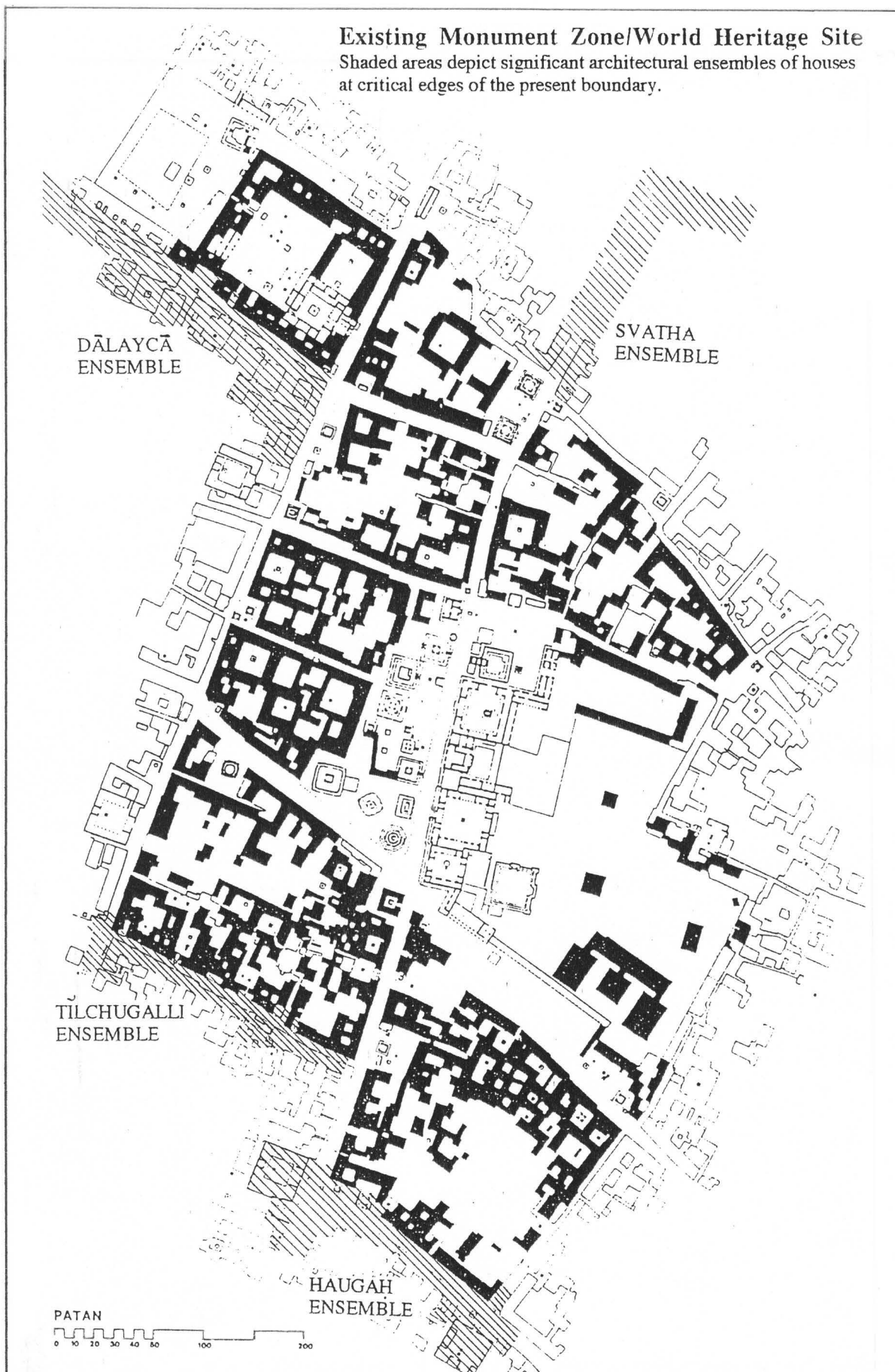
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Above: City map of Patan by E. F. Sekler, 1979.
Below: The Agache seen from the southeast, Spring 1992.





Patan Protected Monument Zone / World Heritage Site as gazetted June 10,1985
Patukva Agache shown in red.

1.0 INTRODUCTION

The Patukva Agache, a rare example of a five-story esoteric shrine house which retains most of its historic features, is a key monument of the Malla era (1400-1769). The seventeenth century structure is composed of a two-story pagoda atop a three-story base, more residential in appearance. In a survey of monuments in and adjacent to the Patan World Heritage Site and in consultation with the Department of Archaeology, the Trust determined this historical structure to be the most threatened monument of significant historical and artistic value. It was proposed as a pilot restoration project to the British Ambassador to Nepal for possible funding by the British Overseas Development Administration with the following background justification:

- (1) In 1989 the working group of the UNESCO Campaign for the Safeguarding of 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.
- (2) Technically, the Patukva Agache lies within the Patan Darbar World Heritage Site Monument Zone (see E.F. Sekler's Patan Darbar Square Monument Zone/UNESCO Mission January, 1984). There are at present considerable misinterpretations and unclarities about that boundary which may be solved by a ongoing redelineation by the Department of Archaeology. The gazetted legal boundary, according to HMG Ancient Monuments Act, follows the centerlines of streets in the vicinity of the Darbar Square and is interpreted to include all adjacent buildings. In practice, however, only those buildings closest to the Darbar Square, i.e. on one side of the street, have been monitored. Thus, the restoration of the Patukva Agache, which lies on the side of the street *away* from Darbar Square, will help to cement the legal boundary of the Patan Darbar World Heritage Site.
- (3) Thirdly, Patan is a city on the edge, a city whose rich artistic and architectural heritage is threatened daily by the pressures of development and the rapidly deteriorating condition of its monuments. The restoration of Patukva Agache will enhance and be complemented by nearby restoration projects currently in progress including Keshav Narayan Chowk and Iba-Bahi, implemented by the Austrian Government and the Japanese Nippon Institute of Technology, respectively. These projects, in combination with the ongoing German-aided Patan Conservation and Development Programme will focus local and international attention on the urgency of preservation efforts in Patan.
- (4) Lastly and most importantly, there exists a tremendous lack of provisions for maintenance, protection, and restoration of monuments which fall under the semi-private ownership of religious trusts (*guthis*). With the degeneration of the historical guthi system in the last decades, dozens of significant monuments have become threatened. They do not come under the direct jurisdiction of the national agency responsible for conservation of monuments, HMG

Department of Archaeology. The Department of Archaeology, in cooperation with the GTZ/ Patan Conservation and Development Programme, proposes to designate many of those buildings "National Monuments", while establishing the legal framework to monitor and provide technical and financial support for their maintenance. This proposal naturally includes the fine Patukva Agache. International financial assistance for the restoration of such a monument is therefore seen as a critical and necessary precedent for the preservation of the semi-private architectural heritage of Nepal.

(5) The Patukva Guthi, in a show of support of this international effort to restore the building has agreed to donate 250,000 Rs/, a substantial contribution for the local economy, and one which makes this a model collaboration. The legal agreement drafted and included in the appendix A similarly will serve as a model document for the terms on which assistance can be given to a semi-private monuments.

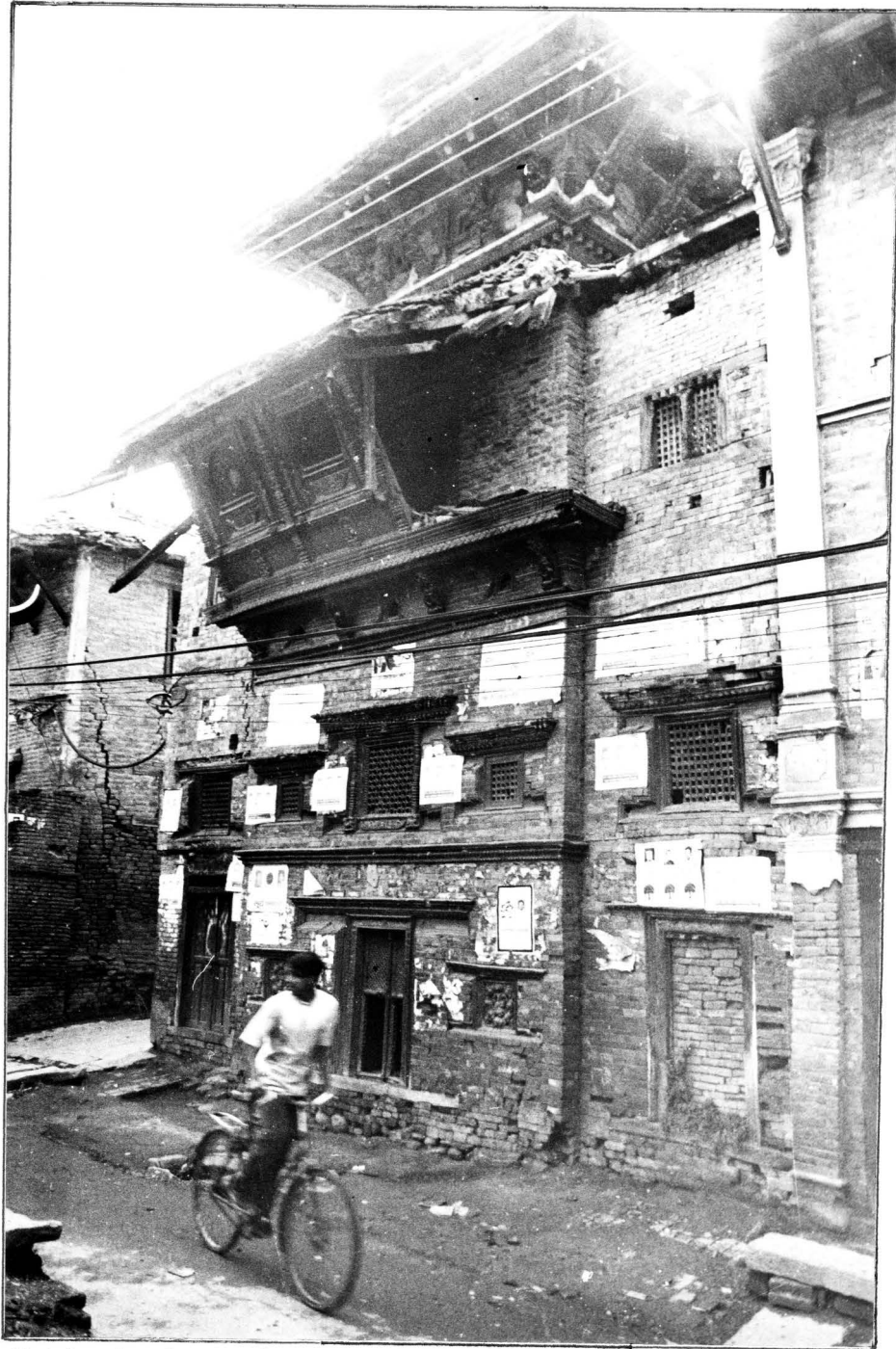


The Agache seen from the southeast, after emergency assistance by K.V.P.T. including tarpaulins on roof to protect building from monsoon rain, Spring 1992.

(6) Lastly, given the intact religious confraternity of the Guthi and their ongoing ritual duties, the building can be rebuilt, restored, and delivered to the owners for its historical use. The only modification of this arrangement, currently under discussion, will be the conversion of part of the ground floor to rentable shop space. This rental income is envisaged to help defray maintenance expenses of the restored building.

2.0 BRIEF HISTORY

For the Patukva Agache no documentary evidence such as manuscripts, *in situ* inscriptions, or photographs have been found to shed light on the building's history. Based on stylistic analysis of the intact carvings of the principal facade, however, the building can be assigned a 17th century date. This places the building in the most active



Patukva Agache, seen from east, summer, 1993.

era of construction in the Patan Darbar Square when a great number of its best-known monuments were constructed including Sundari Chowk in the palace complex, the Viswanath and Bhimsen temples. A seventeenth century date also corresponds to the traditional history of the Guthi which reports that this agache was founded by Biswanath Rajopadhya, son of Gayabajya, the most famous historical and legendary Tantric of Patan. Gayahbajya's residence and esoteric shrine are extant at Sulima Tol, Patan and stylistically appear to be a generation earlier than Patukva.

The Patukva Agache belongs to the Rajopadhya clan, Newar Brahmins of Patan who served as court priests in Malla times (1420-1769). The clan is still resident in the seven courtyards adjacent to the Agache: Hanuman Chowk, Nasa Chowk, Baithak Chowk, Taraghras Chowk, Saga Chowk, Kahisi Chowk, and Kebaha Chowk. The clan includes some 28 neighbouring families.



Bhuteswar with his Shakti on ground floor

Typical of an agache or esoteric shrine house, the god's name is secret and only referred to among outsiders as *agamaju*, a generic term. The principal esoteric god, a gilded sculpture formerly installed on the second floor, was stolen in 1969. On the ground floor there is also a large stone sculpture of Bhuteswar with his *shakti* worshipped by the neighborhood. Bhuteswara is the god of ghosts (Nepali: *bhut* = ghost) and is associated with tantric worship.

As at other Agache there are various social and religious activities which take place over the course of the year, but the focal activity consists of ritual worship and feasting at *Dashain* in October. At present, these minor religious and social activities are curtailed due to the building's state of ruin.

3.0 CONSTRUCTION HISTORY

Due to the lack of documentary evidence, close study of the age of the building structure and fabric has been made to attempt a description of the building's construction history. Annotated section and elevation drawings record estimated dates of many small and major changes. Guthi elder Vishnu Jvalananda reports that the building did not suffer any major damage in the major earthquake of 1934.

Most significantly, the building appears to retain most of its original 17th century fabric except for the following:

(1) The upper pagoda structure appears to have been rebuilt in the 19th century based on the poorer finish of the *daci apa* veneer brick and the 1/4" visible mud mortar joints. Interior timber tructure in pine and sal appears too match this date from visual inspection, although dating of interior timber is difficult.



Patukva Agache, south-east corner, 1993.

(2) The struts of the upper pagoda were replaced sometime in the last 100 years- this happened long enough ago that no *guthi* elder recalls the event. This estimated date is based on stylistic analysis.

(3) The southern end wall was sloppily reconstructed in chimney brick in 1977, as reported by the *Guthi*. Historical openings in this elevation were lost; there is no photographic evidence of this elevation in its historical configuration. At the same time most of the base roof above the lower three stories was replaced with zinc sheets.

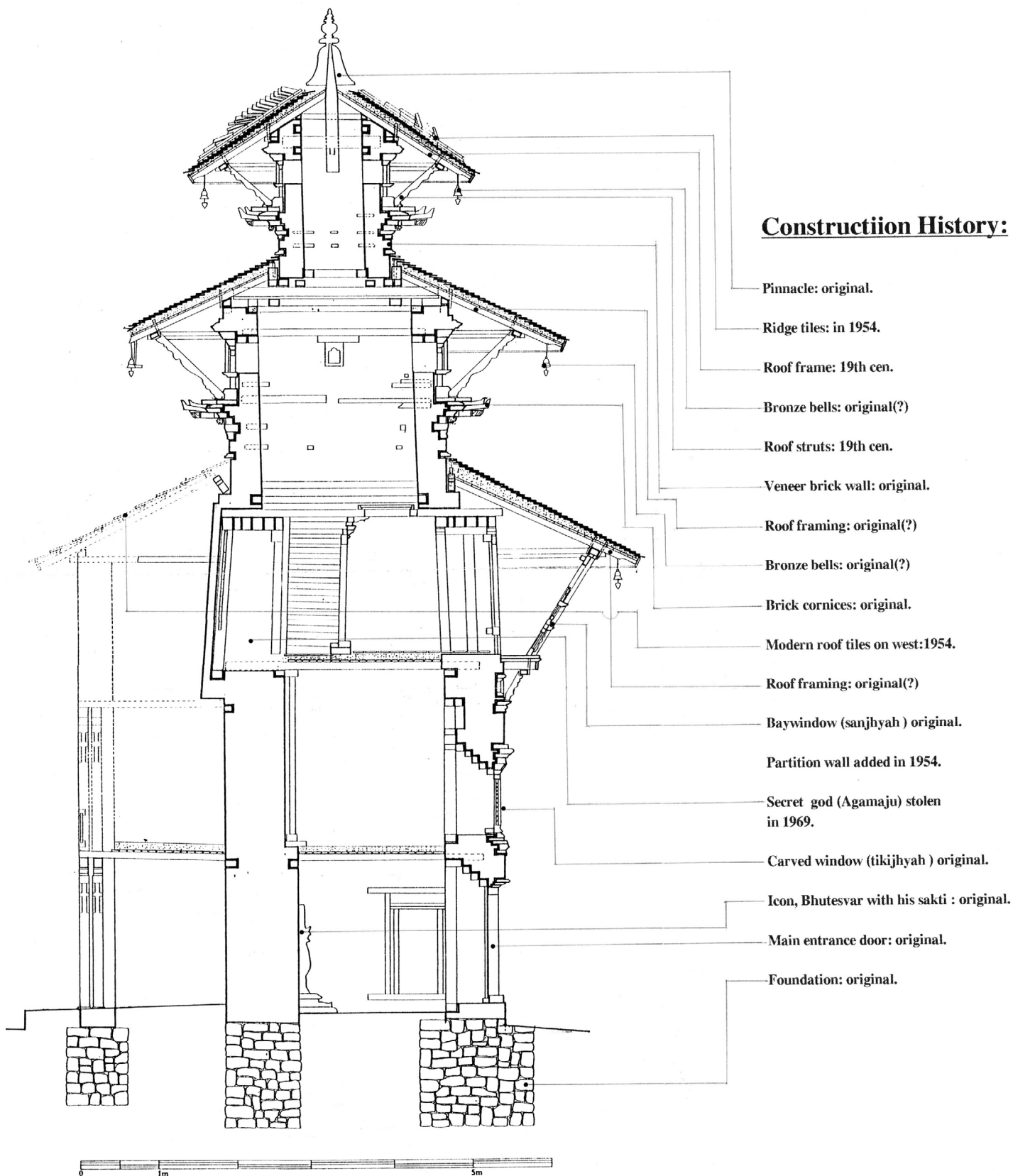
(4) In 1954, as the Guthi reports, two walls were added to the structure, one an additional partition wall on the first floor above ground level. The second, and more critical case, was the addition of a masonry wall at the back of the second story esoteric shrine. This shrine historically was set into the brick wall with



Above left: Partition on first floor (14" thick) wall was added in 1954 and partially blocks the window.

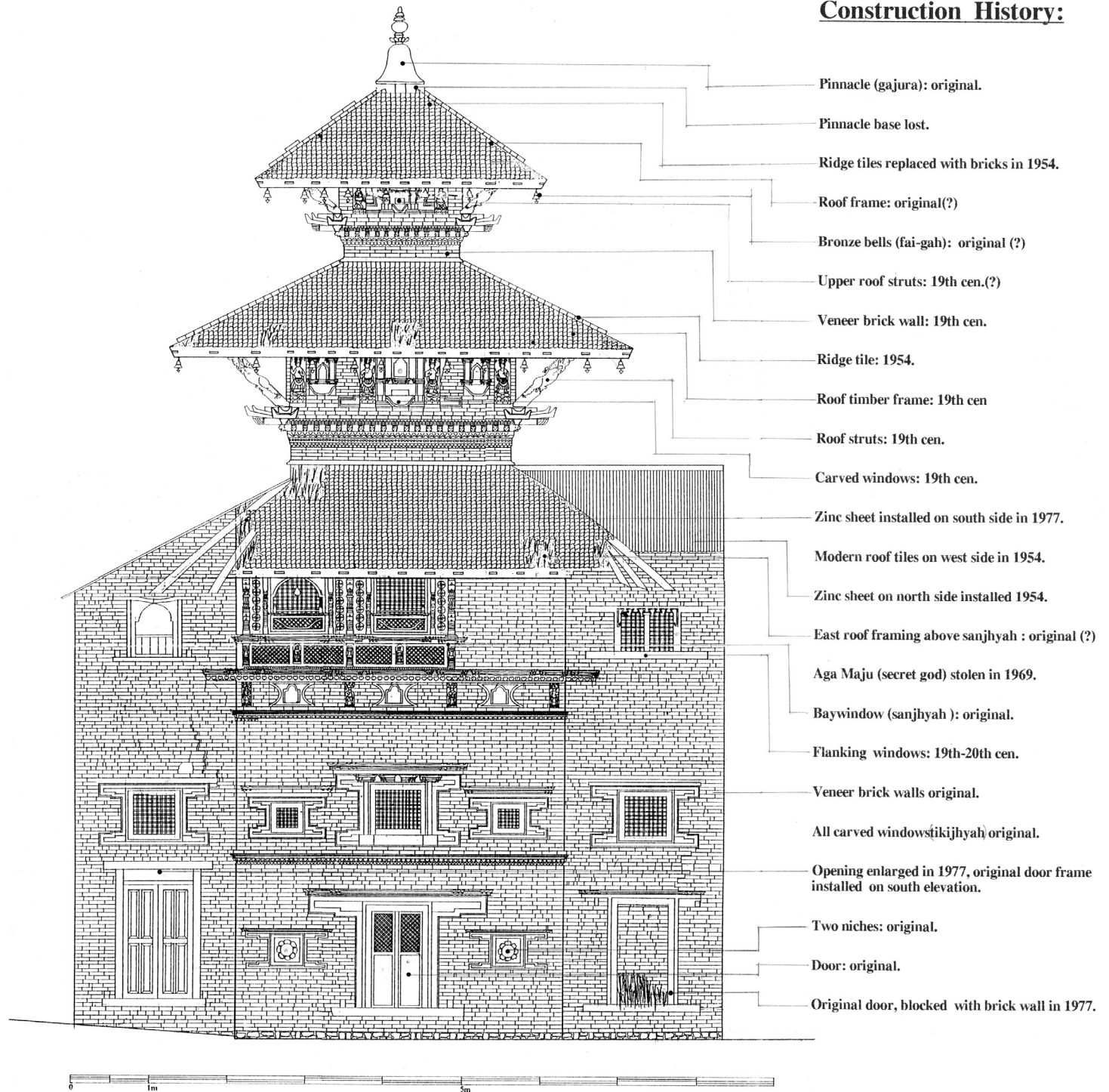
Above right: The masonry wall added in 1954 which led to collapse of joists below and roof above. Seen from below, summer 1993.

Below: Zinc sheet on lower roof south, installed 1977.



PATUKVA AGAM
 PATUKVA TOL, PATAN
 UNESCO WORLD HERITAGE SITE MONUMENT ZONE
 WEST-EAST SECTION: EXISTING CONDITIONS
 KATHMANDU VALLEY PRESERVATION TRUST, APRIL 1992

Construction History:



PATUKVA AGAM

PATUKVA TOL, PATAN
UNESCO WORLD HERITAGE SITE MONUMENT ZONE

PRINCIPAL ELEVATION: EXISTING CONDITIONS
KATHMANDU VALLEY PRESERVATION TRUST, APRIL 1993

only a layer of timber planks closing the niche-like opening at the rear facade. The addition of this improperly supported masonry wall has led in fact to the structural collapse of the rear portion of the building (discussed in detail under 5.0). At the same time, the Guthi repaired portions of the western and northern roofs, replacing the mud bed and traditional *jhingati* tiles with larger tiles. These tiles rest on timber battens instead of the *jhingati*'s mud bed.

(5) Principal facade: 2nd floor windows. Both of these windows replace what was most likely originally a matching pair. The southern window appears to be 50-75 years old based on stylistic comparison; the northern example appears to be nineteenth century.

(6) An intact wall plate on the north side of the pagoda suggests that at some point in the building's early history, the northern roof slope was the mirror image of the southern, that is sloping north and down. Construction of a later building must have necessitated the reconfiguration of the roof to bring the water away from the new adjacent building.

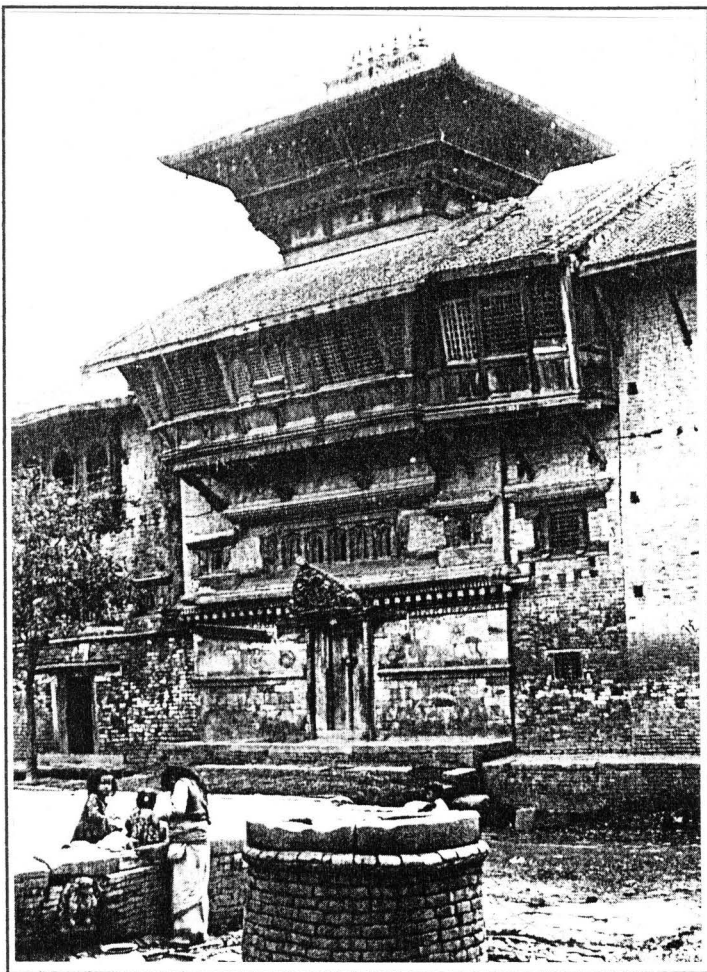
4.0 ARCHITECTURAL DESCRIPTION

General Description.

An *agache* houses the temple of an esoteric god, in this case, a clan god. An *agache* can be a secret chamber (*agakvatha*) in a typical dwelling, or in the case of those more affluent clans, a separate structure exclusively built to house the shrine and its associated activities. These Hindu clan-related *agache* are architecturally similar to Buddhist structures of the same name found in each of the Buddhist quadrangles and housing esoteric Buddhist deities. Both inflect a residential structure with special roofs.



Timber partitioned esoteric shrine, second floor.



Above: Joshi Agache, Sulima Tole,
Patan. 17th century.

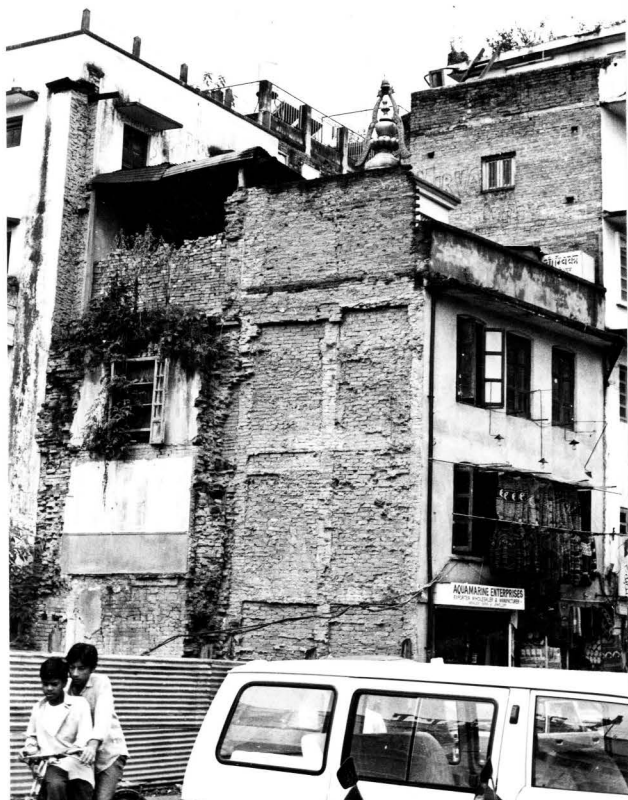
Below: Malla King's Agache, Hanuman
Dhoka, 1653.





Above: Joshi Agache, Maru Tole, Kathmandu.

Left: Pradhan Agache, Bhimsensthan, Kathmandu, 17th century,



Above two royal temples, symbolically raised to the rooftop of the palace complex. Below: two private temples built on the rooftop adjacent to Hanuman Dhoka. Clockwise from upper left: Bhagavati Mandir 17th c., Hanuman Dhoka; Degu Taleju, 18th c., Hanuman Dhoka; Private rooftop temple, 18th c., Basantapur; and Narayan private rooftop temple (pinnacle only visible) 19th c., rebuilt 1990.

These composite structures are a significant building type in Nepal: the duo-partite structures composed of a pagoda-like superstructure above a base building more residential in appearance. In this case, a two-tiered pagoda with no functional interior space perches atop a three-story base structure.

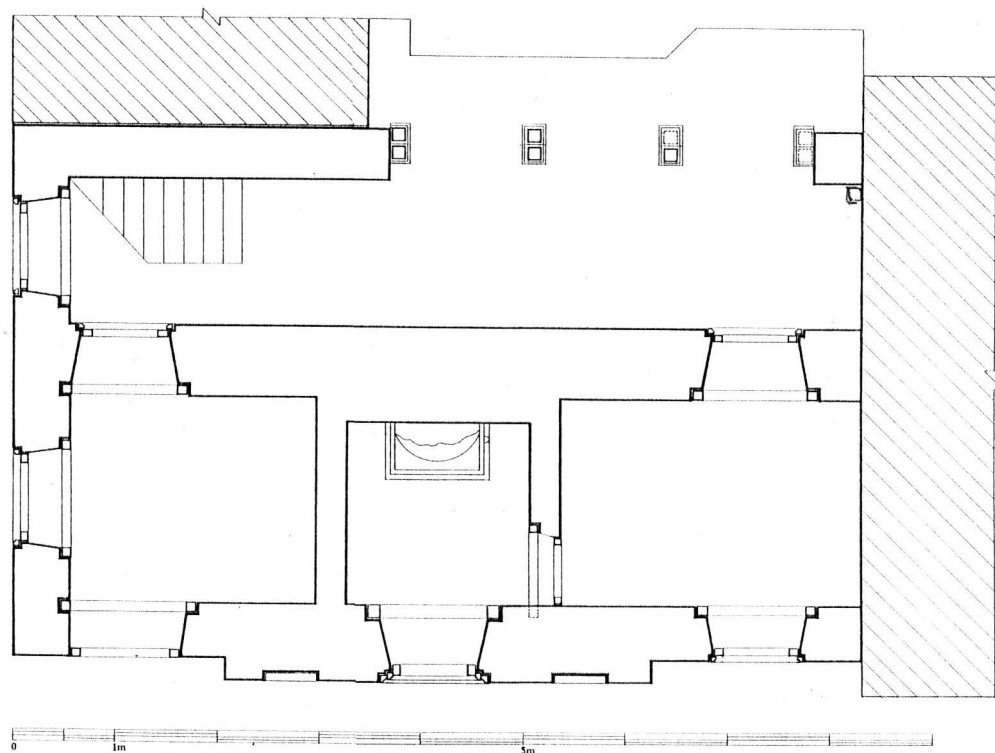
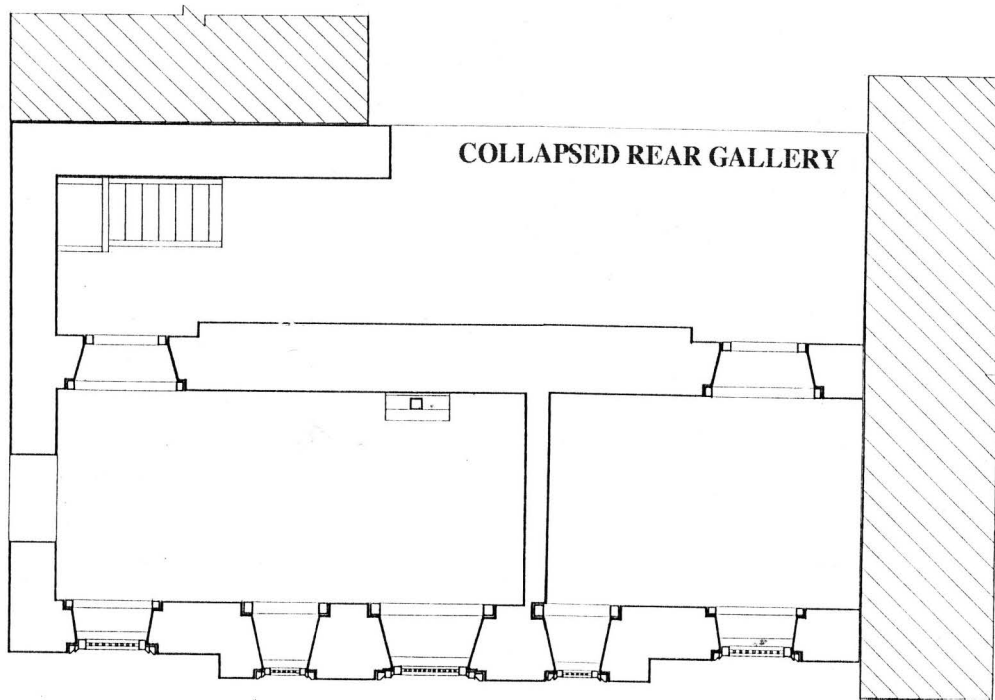
One can locate several similar structures in the Kathmandu Valley including: Joshi Agache in Maru Tole, Kathmandu, (a private shrine belonging to the Joshi family); Pradhan Agache in Binche Bahal, Kathmandu; and the venerable 16th century Joshi Agache of Gayabajya, legendary Tantric, in Sulima Tole, Patan. These are comparable to the royal examples found at the Kathmandu and Patan palace complexes, where three-tier pagoda-like shrines are symbolically sited above the palace itself. The Agam Mandir (1653) at Hanuman Dhoka is of similar 17th century age to that of Patukva Agache.

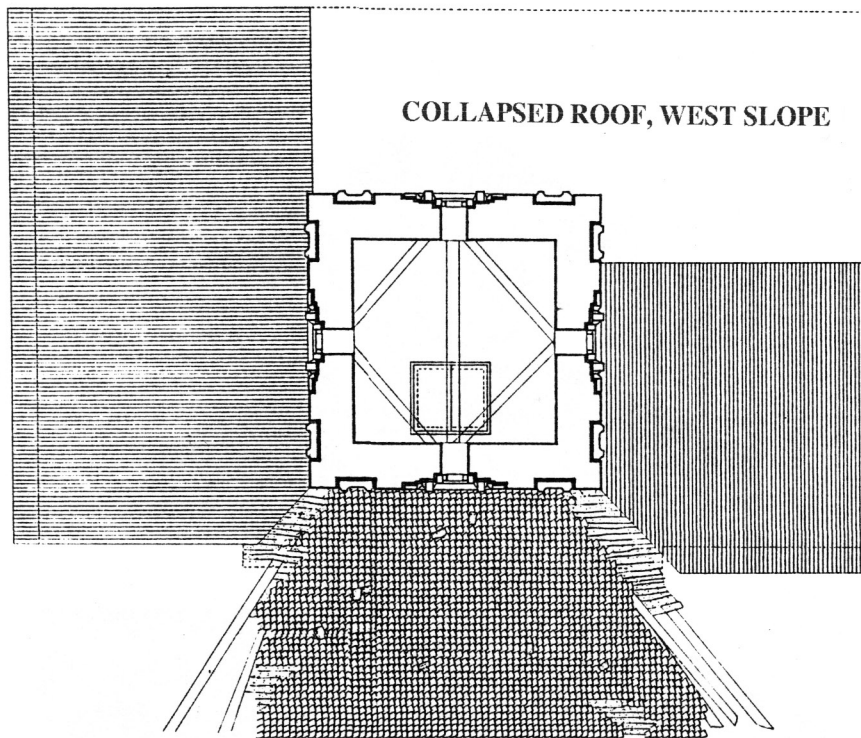
The ground floor plan of Patukva Agache consists of a rectangular brick masonry structure with an interior depth of less than seven feet! This diminuate structure is divided into three rooms at ground level and historically left open at upper levels. The central room at ground level houses a religious icon of *Bhutesvar* with his *Shakti* for local neighborhood worship, The icon rests on a large stone pedestal facing the eastern door.

A rear multi-story open timber gallery (Nepali: *bardali*) almosts doubles the limited floor area,

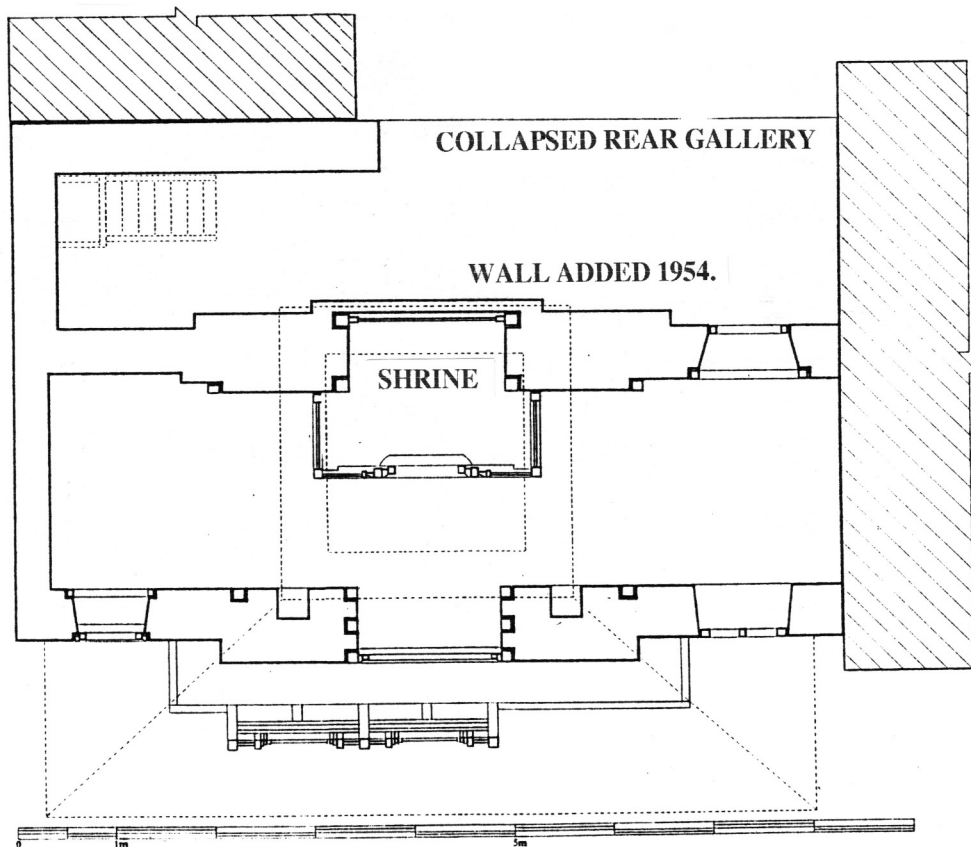


Three pairs of timber columns in front of esoteric shrine, second floor. Summer 1993.

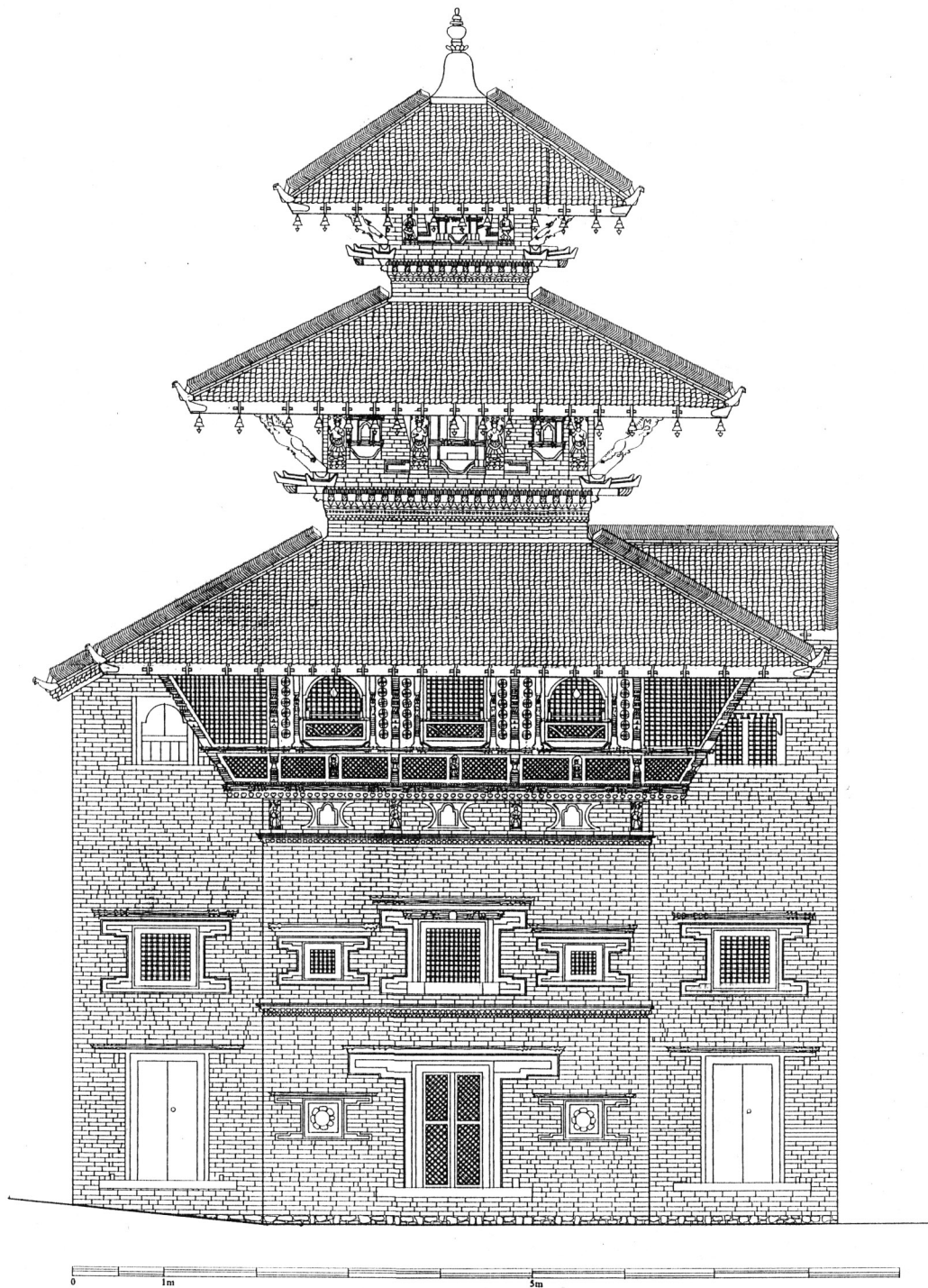




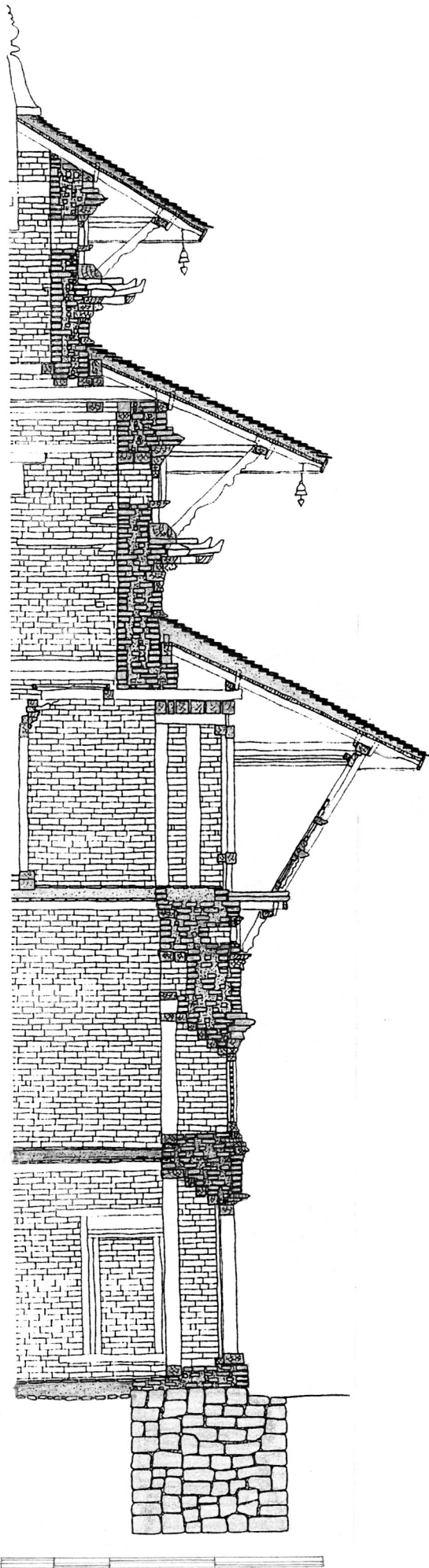
PATUKVA AGACHE
Third floor plan : Existing condition



PATUKVA AGACHE
Second floor plan : Existing condition

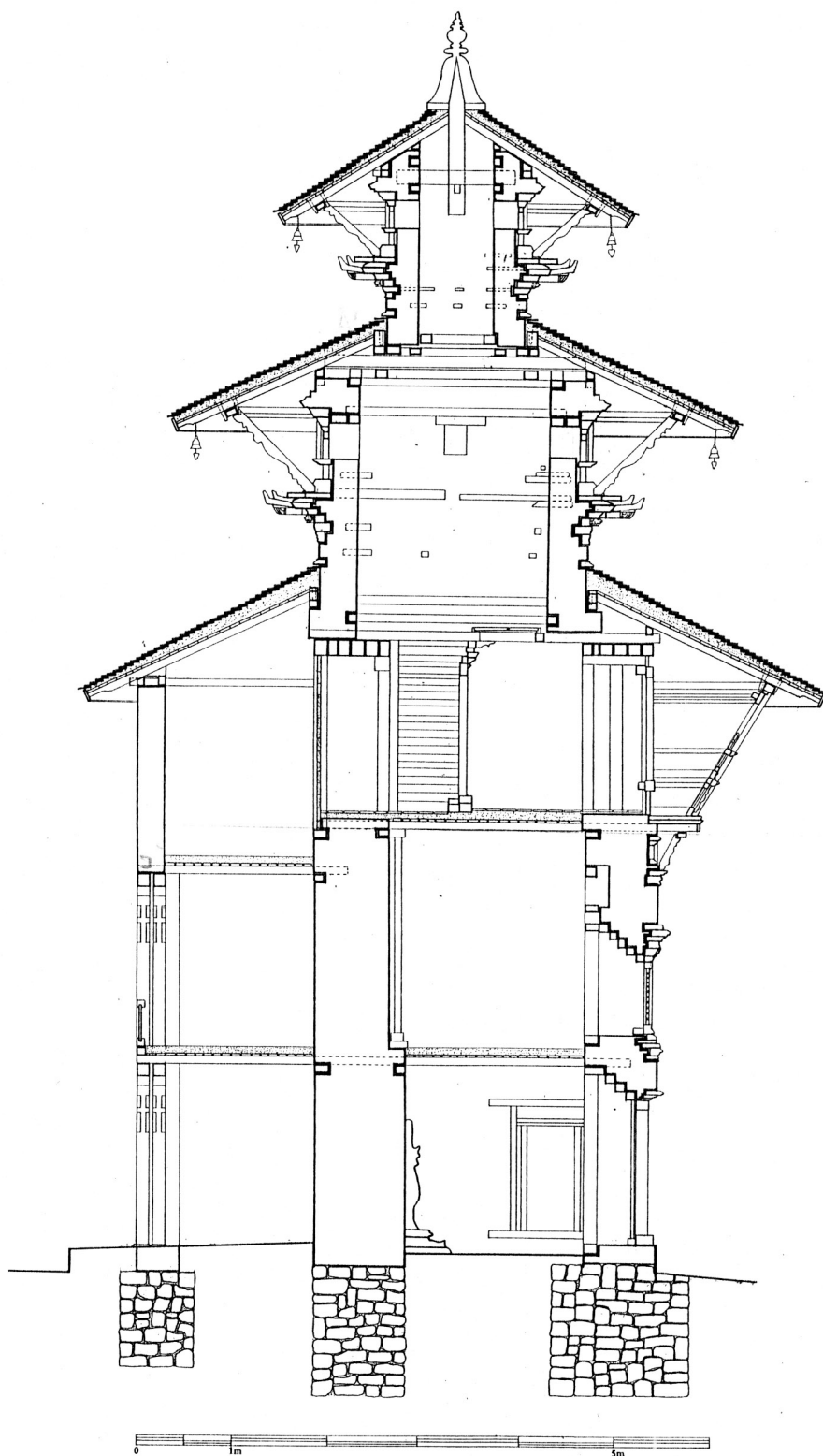


PATUKVA AGACHE
 Restored principal elevation

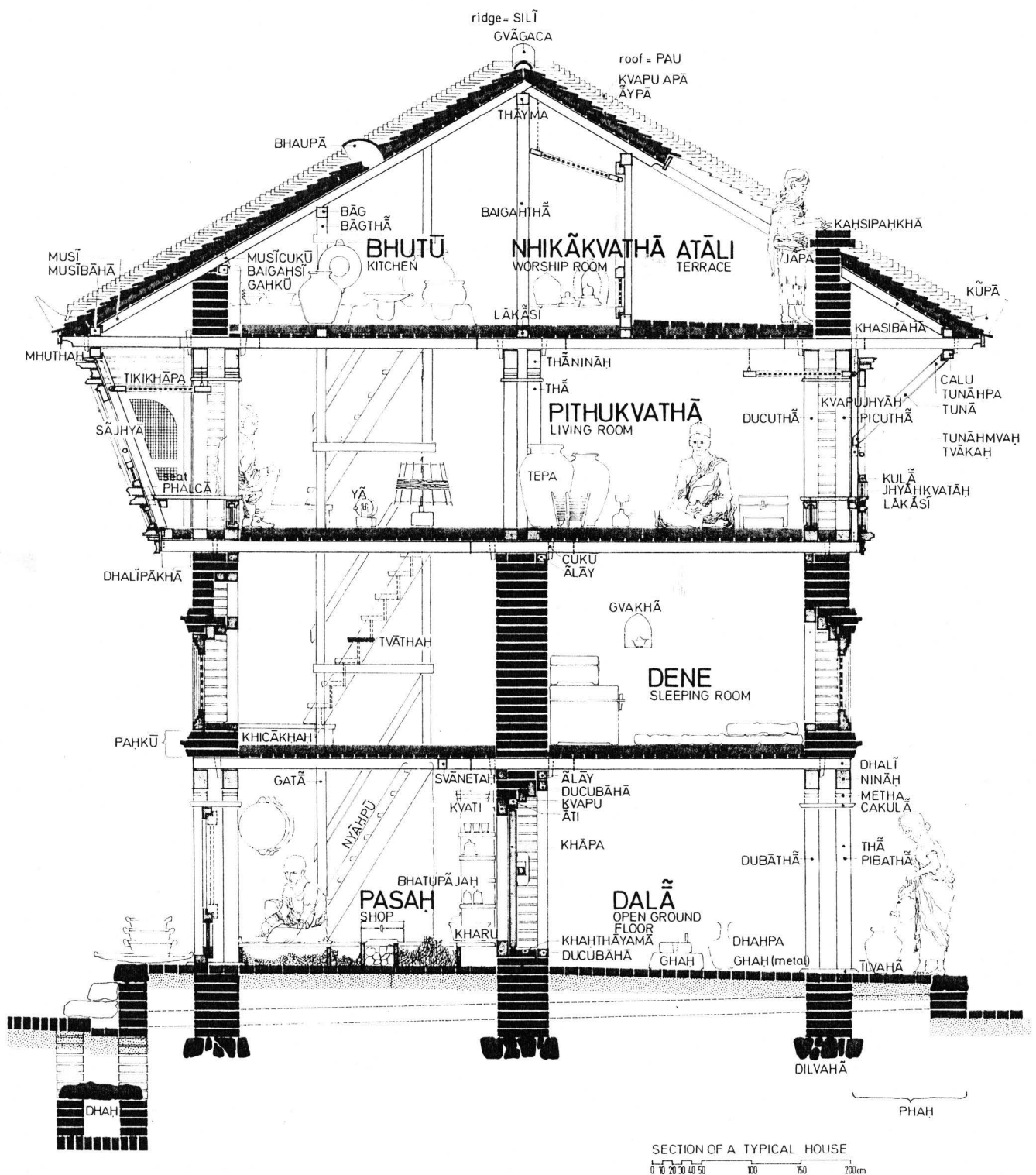


Detail wall section

Traditional composite wall layers of outer veneer brick, middle fill and interior bearing wall. Sept. 1993



PATUKVA AGACHE
Restored West-East section



Section of a typical Newar house from N. Gutschow Newar Towns and Buildings. Compare with Patukva section opposite: the lower portion of the agache is comparable to a dwelling house.

providing circulation space and ladder-like stairs. It is possible that the lowest stair, the only run executed in masonry, is not original. One can hypothesize that the historical configuration of adjacent residences may have provided access to the *agache* at first floor level, making this staircase a later addition. If this was the case, the historical arrangement would have resembled present circulation arrangements at Agam Mandir at Hanuman Dhoka, where there is no direct access from ground level to an upper level esoteric shrine.

On the first floor, the historically undivided room has been used for preparation of feasts and occasionally for accommodation of guthi members during mourning periods, when seclusion is necessary. The second floor houses the most important principal shrine. On this level, a small semi-enclosed shrine is located on axis with a projecting bay window (Newari: *sahjhya*). The shrine of the secret god (*agamaju*) is thus expressed architecturally by the surmounting pagoda in plan, and by the multi-bay window in elevation. This multi-bay window creates ambiguity in the reading of the composite facade: it simultaneously suggests a base to the pagoda and a crown to the lower facade.



Front facade, lower two stories. April 1993

The interior of the pagoda superstorey consists only of one floor level above the shrine, accessible by an opening in the ceiling joists of the shrine itself. The exterior of the pagoda is arranged identically on four sides with a single central window opening flanked by blind windows. At the uppermost level, the diminished wall size allows only one central window.

The visually dominant timber framed roof consists of a four-sided pent roof at each of two levels with generous overhangs (5'6" and 4'0" lower and upper levels) supported by purlins. The purlins are in turn supported by twelve inclined carved timber struts. There are four corner struts and two additional struts per side, these pairs suggest flanking elements at each of the windows. The timber struts rest on a continuous timber and carved brick cornices which protrude from the wall structure. The entire roof structure is surmounted by a gilt pinnacle (Nepali: *gajura*).

The lower facade is organized by a central and focal bay which projects one brick thickness in front of the adjacent wall areas. Typical of the Newar architectural vocabulary, larger focal elements-- a door at ground level and a window above-- are flanked by minor blind and latticed openings. The axial symmetry is made more complex by the additional windows and doors of the side bays. These openings are slightly smaller than those of the central bay, reinforcing the pattern of flanking axial symmetry, yet at the same time they are large enough to suggest that the central window is repeating. At the top and second level of the lower facade the focal bay window is flanked by two individual windows.

In addition to the complex pattern of openings, the brick facade is further punctuated by a timber cornice in the central bay. This cornice above the ground floor does not continue across the side bays, emphasizing the focal quality of the central bay. On the upper pagoda, continuous composite timber and brick cornices carry struts at two levels. The timber door and windows and inset panels, cornices, niches, blind windows and roof struts provide the field for intricate carrying of iconographic and decorative forms.

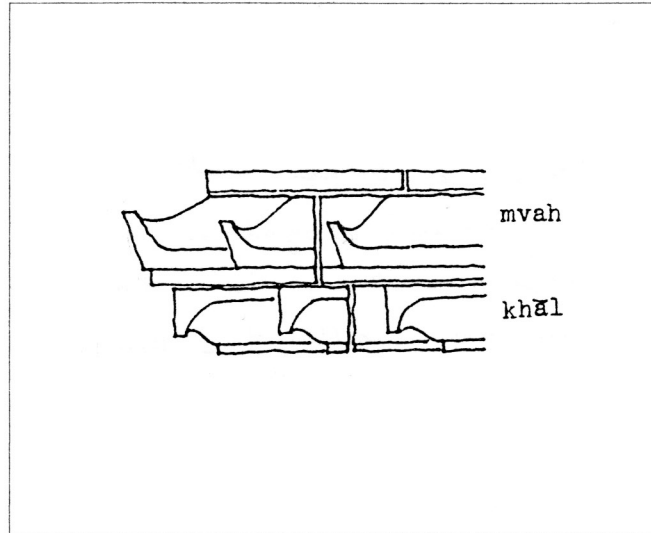
In section, the building is quite curious. While the rear gallery suggests a symmetry between front and back of the building, the slight displacement of the upper pagoda, that is, slightly off center with the lower masonry core, creates a blatant eccentricity. Put another way, the back wall of the pagoda is continuous with three levels of masonry walls below, while the front wall of the pagoda is supported by timber beams.

4.1 Traditional construction techniques

The traditional construction of Patukva Agache employs bearing brick walls laid in yellow mud mortar (Newari: *mhasula*) together with a secondary timber frame construction wall whose plates, door frames, tie members, joists and rafters are connected by timber pegs and lapped joinery.

The foundation of Patukva Agache consists of a 8-12 layers of natural stone, above which and at ground level begins the brick wall construction. There is no damp-proofing course or layer, typical of traditional construction practice here.

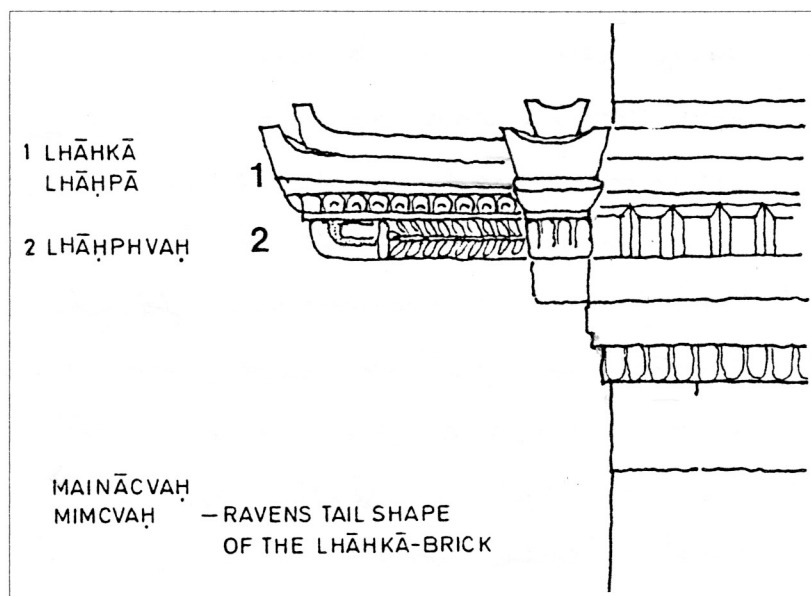
Masonry bearing wall construction consists of three layers with very few cross bonds: an outer facade brick (Newari: *daci apa*) one course thick; an inner bearing wall of common fired brick (Newari: *ma apa*) two layers thick; and a middle fill of brick fragments (Newari: *dathu apa*). The characteristic facade veneer brick (*daci apa*) tapers in section away from the facade to allow hairline joints on the face with additional mortar behind.

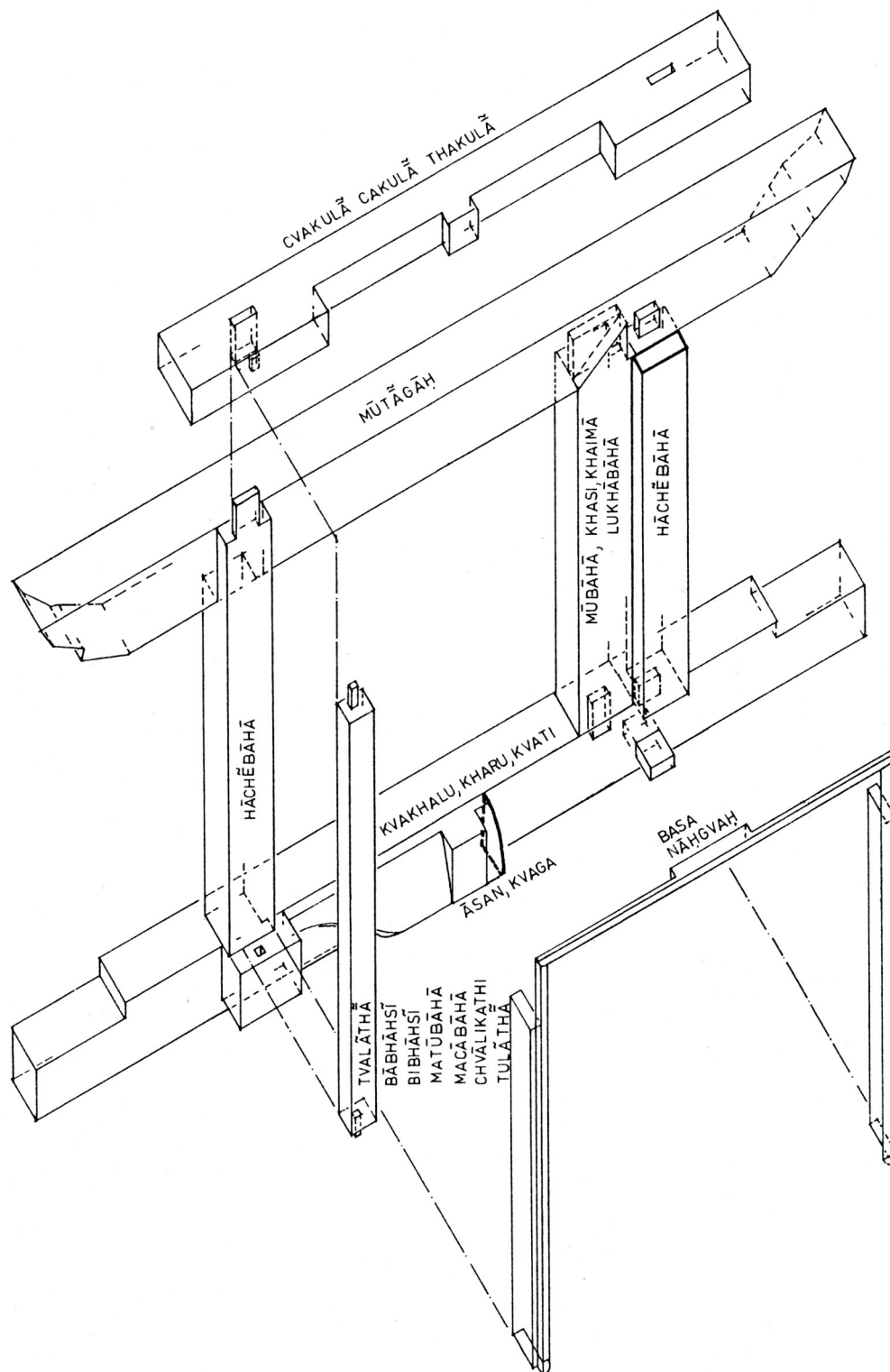


The *daci apa* of the Malla period (and well up to the turn of this century) is extremely well-fired and dense with a finished surface on only one side. Only on corner bricks is the smooth finishing rendered on two sides. Finishing is achieved through the application of a red clay slurry (Newari: *laca*) applied after sun drying and before firing. Laid tightly, the lustrous brown crimson *daci apa* provides a fine and smooth background for the sculptural effects of the wood carvings.

In addition to the *daciapa* other specialty bricks are found in Patukva Agache. Moulded bricks, for example, are found incorporated at the cornices above individual openings, artfully integrated with the timber

Above: 3 course of moulded cornice brick (Newari: *cvalaku*) above first floor windows. Below: the oversized corner pieces are supported by timbers in the shapes of hands (*lhahphvah*) at corners of upper pagoda cornice.





Structural elements of a traditional window, from Niels Gutschow: Newar Towns and Buildings.

cornice. The larger scale building cornices, which support the lower ends of inclined roof struts, are similarly formed by different projecting carved timbers and two layers of projecting moulded brick. . At the corners, the overlap generates a projecting element (Newari: *lhahka*).

Another characteristic terracotta product are the floor tiles (Newari: *cika-apa*, size approximately 6"x 6"). Their smooth and convex top surface is finished with slurry in the same manner as the *daci apa*.

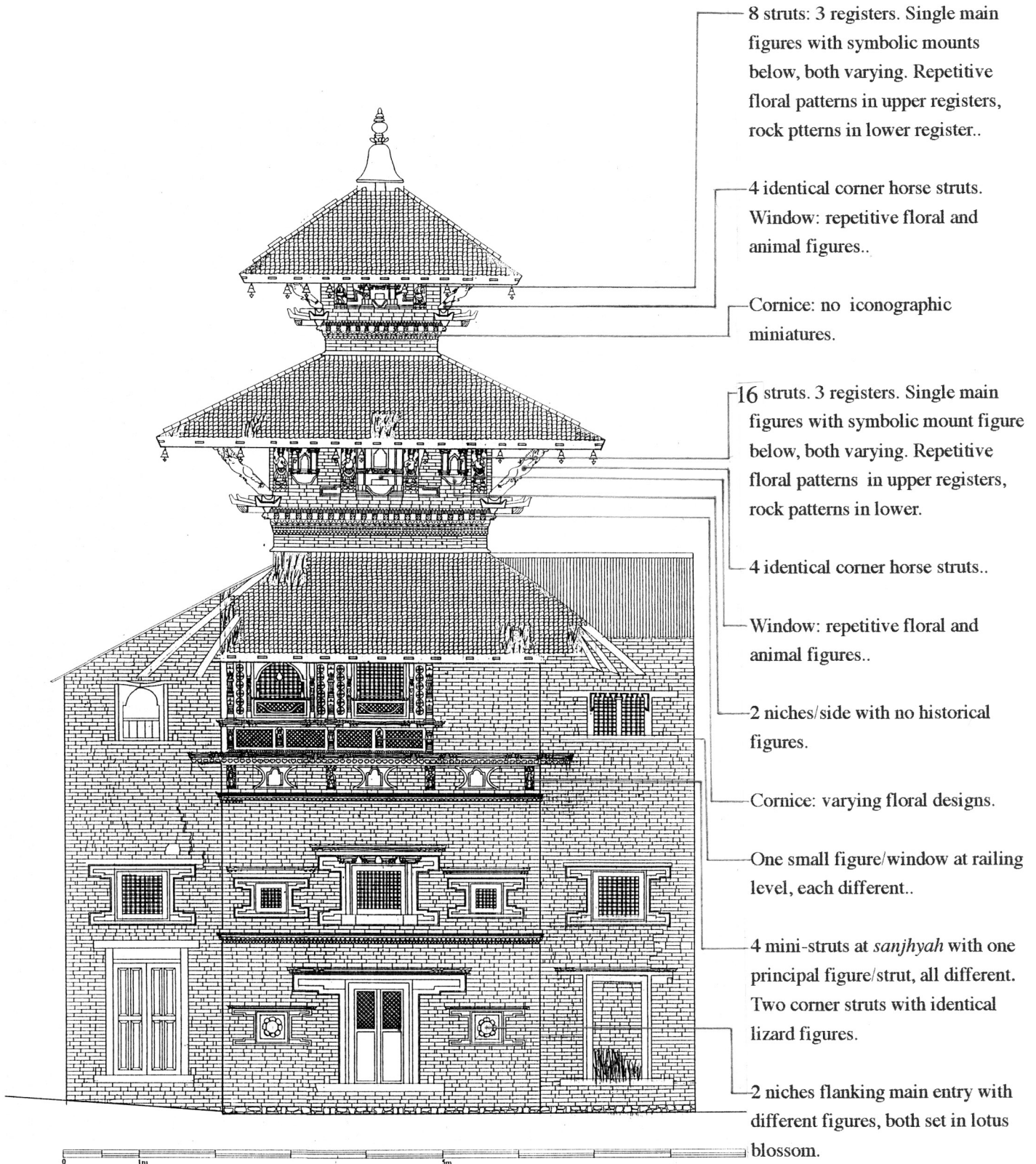
The timber structure of Patukva Agache conforms to the traditional formula of both the typical Newar house and the pagoda temple. Closely-spaced joists (varying centre to centre dimensions 9" to 12") and rafters (varying centre to centre dimensions 9" to 16") laid on flat and tied to wall plates with timber pegs (Newari: *cuku*; Nepali: *chukul*). The rafters, wall plates, and purlins at Patukva are assembled to create "hanging eaves" (Newari: *kvachupakha*), a local term describing roof configuration and indicating the lack of horizontal members linking eaveboard and wall.

Sal timber (*Shorea robusta*) a local species related to Malaysian teaks, is traditionally employed in Nepal for most structural and virtually all decorative applications. Pine is found in many 19th and early 20th century reconstructions; it may also have been employed often in the Malla period for structural framing. The Patukva Agam conforms to these formulas of interior structural timber for the most part in pine and all exterior timber and carved elements in sal. In particular one finds many examples of pine lintels in facade locations where long lengths are needed. Timber door blades are made of magnolia, a timber used traditionally because it is not prone to cracking.

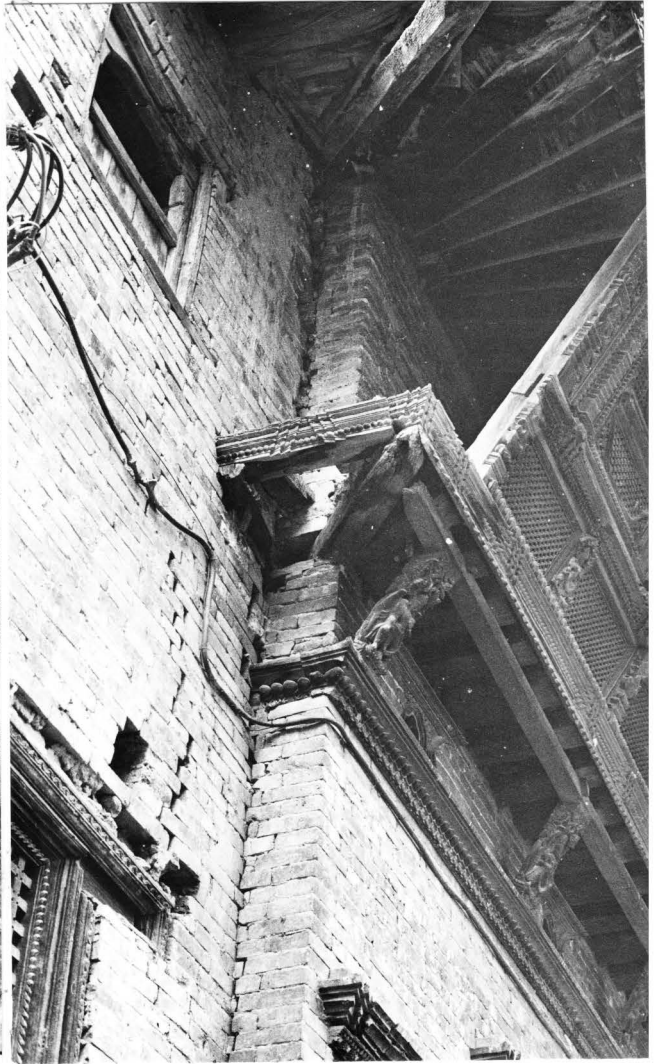
The sophisticated design and joinery of elaborate facade openings contrast interior structural joinery. Stepping timber lintels in the wall thickness expand door and window openings toward the interior, while four interlocking layers of timber frames, both structural and decorative, define the door and window openings in elevation. The central window of second level, for example, consists of

- (i) an inner largely concealed structural frame with extending sill (Newari: *kvakhalu*), lintel (Newari: *mutagah*) and main vertical support (Newari: *mubaha*);
- (ii) a secondary trabeate frame set in front of the first (Newari: *hachebaha*); and
- (iii) stylized curving and non-structural frames which wrap the extended surface of the primary frame, flush with the wall.

Iconographic programme



PATUKVA AGAM
 PATUKVA TOL, PATAN
 UNESCO WORLD HERITAGE SITE MONUMENT ZONE
 PRINCIPAL ELEVATION: EXISTING CONDITIONS
 KATHMANDU VALLEY PRESERVATION TRUST, APRIL 1993



Left : Lower roof strut on back (west) facade of upper pagoda.

Right : Mini- struts below *sanjhya*; corner struts with lizards are in storage.



Blind windows of entrance ensemble
Above, left of entrance; Below, right.
Figures are unidentifiable.

4.2 Iconography - General Description.

One of the richest and most characteristic expressions of Newar art is found in the conception and execution of woodcarving which adorn the building. Thousands of images-- many of them unique and unrepeated in other comparable locations on the building - contribute to a complex often inscrutable iconographical program. This iconographical 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 temple or shrine houses one finds variations in the iconographic programs, even of temples or shrine houses 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.

The figurative carvings of the Patukva Agache's architecture consist of:

- (1) Roof struts on two levels of the upper pagoda
- (2) Miniature struts below the bay window (*sanjhyah*)
- (3) Blind windows at entrance ensemble.

In general, the iconographic program has fewer images than a pagoda of the same age; the esoteric and Tantric nature of the images makes precise identification of images very difficult. The doors and windows are notably plain without iconographic material, they utilize stylized decorative elements.

Pagoda Roof Struts

Excepting the horse designs of corner struts (Newari: *kunsas*), repeated at both levels, all struts are articulated in three registers. A principal female figure dominates each strut with foliage register above and rock register below. The foliage register consists of four rows of four leaves each, total sixteen leaves. The base register of 4 leaves across, middle portion of the struts; below are symbolic mounts.

Sanjhyah

Four different female figures are located beneath the vertical of the leaning bay window. At the corners the miniature struts are rendered as lizard figures.

Blind windows

Two different figures flank the entrance door to the ground floor shrine. The figures are unidentifiable female figures set in lotus blossoms.

5.0 EXISTING CONDITIONS

5.01 Foundations/walls: structural

5.02 Wall fabrics

5.03 Wall openings and decorative elements

5.04 Roof Structure

5.05 Roof Cover and decorative elements

5.06 Timber floor structure

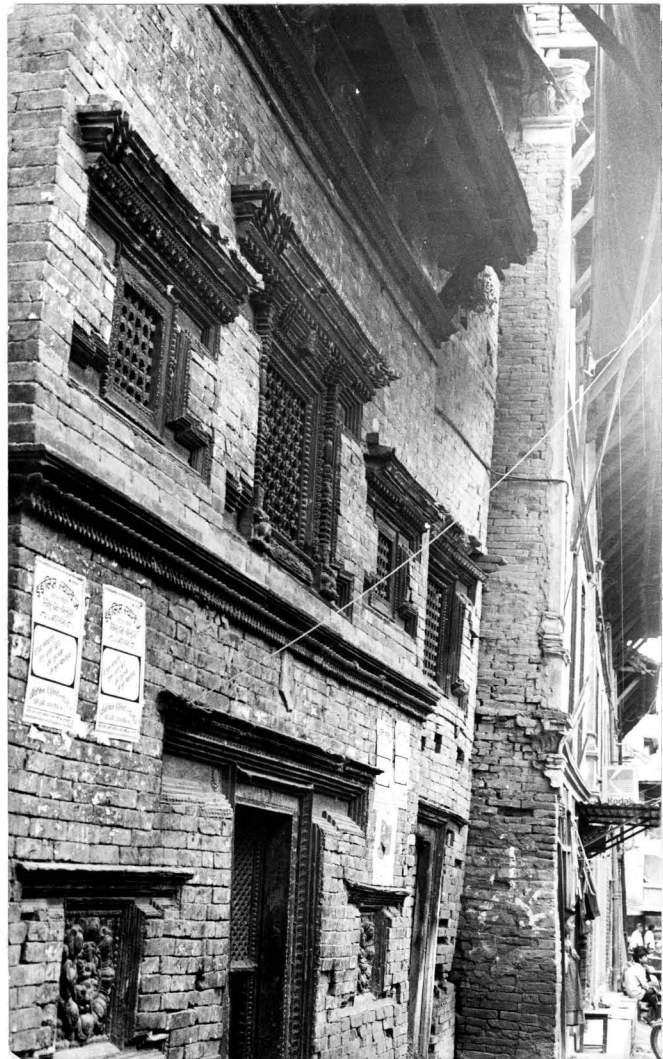
5.07 Interior

5.01 Foundations / Walls structural

Summary

While the masonry walls of the upper pagoda and their timber supports are structurally sound, the lower base structure approaches ruin. The rear masonry bearing wall of the lower structure has buckled out on the lower two stories (below the shrine) to create a cavernous hole approximately eight feet square. This wall has also settled as much as 7" in its central portion under the tower. The rear gallery timber structure has disappeared but for the lower two levels, which are heavily damaged. Roof cover over the entire base structure has been minimal for the last five years: unchecked rain damage has rotted out most timber structural members. The principal facade of the lower facade is not damaged, although serious cracks and movement are found to both sides.

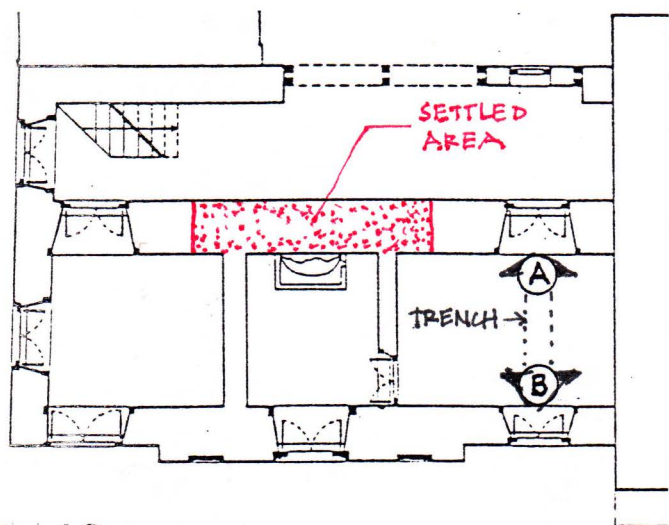
In general, the traditional masonry wall construction is structurally deficient because of minimal through-bonding between three distinct layers and settlement of the middle fill layer (see 4.1).



One brick projection of central bay of the principal facade.



The foundation of the building appears to be in excellent condition, consisting of river stones laid in mud mortar total height 5'-1" to ground level. Excavation summer 1993. It is unclear why significant settlement of up to 6" has taken place in the tower area of the N-S wall facing back courtyard (called middle wall in text).



Ground floor

5.01 Foundation

Excavation in two locations during summer 1993 determined the composition and condition of the foundation: it's height is exactly 5'0" from the bottom of the bricks above (ground level) to the bottom of the lowest stone below. The construction is of river stone (varying sizes approximately 9-12" diameter oval) laid in mud mortar, thickness of the stone foundation wall varies (front eastern wall: 4'3-1/2"; rear wall: 2'6"). Excavation has not been undertaken at the timber posts of the rear gallery in order to preserve adjacent historical tile pavement.

Settlement of the middle masonry wall has occurred only under the tower section of the building. Settlement varies from 7" maximum in the middle to 5" under the tower's north and south walls. No settlement is found at the end of this wall (outside central tower area). Settlement has been determined by comparative study of the wall plate levels.

No settlement is found on the front principal facade. Minor settlement of 1-2-1/2" is found in the stone bases of the rear timber gallery (from north to south: column 1: no settlement; column 2: 2-1/2" settlement; column 3: 2" settlement; column 4: 1"). These settlements were determined with a pipe level.

Lower base structure

The most significant failure of the structure consists of the buckling out and collapse of a later added masonry wall directly behind the 2nd floor shrine. This 9" thick wall appears to have been added as a security precaution for the shrine (otherwise closed only by timber planking at this level). Because of insufficient support by the historical floor joists, this wall led to the collapse not only of the joists it sat on, but also of the rafters above and portions of the original middle masonry wall.

There is a major void in this same bearing wall directly below the northern interior-gallery door. This void measuring 4'2" x 2'7" x 4-1/2" (one brick layer deep) appears to have been caused by unchecked water damage after roof loss over the gallery.

On the principal facade (south side, above first floor window) is found a structural crack 16 courses tall spreading two feet to the south with maximum gaps of 2-1/4" both inside and out. This crack again appears to result from water damage from the lost roof above, exacerbated by poor bonding at this the intersection of the old principal facade and 14 year old south wall.

A smaller crack is found on the northern side bay of the principal facade (above first story

window, six course high, maximum gap 1", no cracking inside. Another separation crack is found between the Agache building and its neighbor to the north. This crack is 3" wide at its maximum and extends from first floor to second floor height (approximately 6'0" height).

Above the second floor southern window of the principal facade, a failed timber lintel has resulted in the deflection of several masonry courses above. This failure has been caused by water damage allowed by the poor roof condition.

Notably, at the northern bearing and party wall of the agache is found only a 4" (one layer) brick wall connecting front and middle longitudinal walls. This lack of critical structural wall has resulted from an historical encroachment by the northern neighbor.

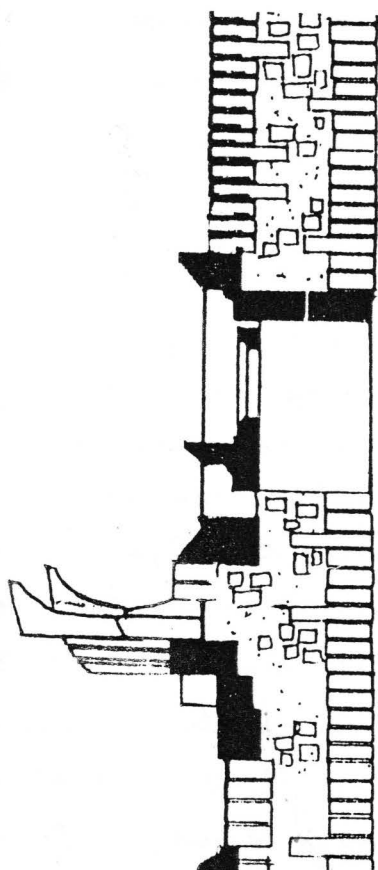
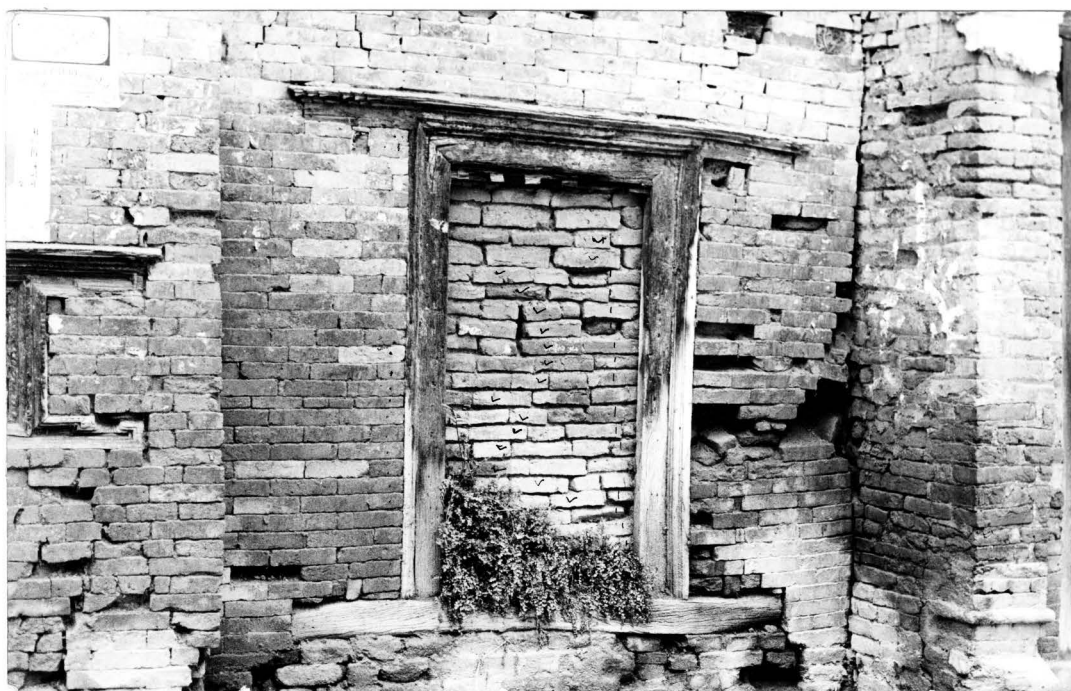
Lastly, the masonry wall in the stair area (west wall and party wall) is constructed in sun-dried brick above the ground floor. This wall shows signs of movement away from its neighboring structure of maximum 2" resulting from rain damage. All other brick construction in the building uses fired brick of mixed sizes (range 8"x 4-1/2"x 2-1/2" to 8" x 4"x 1-3/4").

All other masonry wall locations are in good condition with no visible signs of damage or movement.

Upper pagoda

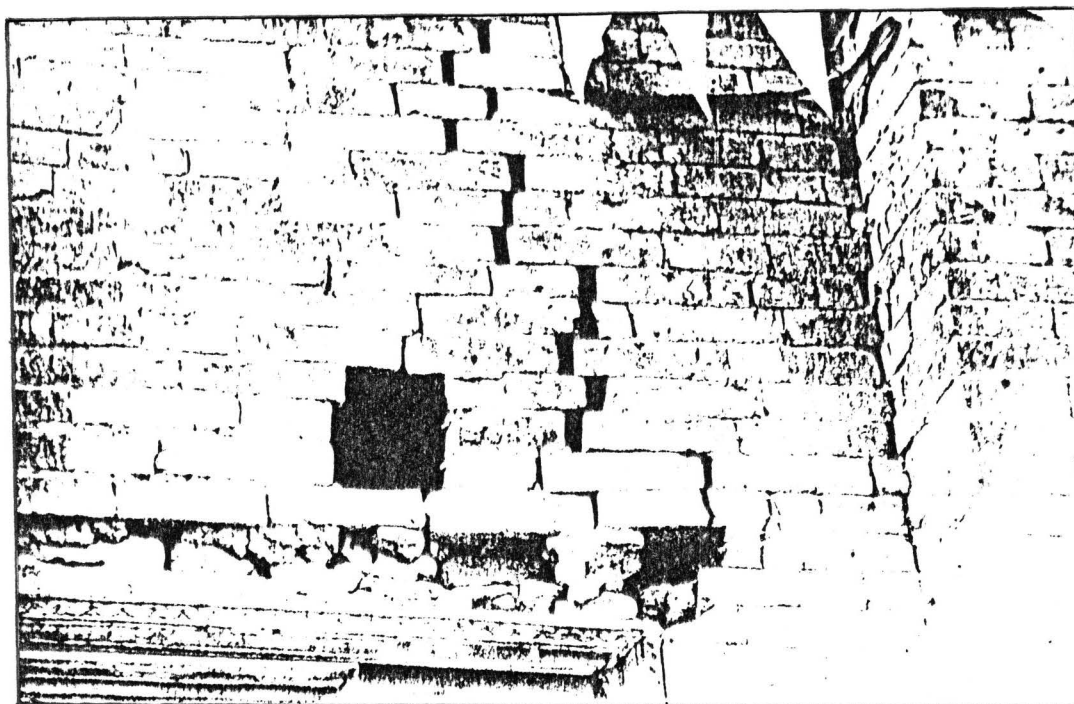
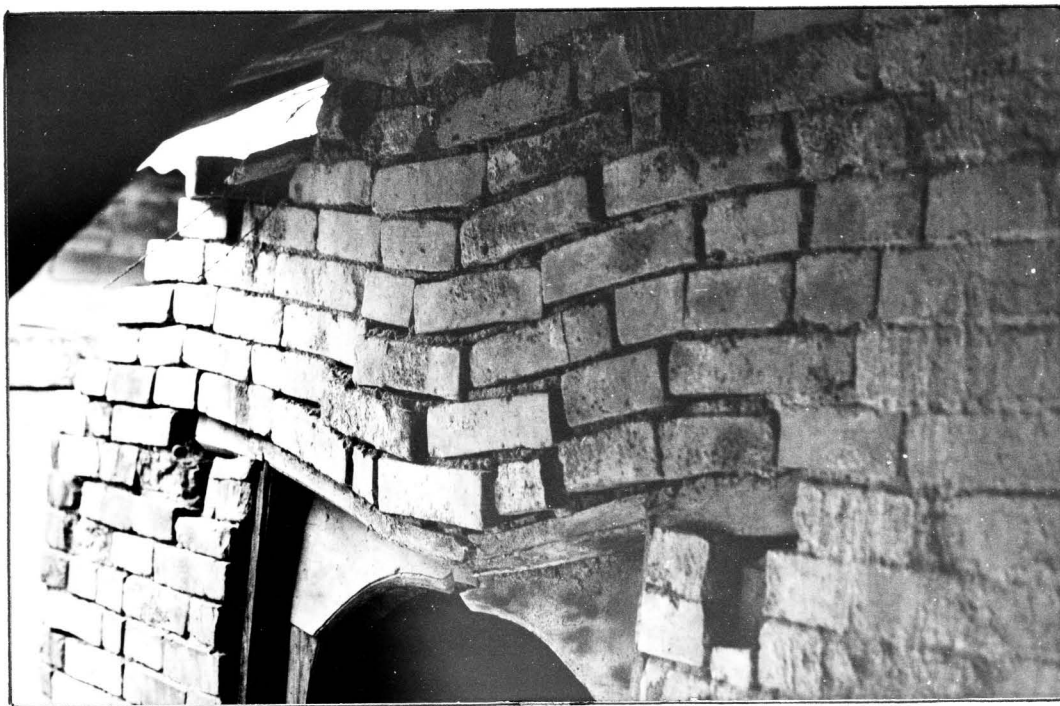
The upper pagoda structure, like many temple buildings in Nepal, rests atop timber beams and is thus discontinuous with the lower masonry wall structure. These timber beams in sal have been carefully inspected and found to be in excellent condition, although some historical deflection (maximum 1-1/2") is evident at centerspan.

There is no damage to the two levels of masonry walls which form the pagoda: there are no cracks; slight outward displacement of the walls from the roof thrust is recorded at 1- 1-3/4" at the four corners.



Above : Right (northern) door of principal facade: adjacent area with missing bricks.

Below : Section through wall at upper base storey windows shows typical construction: inner and outer layers with few headers and rubble fill between. This accounts for failure in veneer brick..



Above : Settlement of brick work above the second floor window resulting from roof damage and water penetration. August 1993.

Below : Wall crack above the first floor lattice window, south side principal facade. August 1993.

5.02 Wall fabric

Summary

The veneer brick (*daci apa*) of the principal facade of the lower structure and all sides of the upper pagoda tower is in good condition with a few exceptions.

Base story: principal facade

The building plinth (Nepali: *peti*; Newari: *fa*) of the principal facade is lost, exposing several layers of common brick (*ma apa*) and in some locations the foundation stones as well. Above, the highly fired veneer brick (*daci apa*) is of a deep crimson color and smooth finish typical of brick more than a hundred years old.

Damaged bricks are found in a register across the facade and three feet in height from ground level. Some 25 bricks show signs of spalling; adjacent to these damaged bricks, others have



Southeast corner: notice later patch at corner at plinth level. August, 1993.

been pulled out leaving several gaps, notably one to the right of the northern door 2'2" wide by 4 courses high. The spalling is a result of the lack of damp proof course.

Separations between the bricks are discussed in the previous section 5.01.

The decorative cornice bricks (*kopu apa*, lit. lintel brick) are lost above the first floor south window and damaged and 50% lost above the first floor window to the north.

During the reconstruction of the south wall 17 years ago, the left bay of the principal facade was modified to include a quarter round cornice (just above the timber cornice of the central bay of this facade). Above this simple cornice, the face of the re-used brick was shifted some 3-4" forward. A small patched area is found at the southeast corner (see photo).

South elevation

This reconstructed facade in chimney brick and mud mortar is in good condition except for the scouring of joints. Lack of roof protection has allowed the yellow mud mortar (thicknesses 3/8"-1/2") to be washed out. Some 5-10 bricks show signs of spalling from lack of damp-proofing in the lowest registers.

The raised ground level in the small lane defined by this elevation most probably resulted from debris from the 1934 earthquake. It can be hypothesized that this raised ground level combined with rising ground dampness did enough damage to necessitate this wall's reconstruction.

Rear elevation

Outside of the areas where major structural damage has occurred, the historical common brick and/or mud plaster is in good condition.

Upper pagoda

These *dacia apa* walls are in excellent condition, although the finish of the brick and tightness of joints does not compare favorably with the lower principal elevation. Here, visible yellow mud mortar (thickness $\pm 1/4$ ") are typical. Decorative brick and timber cornices are intact.

At the corners above the timber cornices are found two levels of overlapping and projecting decorative corner bricks (Newari: *lhahka*). Their considerable cantilever is supported by projecting timbers, are also decoratively rendered. At these two upper most levels all *Lhahka* are intact, but chipped.



Upper level of rooftop pagoda shows daci apa framed by timber cornice pieces.
Below common fired brick with visible mud mortar joints. All in excellent condition.

5.03 Walls openings, decorative elements

Principal facade

The very fine second-story leaning bay window (*san jhya*) has partially collapsed due to water damage from missing and damaged roofs. The right-hand of three principal bays, together with the two triangular corner bays, have fallen down in the last three years. Some of these damaged components have been secured by the project team. The remaining bay element are in good condition. The entire assembly is constructed in sal timber.

Flanking the *san jhya* on the second floor are two additional windows. The left window lintel has collapsed due to water damage. The right hand window is in fair condition with some superficial wet rot, having suffered in its high location susceptible to rain water.

On the first floor, openings are in good condition except for missing brick cornice discussed under 5.02. Lattice work in the central and northern windows is damaged, approximately 6"x4" and 4"x4", respectively.

On the ground floor, the southern historical door has been replaced by a modern and larger opening. The historical door frame has been installed in the reconstructed south facade. The latticework of the central door is largely damaged or lost; the northern door has lost its shutters, replaced with brick infill.

The timber cornice of this facade's central bay is intact. The side bays appear never to have had a cornice.

South elevation

There is no historical evidence of the original configuration of this facade. Two doors have been installed in the 1977 rebuilding, one of which was originally found on the principal facade. Both doors are damaged by wet rot in the lower 18" of the frame. Historical shutters of the right (eastern) door are intact with damaged sections from wet rot; the left door has been blocked with brick infill.

Rear courtyard elevation

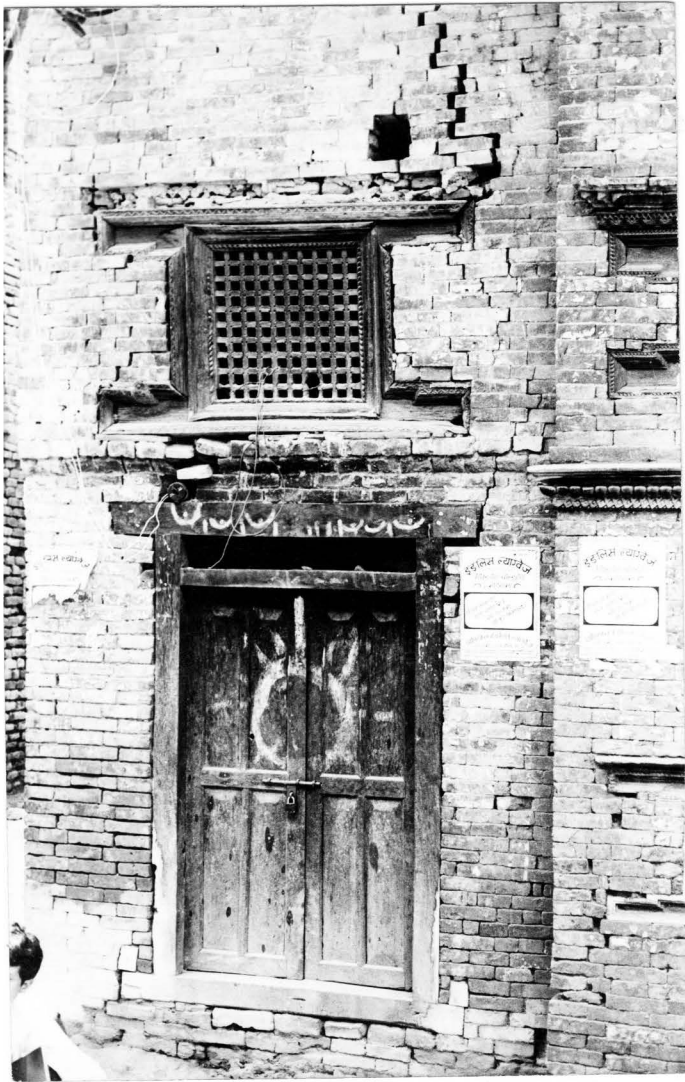
Five timber door openings on this elevation have all lost their shutters. All five door frames are damaged by wet rot in the lower third (approximately 18"). Timber lintels and inner frames also largely damaged by wet rot. This facade has been the most exposed to rain since roof was lost/damaged.

Seven of 16 historical columns survive, all damaged in the lower half by wet rot. Stone bases survive; one of four is cracked.



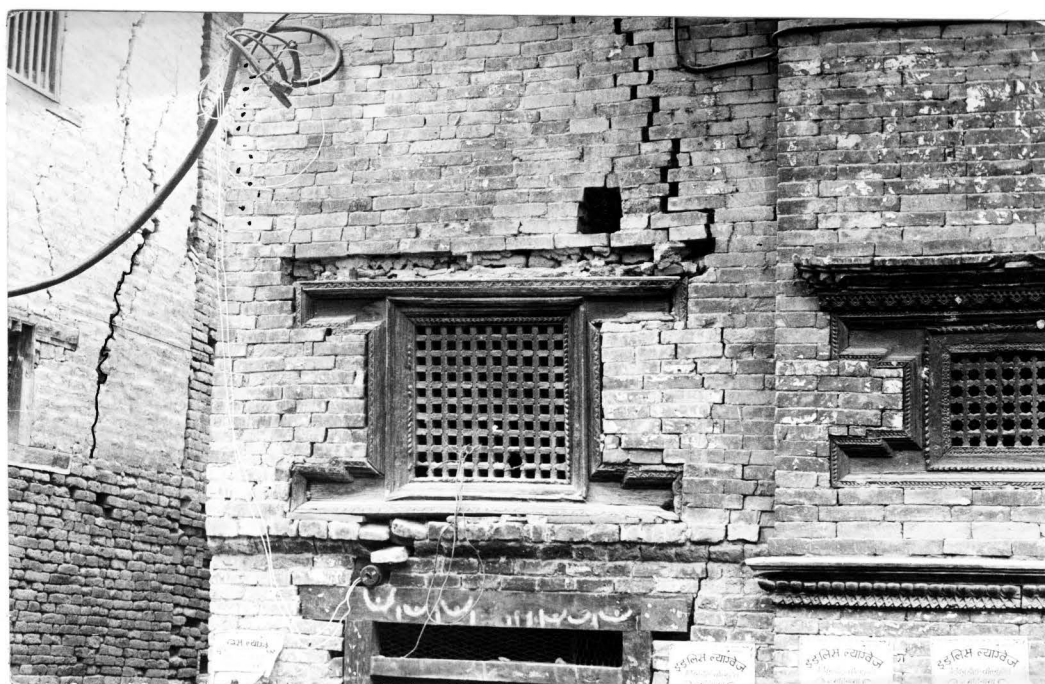
Left : Wall opening on South facade blocked by brick wall in 1977 repair.

Right : South facade: original door re-installed here from principal facade..

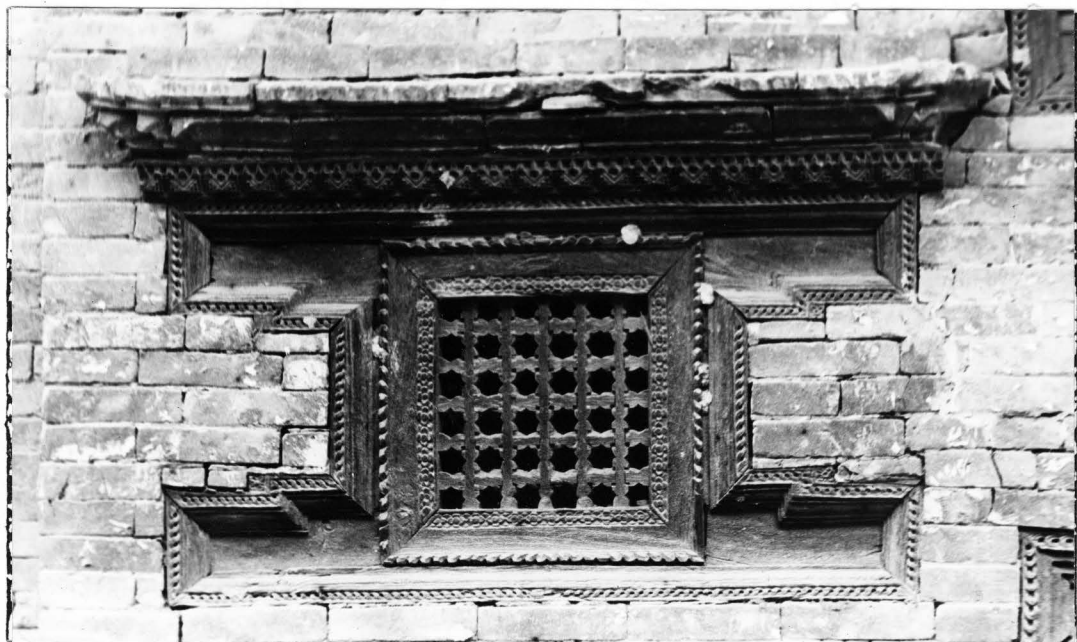
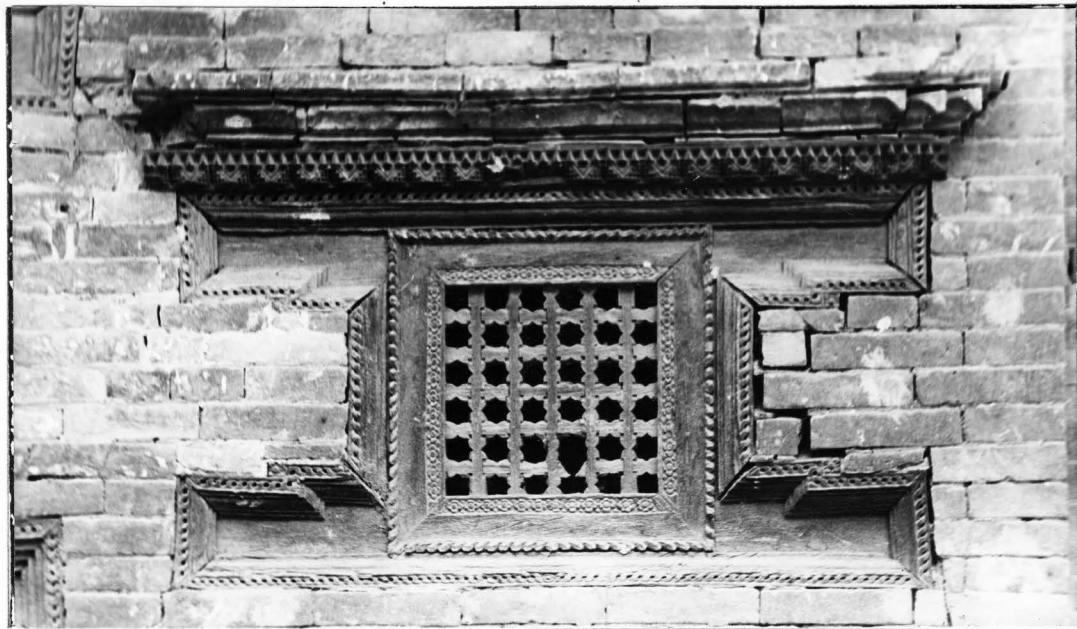
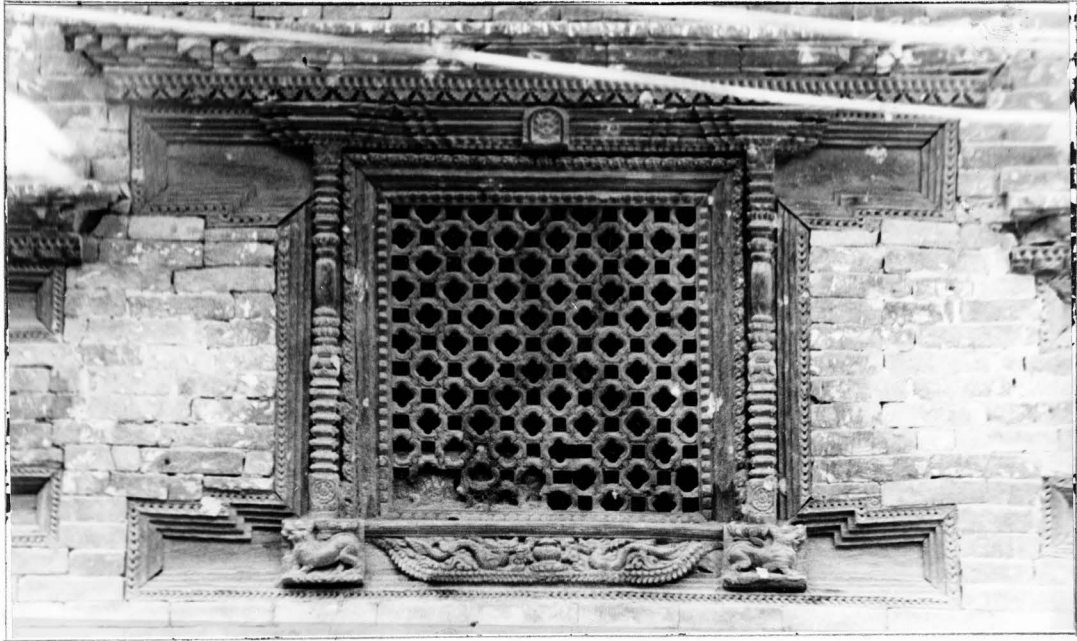


Above : New opening front facade left, from 1977 repairs.

Below : Historical door, principal facade north, blocked by brick in 1977 repairs.



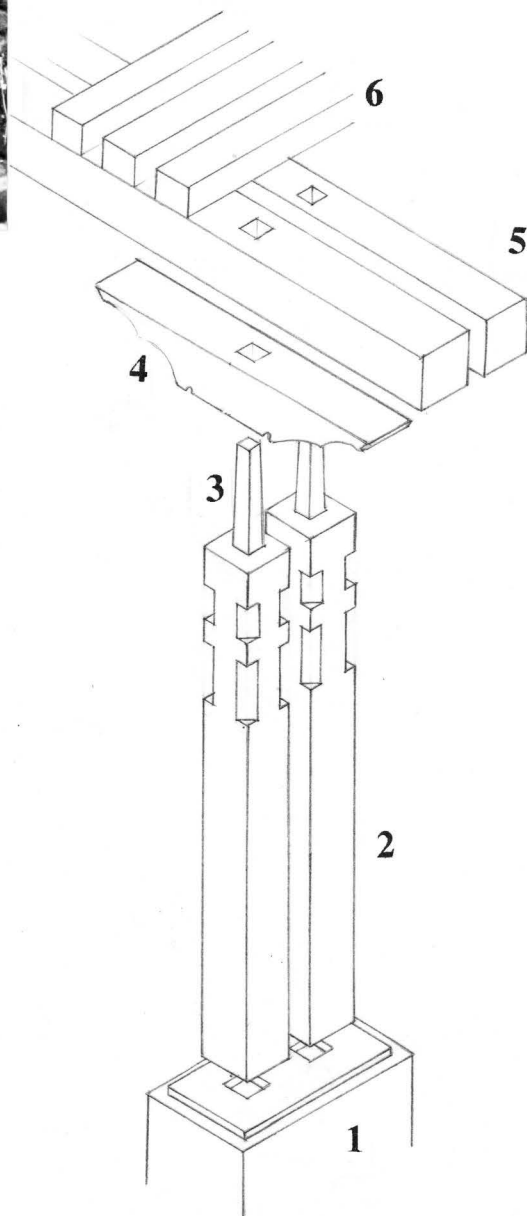
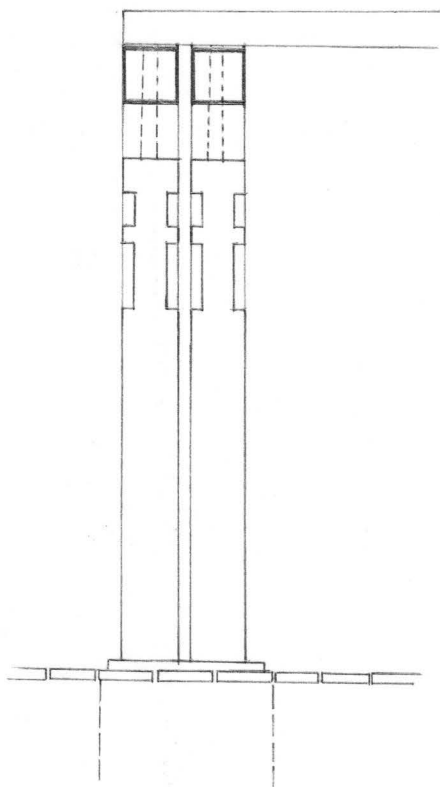
This page: First floor windows north and south ends. Opposite page: central window first floor. above with north and south flanking units below, respectively.





At the back elevation upper two floors (first and second floor) collapsed some five years back after several years of water penetration. Now only seven of the ground floor timber posts remain.

1. Base stone (*I Lohan*)
2. Timber column (*Than*)
3. Tenon (*Sa*)
4. Bracket (*Meth*)
5. Beam (*Nina*)
6. Joist (*Dalin*)



5.04 Timber roof structure

Summary

Little of the Patukva Agache's historical timber roof framing survives 1977 repairs which replaced historical pine members with new members in a jerry-built configuration to carry zinc sheets. Elders report that removed damaged roof frame members were pine has been confirmed by inspection of certain re-used elements, cut down and used for the metal roof supports. Extant historical interior floor joists are similarly of pine, contrasting exterior components like carved doors, cornices, and windows in sal. The distinction is here emphasized because of the common misconception that all historical applications used only sal, when in fact it is only the restoration and repair projects of the last two decades which have used sal exclusively. The general condition of the new roof frame is poor, damaged by wet rot, because the 1977 metal roof was not installed properly. The only extant historical portion of roof framing is found over the bay window of the principal elevation.

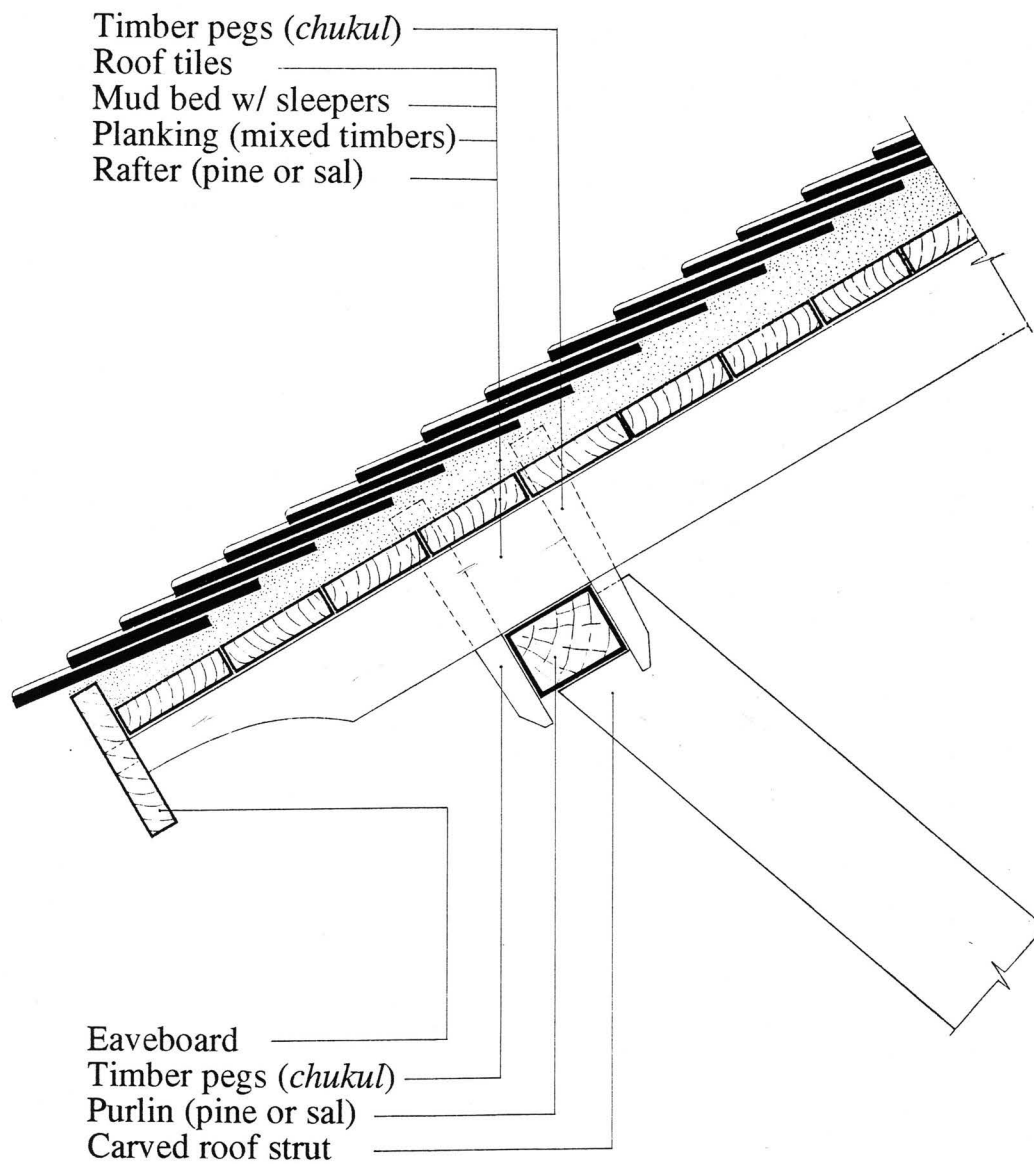
All pine and rafters in this extant portion show minor signs of past insect infestation (as do the interior historical pine floor joists). These bore holes, approximately 1 mm in diameter are found in irregular patterns and do not threaten the structural integrity of the members.

An important conclusion after detailed study of the extant roof structure is that the traditional wooden peg (Newari: *cuku*, Nepali: *chukul*) inserted as a key at wall plate and purlin is a principal entry point for water into the structural timbers. The traditional detail uses the peg as a key into the mud layer above. Thus any damage to or movement of the rather loose roof tile (Newari: *Jhingati*) allows water to reach the mud and then penetrate into 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 is especially critical at purlin locations.

At almost all (approximately 90%) of these peg locations, structural deterioration and in particular enlarged holes of these pegs to as much as 3" square (300%) has led to structural failure of the joints. This failure pattern is exacerbated by general dampness transmitted by the timber lath beneath the mud bed. This scenario describes the loss of rafters above the bay window here as well as the majority of roof failures in Newar buildings, and in particular at our other recent projects, Radha Krishna and Uma Maheswar Temples.

Lower Roof

Except for the front part above the bay window, this roof has been completely rebuilt with metal sheet roofs (north and south slopes), while the courtyard slope (west) was rebuilt with big tiles. These substitutions of lighter roof cover have allowed the Guthi to completely dismantle the historical pine roof framing, replacing it with an undersized ahistorical sal frame.



THE "KEY" PROBLEM

*Section at roof overhang:
as traditionally detailed*



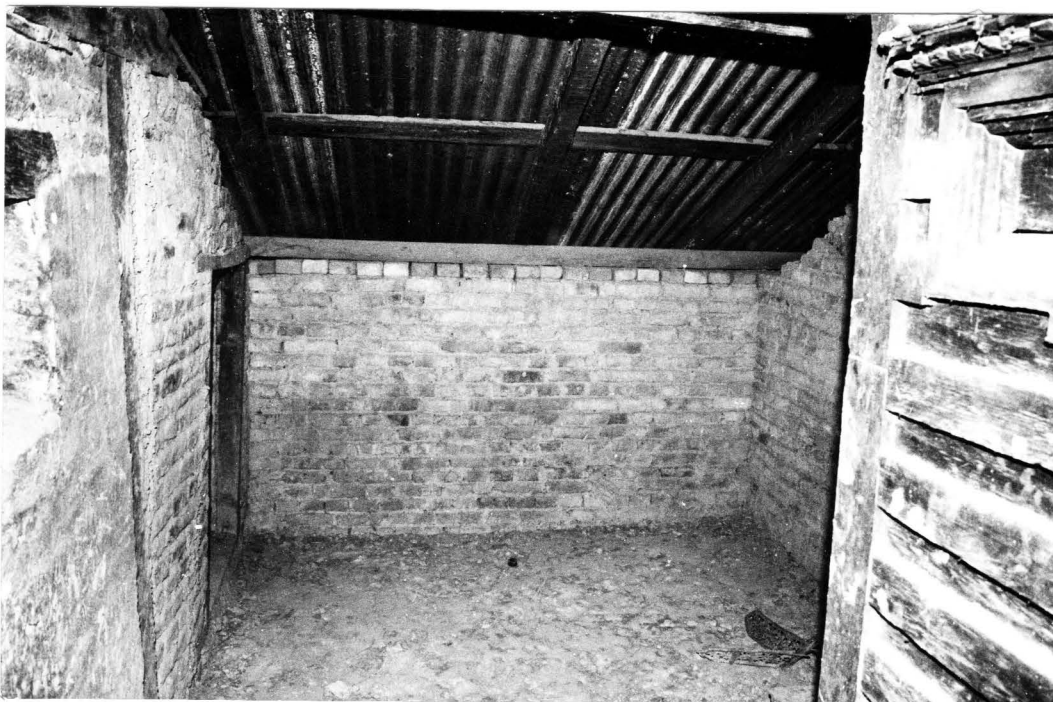
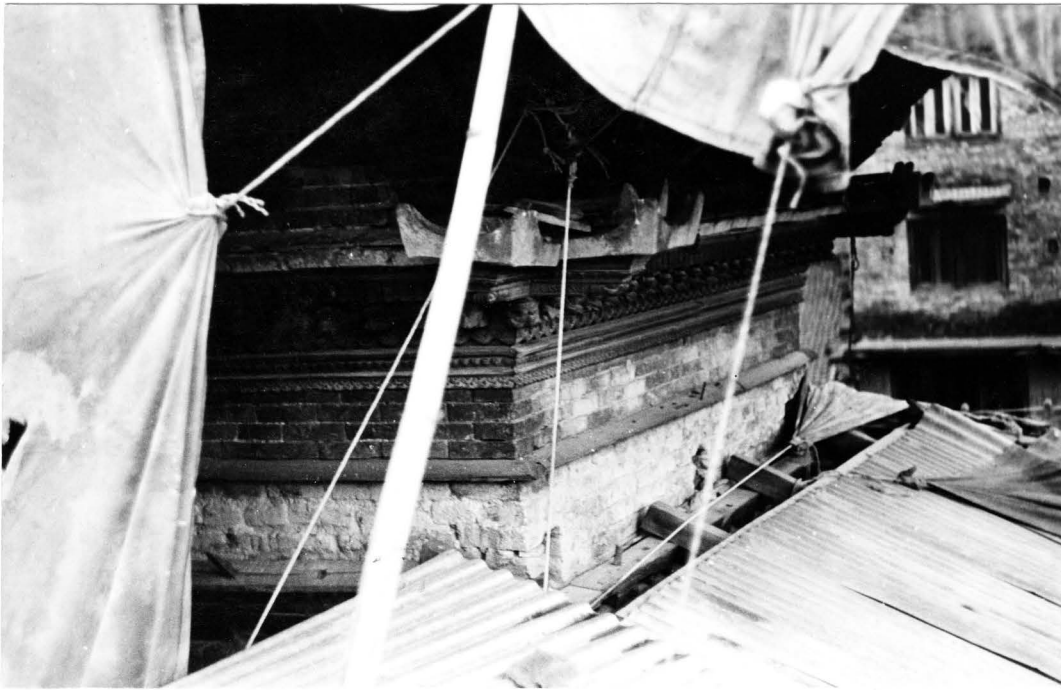
Timber lath above pine rafters has transmitted dampness from mud to rafter. Principal facade, August 1993.

The condition of these machine sawed sal members is good, although their reduced size does not correspond with the historical members (4"x 3" cf. 5"x 3"). The members have been fixed with an inappropriately shallow pitch and with insufficient overhang.

Elders report that the front (east) roof above the bay window was not rebuilt after the 1934 earthquake; it retains pine rafters, closely spaced (14" o.c.) with lath above. Most of these rafters are structurally damaged, from *chukul* or dampness transmitted by the lath.

Upper Pagoda Roofs

The upper roof has also not been repaired since before the 1934 earthquake, as reported by Guthi elders. All of the rafters and purlins are pine (5"x 4" on average, spacing 12" o.c. at eavesboard) and in very poor condition. Several pieces of the sal eavesboards are missing, surviving portions are in poor condition. All damage is related to wet rot caused by water penetration. Source of the problem, as at other roof locations, consists of water entry via *chukuls* and general dampness transmission from mud bed to rafter via lath under the mud.

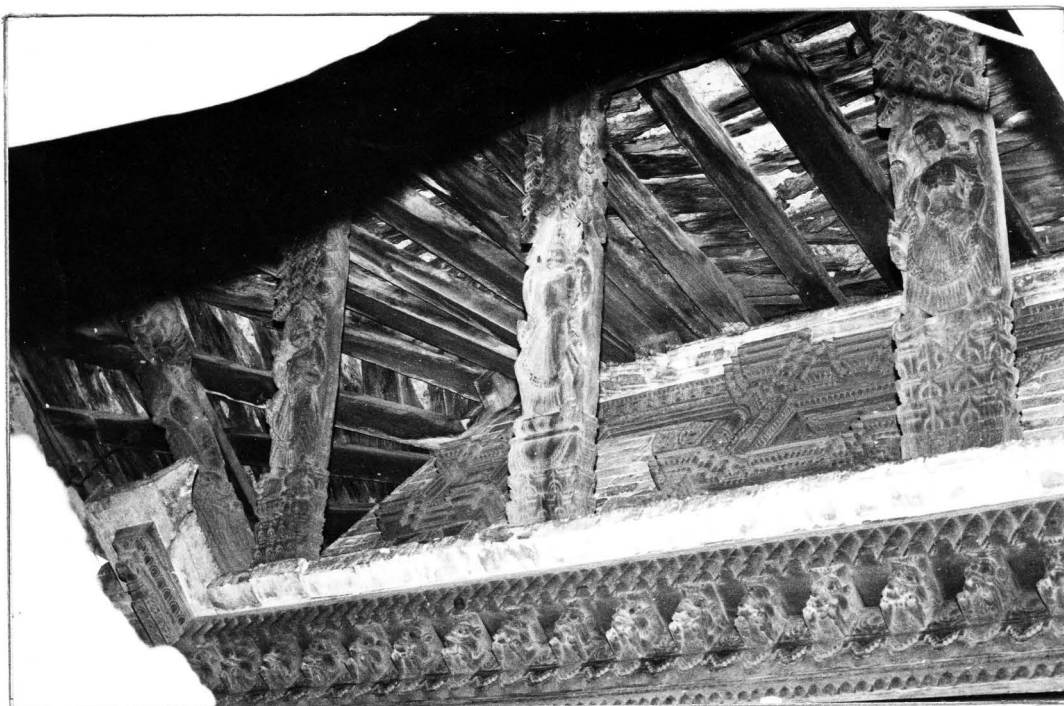


Above: Zinc roof on south side of building from 1977 repairs. Although zinc sheet is relatively easy to fix (especially in comparison with *Jhingati*), nevertheless, improperly executed repairs with zinc sheets have allowed water to enter the building.

Below: Replacement with zinc sheets allowed minimally rebuilt roof frame (rafter spacing +/- 3'7" o.c.).

Right: Eavesboard already lost and rafter ends rotted off, Upper pagoda(lower of two roofs) , south elevation. August 1993.
Below: Only a few metal strips hold a damaged eavesboard on west facade, upper pagoda (lower of two roofs).August 1993.





**Above : Uppermost pagoda roof from west shows broken eaves on North-West corner.
August 1993.**

**Below : Middle roof shows timber lath above pine rafters, typical of upper and lower pagoda roofs.
August 1993.**

5.05 Roof cover and decorative elements

Summary

On the lower roof, a traditional roof cover of lath on rafters with a clay bed above to receive the tiles is intact only above the bay window ,i.e. the eastern slope. The upper pagoda roofs similarly retain this traditional treatment with lath, a convention that has been in general replaced in all repairs and renovations of the last two decades, The norm during these years has been to substitute more water-resistant sal planking. Lower roof areas have been recovered in zinc sheets or larger tiles, laid dry.

Roof Tiles *Jhingati*

The roof tile cover laid in clay is largely intact on the two pagoda roofs, although many individual tiles have been displaced. All the ridge tiles have been replaced by two layers of brick laid in mud mortar from the 1977 repair. On the lower roof above the bay window even this later ridge in brick has been lost. Not a single corner aviform tile survives on any of the three roofs. These aviform tiles are the traditional corner treatment which give the roofs a slight *upswept* effect.

Metal work

One inch wide metal strips with triangular points are found with nails connecting all rafter heads at their penetration of the eaves boards of bottom, middle and top roof. Their 1 mm thickness has allowed them to rust through in all locations.

Roof Struts

All roof struts are in place. Based on stylistic grounds and visible lack of texturing by wind and rain, they appear to be not more than 100 years old. All the struts are sal and structurally sound showing no damage by fungi or insects. Historical cracks from the wood's seasoning are visible on several components, but pose no structural threats. Some struts have been discolored by water and mud running off the damaged roofs above.

See inventory.

Pinnacle (*Gajura*)

Rafters of the topmost roof meet to carry a central kingpost in sal wood. This kingpost supports the gilt copper pinnacle of traditional bell shape. The pinnacle appears to be original: it is nicely proportioned and undamaged. A 6" gap between the bottom of the pinnacle and the roof tiles below is found where such pinnacles would normally have a rectilinear base. Elders report that some thirty + years ago a masonry base existed, but since was lost. Many traditional buildings in the Kathmandu Valley have lost this base, which can be of masonry, but is more often in gilt or ungilt copper.

5.06 Timber floor structure

Base structure

Extensive water penetration over the last five years has induced wet rot and severely damaged at least 60% of the interior timber joist framing. The historical timber joists are of pine in sizes averging 5"x 4" (laid on flat, 12-14" on center according to local convention). Ten new joists in undersized machine sawn sal replaced damaged members in the 1977 repairs.

The wall plates are also of pine. Their long lengths (north-south) are made of up 3-4 pieces per side and lap jointed. In the western or middle wall, wall plates and opening lintels are in very poor condition, all damaged from years of rain pouring in. On the front facade there is less damage to wall plates because of limited roof cover. Surface probes suggested that between 30 and 50% of wall plate lengths are still structurally sound.

Upper pagoda

The beams which rest at wall plate level to carry the upper pagoda are the only interior structural members in the more durable and strong sal. They are in excellent condition despite what appears to be an historical deflection of 1-2" in the center.

Interior framing in the upper pagoda is intact and in good condition. It consists of joist like framing (although without floor cover) just above the principal econd story shrine. Above this tie members brace the structure at 45 degrees at the corners. Crossing members at the centerpoint support the pinnacle's kingpost. The kingpost of sal is in good condition; its pine supports are completely decayed from wet rot, especially in the central portions where pieces of timber 4"x 5"x12" have actually crumbled away.

TIMBER CONDITION

Ground floor ceiling joist

Location	Size	wood Type	Age	Condition	Remarks
Back Dalan (South-North)					
01.	11x8	Pine	19th cen	1/3 part damage rotten	Reuse
02.	8 1/2x5	Pine	19th cen.	Normal	Use
03.	10x10	Pine	14 year old	Rotten	Replace
04.	8x9	Pine	14 year old	Rotten	Replace
05.	10x10	Pine	14 year old	1/2 rotten	Replace
06.	11x7	Pine	14 year old	1/3 rotten	Replace
07.	14x8	Pine	14 year old	Centre rotten	Replace.
08.	16x8	Pine	14 year old	Seen face rotten	Replace
09.	13x10	Pine	?	1/2 thick rotten	Replace
10.	13x8	Pine	?	1/2 rotten	Replace
11.	15x9 1/2	Pine	?	1/2 rotten	Replace
12.	13x10	Pine	?	1/2 rotten	Replace
13.	10x9	Pine	19th cen.	1/2 rotten	Replace
14.	-----	-----	-----	-----	Missing
15.	-----	-----	-----	-----	Missing
16.	13 1/2x7	Pine	19th cen	1/2 rotten	Replace
17.	13 1/2x9	Pine	19th cen.	1/2 rotten	Replace
18-26	-----	-----	-----	-----	All missing
27.	10x4	Pine	19th cen.	Fully rotten	Replace
28.	8x9	Pine	19th cen.	End rotten	Replace

Ground Floor ceiling joist

Location	Size	Type wood	Age	Condition	Remarks
Front wing (South-North)					
01.	13x8	Pine	14 year old	Fully rotten	Remove
02.	13x10	Pine	14 year old	Surface rotten	Remove
03.	10x7	Sal	14 year old	Good	Usable
04.	12x10	Pine	19th cen.	Bad	Replace
05.	13x10	Pine	19th cen.	Normal	Use
06.	13x10	Pine	19th cen.	Normal	Use
07.	16x10	Pine	19th cen.	Half missing	Replace
08.	13x10	Pine	19th cen.	Surface rotten	Use
09.	13x10	-----	-----	-----	Missing
10.	13x10	Pine	14 year old	Side rotten	Usable
11.	14x10	Pine	19th cen.	Normal	Usable
12.	11x10	Pine	19th cen.	Normal	Usable
13.	15x10	Pine	19th cen.	Normal	Usable
14.	14x10	Pine	19th cen.	Normal	Usable
15.	14 1/2x9	Pine	19th cen.	Normal	Usable
16.	16x9	Pine	19th cen.	Normal	Usable
17.	14x10	Pine	19th cen.	Bad	Replace
18.	11x10	Pine	19th cen.	Bad	Replace
19.	16x9	Pine	19th cen.	End rotten	1/2 can use
20.	13x10	Pine	19th cen.	Surface rotten	Replace
21.	12x8	Pine	19th cen.	Surface rotten	Can use
22.	Variable	Pine	19th cen.	Bad	Can use
23-28	-----	-----	-----	-----	All missing

First Floor ceiling joist

Location	Size	wood Type	Age	Condition	Remarks
Front wing (South-North)					
01-05.	-----	-----	-----	-----	All missing
06.	12x8	Pine	?	surface rotten	Replace
07.	11x8	Pine	?	surface rotten	Usable
08.	10x7	Pine	19th cen.	surface rotten	Usable
09.	10x7	Pine	19th cen.	surface rotten	Usable
10.	12x9	Pine	19th cen.	surface rotten	Remove
11.	12x9	Pine	19th cen.	1/2 surface rotten	Remove
12.	12x8	Pine	19th cen.	1/4 surface rotten	Reusable
13.	14x8	Pine	19th cen.	1/4 surface rotten	Reusable
14.	15x8	Pine	19th cen.	1/4 surface rotten	Reusable
15.	16x8	Pine	19th cen.	Rotten	Replace
16.	16x8	Pine	19th cen.	Rotten	Replace
17-26.	-----	-----	-----	-----	All missing
27.	12x8	Pine	19th cen.	Rotten	Replace

First Floor ceiling joist

Location	Size	Type wood	Age	Condition	Remarks
Back wing (south north)					
01.	14x8	Pine	19th cen.	Rotten	Replace
02.	12x8	Pine	19th cen.	Rotten	Replace
03.	12x7	Pine	19th cen.	1/2 rotten	Replace
04.	10x8	Pine	?	Bad	Replace
05.		?	?	Bad	Replace
06.	16x8	Pine	?	Bad	Replace
07.	14x7	Pine	?	Bad	Replace
08-27.	-----	-----	-----	-----	All missing

5.07 Interior

Because of damaged and missing floor joists, the structure has been uninhabitable for almost a decade.

Finishes

The floors and walls are finished with mud plaster. This traditional plaster is made with mud, cow dung, molasses, and rice husk. This plaster is impressively durable and intact in many wall locations, approximately 40%.

Floor plaster is generally never removed, but simply added to in order to repair. The thickness of extant mud floors is between 4 and 8 inches. The mud floors rest on a mixture of timber lath and small bamboo stalks, a local variety of diameters less than 1/2" called *nigalo*.

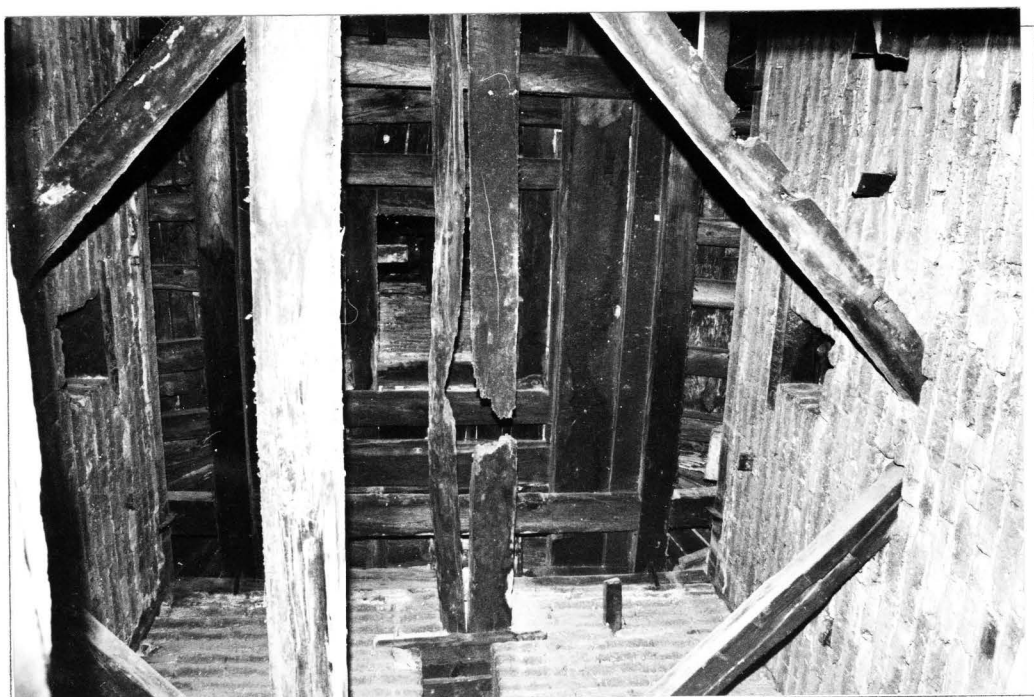
Services

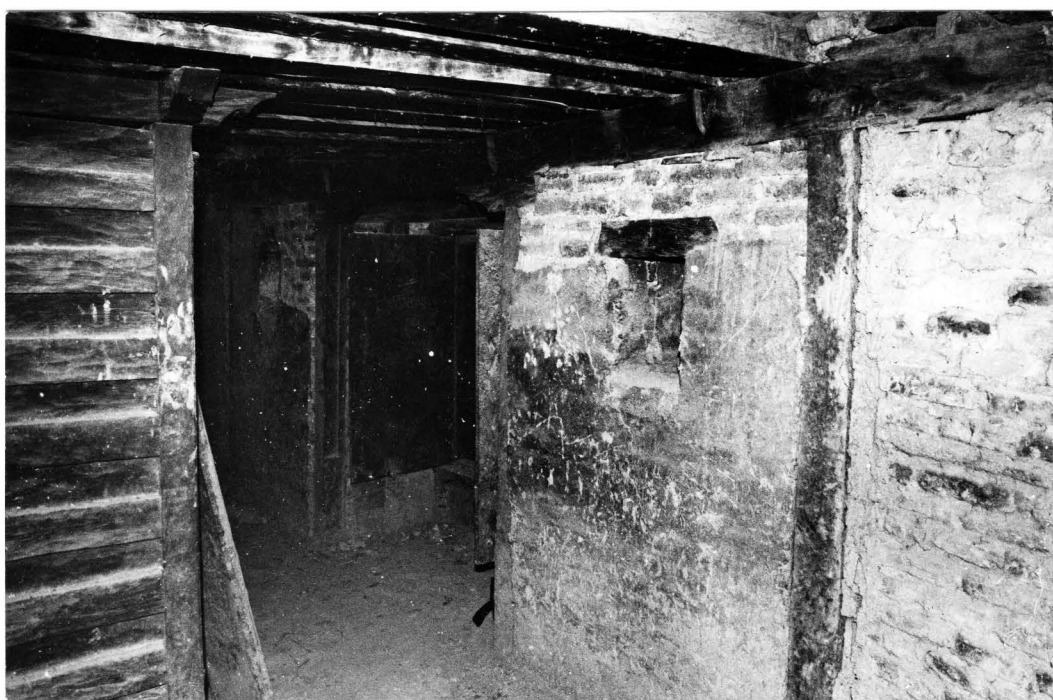
The building has never been electrified or fitted with running water or toilet.



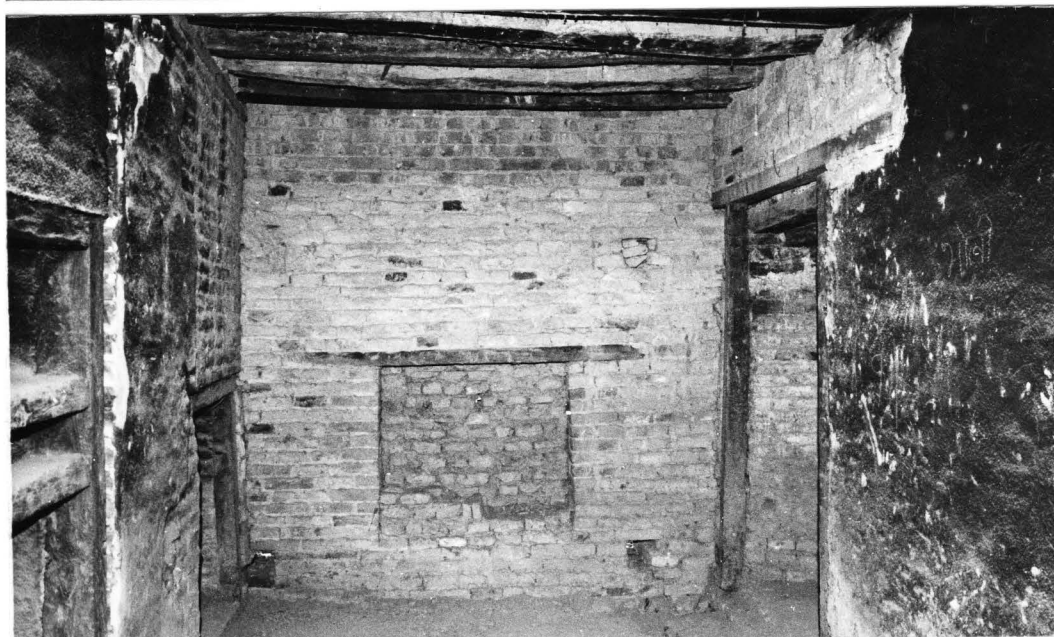
Left : Gap between bottom of pinnacle and roof tiles. August 1993.

Below : Inside timber structure of upper pagoda showing damaged tie in center and corner bracing, perhaps added in 19th c. reconstruction. August 1993.

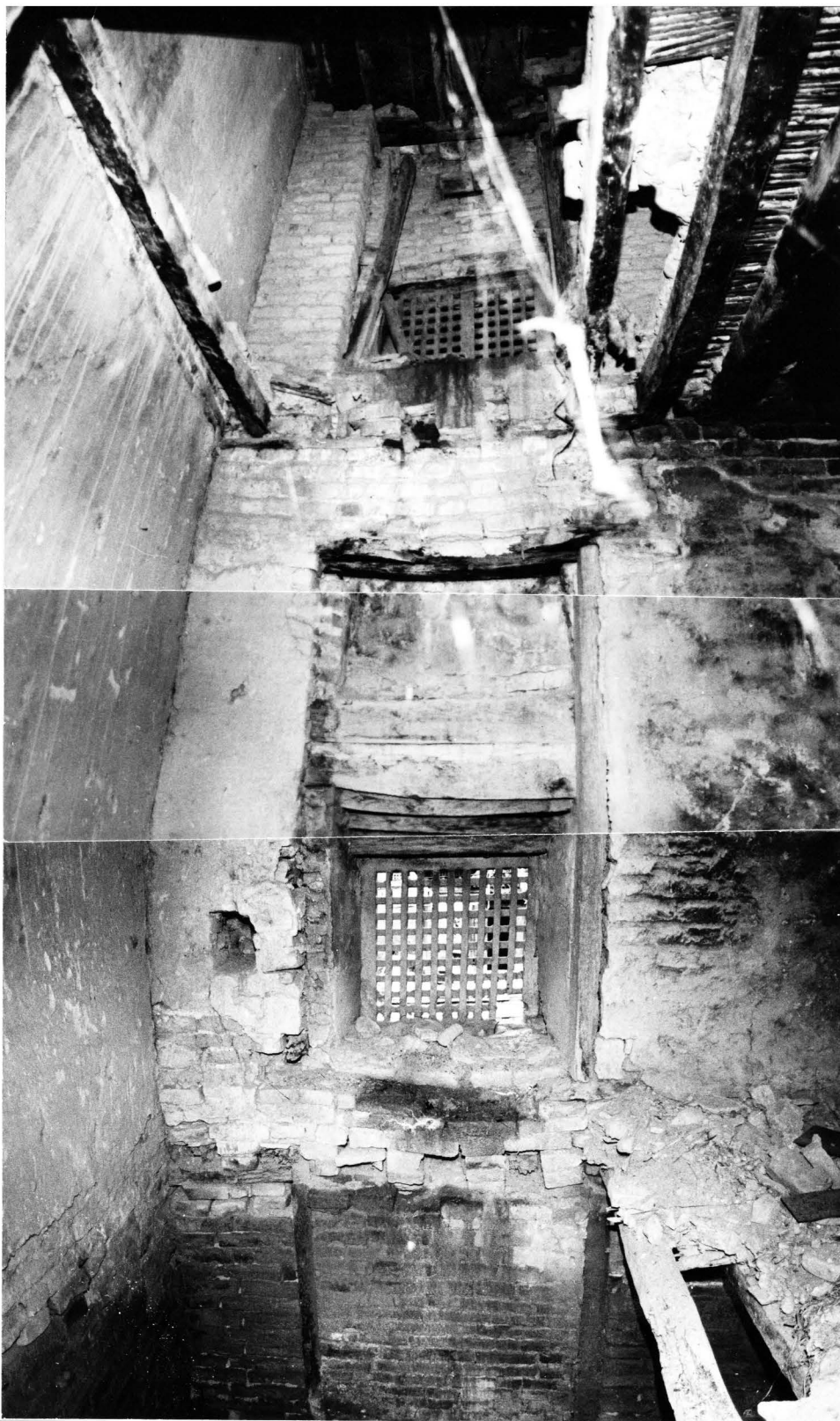




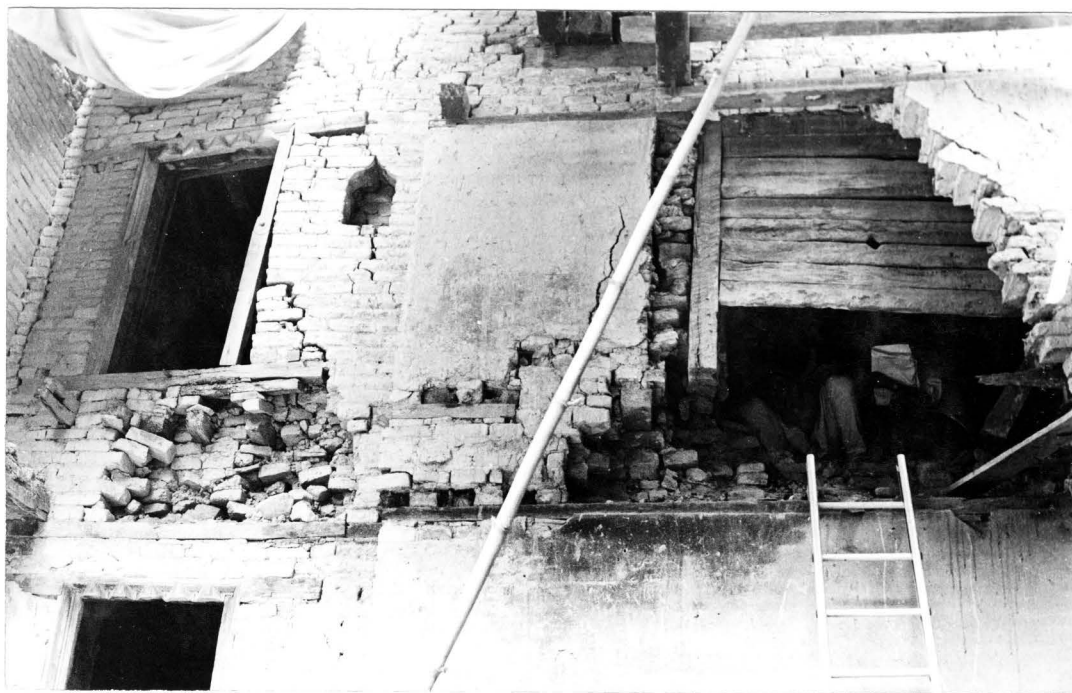
Above : Partition of esoteric shrine, second floor. Below: view towards *san jhya* with esoteric shrine left.
August 1993.



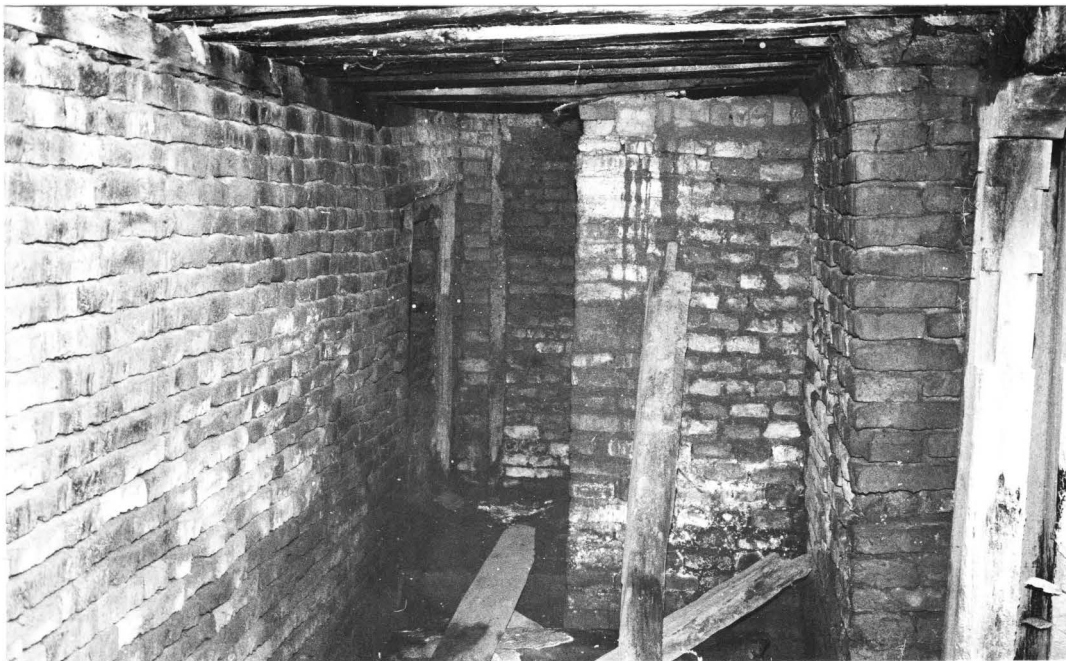
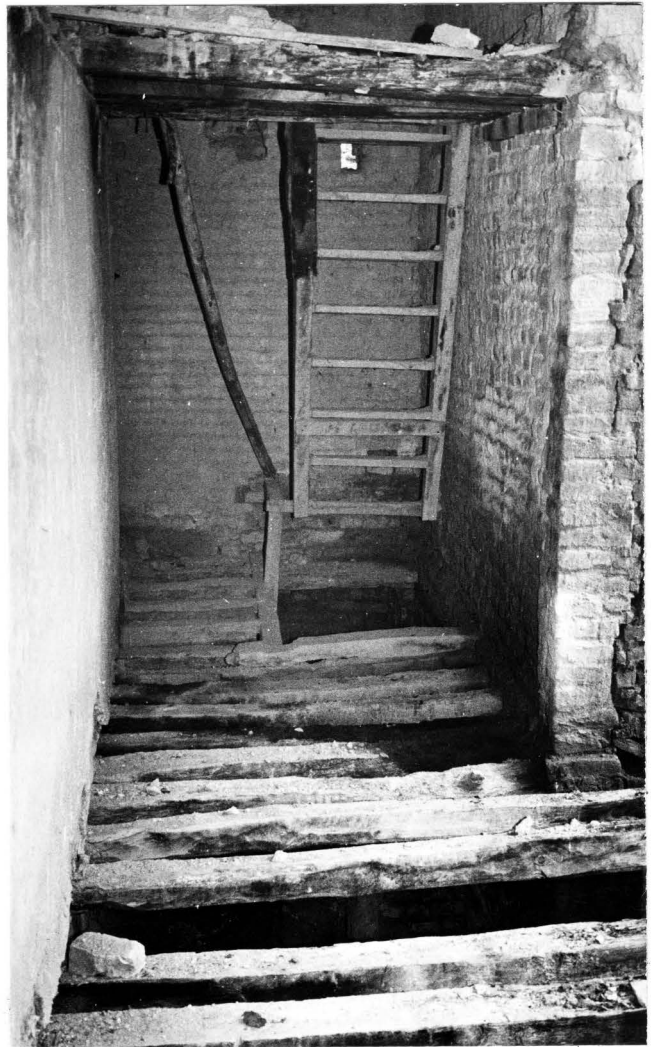
Above: Detail above south window first floor showing intact mud plaster and common brick beneath. Middle: First floor south face of 1954 partition left, central and south windows of principle facade right. Bottom: First floor looking south to blocked window.



Composite photo view looking east. The three northern openings of the principle facade (blocked door below) are visible as is collapse of all floor joist in this area.

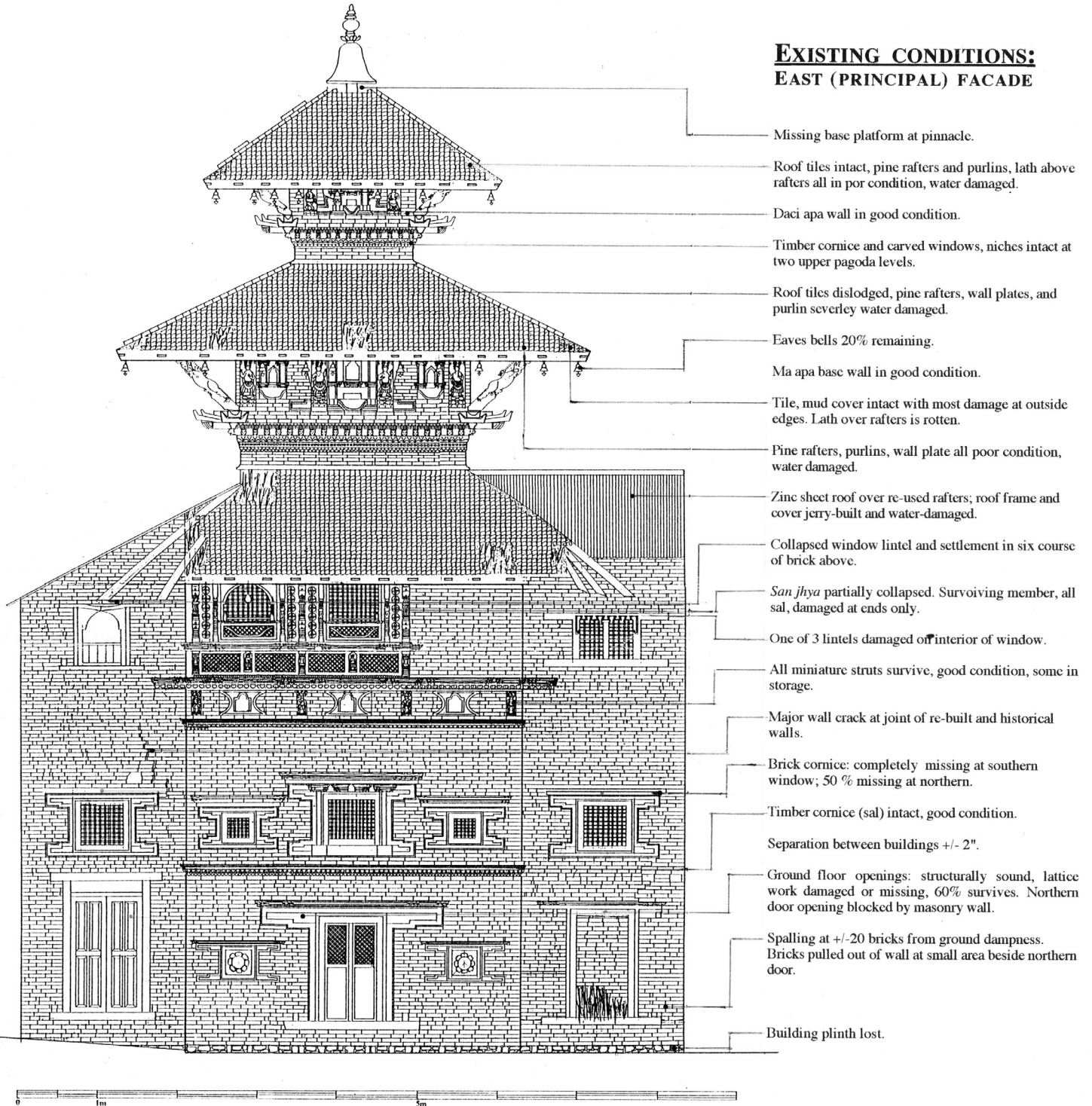


Above: Back of main building ("middle wall") showing second floor shrine location where masonry wall added behind timber partition led to structural collapse of rear gallery. Summary 1993. Below: First floor of rear gallery showing missing joist and partially collapsed adjacent masonry wall (left).

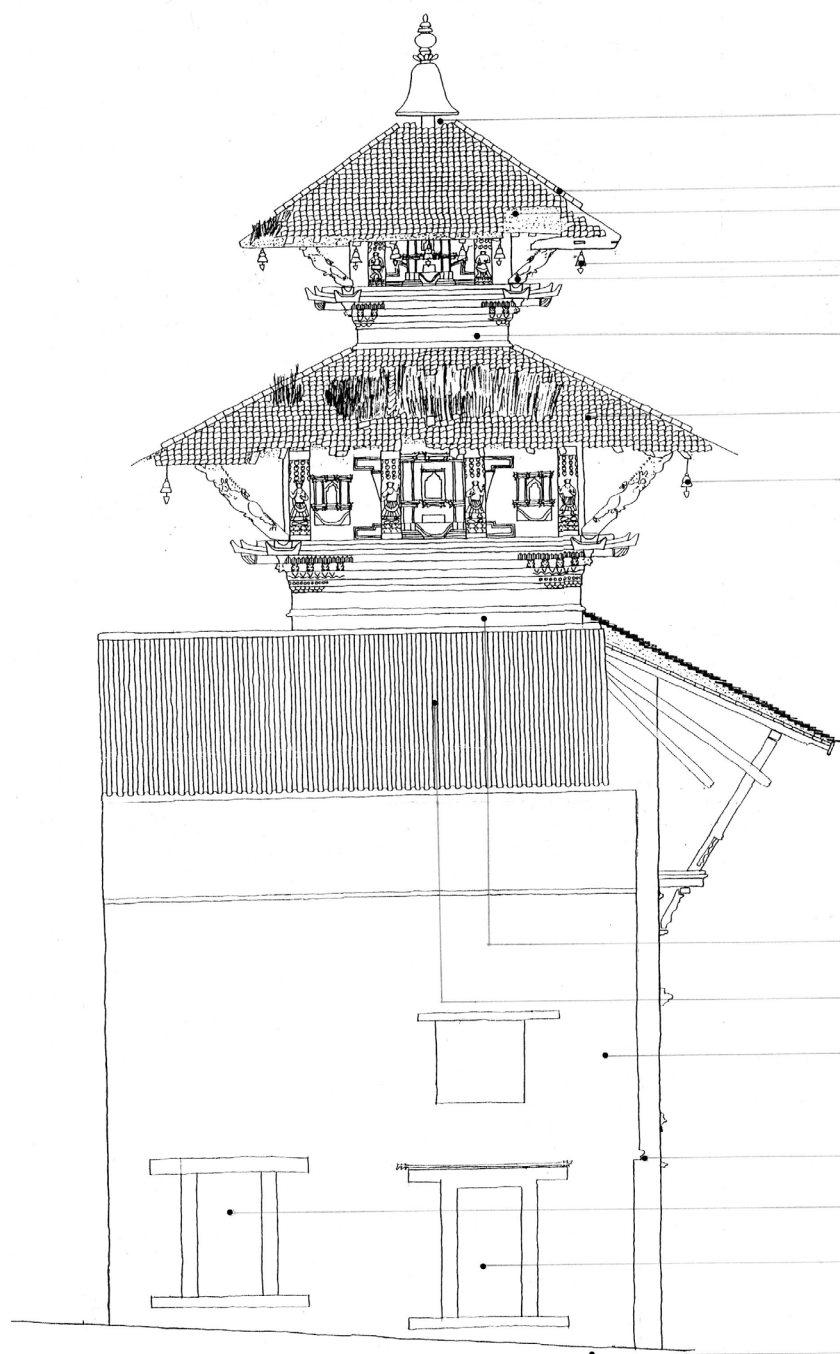


Above left: Back of esoteric shrine, second floor, showing original planking partition as well as later added and partially collapsed masonry wall behind, summer 1993. Above right: first floor level at back wing looking south to stair ladder. Below: Ground floor at back wing looking south, showing masonry stair middle, and gallery timber pier right.

EXISTING CONDITIONS: EAST (PRINCIPAL) FACADE



PATUKVA AGAM
PATUKVA TOL, PATAN
UNESCO WORLD HERITAGE SITE MONUMENT ZONE
PRINCIPAL ELEVATION: EXISTING CONDITIONS
KATHMANDU VALLEY PRESERVATION TRUST, APRIL 1993



Existing Conditions

South Facade

Missing base platform of pinnacle

Roof tiles broken in west-south and south-east corner, ridge tiles replaced by brick.

All pine rafters, wall plates, and purlins and sal eavesboard in poor condition, water damaged.

60 % of bronze bells at eaves missing.

Sal struts and cornices in good condition at upper pagoda two levels.

Daci apa walls in excellent condition at upper pagoda two levels.

Roof: damaged pine rafters, purlins, wall plates; timber lath-poor condition, small holes in cover, esp. at outer edges; missing eavesboard. Ridge tiles replaced by bricks.

85 % of bronze bells at eaves missing.

Ma apa base wall in good condition.

Jerry-built sal roof frame, zinc roof sheets.

1977 chimney brick facade (south) in good condition, joints scoured.

Wall rebuilt above ground floor cantilevering 4" forward of ground floor.

Left opening blocked by brick wall.

Right door lintel and frame water damaged from raised ground level.

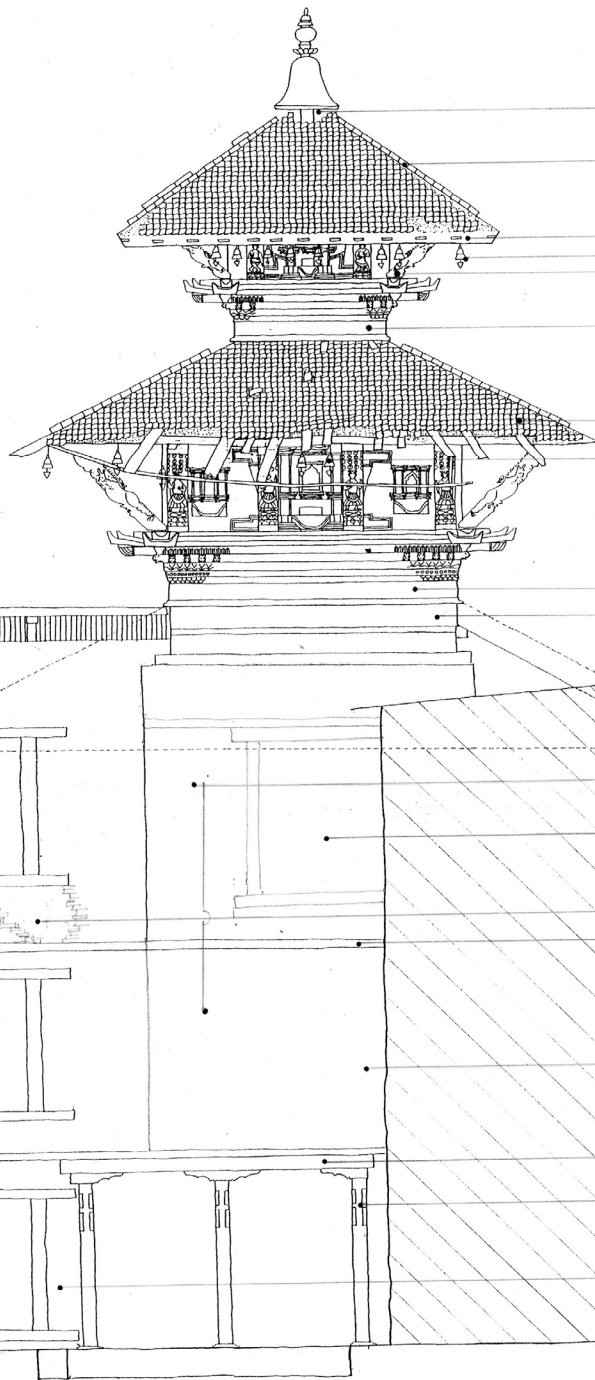
Missing plinth



PATUKVA AGAM

PATUKVA TOL, PATAN
UNESCO WORLD HERITAGE SITE MONUMENT ZONE
SOUTH ELEVATION: EXISTING CONDITIONS
KATHMANDU VALLEY PRESERVATION TRUST, APRIL 1993

Existing Conditions West Facade



Missing base platform of pinnacle

Roof tile intact, ridge tiles replaced by brick.

All pine rafters, wall plates, and purlins and sal eavesboard in poor condition.

65 % of bronze bells missing.

Sal struts in good condition.

Upper walls in excellent condition.

Roof damaged (broken rafters, small holes, and collapsed eavesboard); ridge tiles replaced by bricks

80 % of bronze bells missing.

Dachi apa wall in good condition.

Ma apa base wall in good condition.

Lower roof: rafters, purlins collapsed.

First and second floor rear gallery collapsed.

Timber partition at the back of esoteric shrine broken in many places.

Wall (middle wall facing courtyard) damaged in many places esp. large collapsed areas at second floor level.

Pine wall plates: poor condition, water damaged.

Wall cracks in several places (min. 1/2", max. 1 1/2").

Pine wood beams: poor condition, water damaged.

Sal timber columns, surviving 8 of 16 are all water-damaged in lower 1/3.

Left (north) bay of gallery, which had been rebuilt in masonry, collapsed.

PATUKVA AGAM

PATUKVA TOL, PATAN
UNESCO WORLD HERITAGE SITE MONUMENT ZONE
WEST ELEVATION: EXISTING CONDITIONS
KATHMANDU VALLEY PRESERVATION TRUST, APRIL 1993

6.0 RECOMMENDATIONS FOR REPAIR

6.01 Foundations/walls: structural

6.02 Wall fabric

6.03 Wall openings and decorative elements

6.04 Roof structure

6.05 Roof cover and decorative elements

6.06 Floor structure

6.07 Interior

6.01 Foundations/walls structural

Introduction--seismic reinforcement

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 help withstand earthquakes. Structural characteristics in the historical design and present conditions of the Patukva Agache which affect performance in an earthquake can be summarized.

*The lack of vertical structural continuities in the mud mortar wall is not good for performance in earthquakes. Typical of Nepalese buildings, the discontinuity of masonry walls at the base of the upper pagoda is especially noteworthy. At this location, the loads of the upper pagoda are carried by timber beams.

*The general looseness of the walls is a major problem in Nepalese historical buildings. Insufficient or non-existent through-bonding (to connect three distinct layers) greatly diminishes the strength of the walls. The exterior veneer has little to restrain it from movement out.

*These deficiencies of the wall structure are exacerbated by the “top-heaviness” of the overall building created by the rooftop pagoda and more generally by the great mass of the roofs. The mud bed of the roof tiles together with the significant projecting overhang of the roofs create unusually heavy roof loads.

*Furthermore, the general looseness of the timber structure resulting from traditional timber pegged joints, rigid in only one direction, detracts from performance in an earthquake.

*The mud mortar construction of the structure, on the other hand, would improve performance in an earthquake because of its damping effect—the mud is able to absorb shocks without fracturing adjacent bricks and/or wall areas.

* The present condition of the building threatens the monument: timber floor and roof structure are greatly compromised by water damage and, to a lesser extent, by careless rebuilding. A critical end wall to the north has been lost by encroachment.

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. Several alternative design solutions for seismic strengthening of the building have been pursued.

Key features of proposed seismic reinforcements are:

- (1) Rebuilding of the floors with double layer planking at 45 degree angles to create rigid plates at two levels. A perimeter beam frames this floor system.
- (2) Introduction of a timber frame on the interior of the building designed to carry floor and tower loads in the event of severe damage to the walls. Connections to repaired and renewed historical timber structure are maximized; this frame or skeleton also compensates for the critical missing end wall (north) of the building. Post locations (eight per floor) correspond to building interior corners and most critical locations beneath the upper pagoda's masonry walls.
- (3) General strengthening of timber structural connections (rafter-wall plate; rafter-purlin; post-beam) during repair and rebuilding work.
- (4) Reinforcement of the timber beams which carry the upper pagoda by insertion of two additional beams underneath and perpendicular to the historical members.
- (5) Introduction of new diagonal timber bracing in the upper pagoda interior.

An important development in the design process for the above was the conception of the new timber frame as an *auxiliary* skeleton, rather than as a framework inserted into the wall. This was suggested by Engineer Guy Nordenson and has several important benefits. Mr. Nordenson maintains that given the extreme structural deficiencies of the historical walls, it will be safer to construct a new auxiliary or *back-up* reinforcement than to attempt to improve the old walls. At the same time, the solution is critical for the project's conservation philosophy as it allows a minimum intervention to the historical walls and proposes a solution which is reversable, i.e one could theoretically remove it without doing damage to the historical structure. The independent timber skeleton is sympathetic visually to the historical interior while also being clearly distinguishable from the historical timbers.

Philosophically, it is in keeping with many historical structures in Nepal where later repair and rebuildings have introduced additional (sometimes inelegant) timber reinforcements (Kwa Baha and Vabaha towers are two examples where distinct 19th and 20th century layers of timber reinforcement are recognizable).

In all but two ground floor locations introduction of the new posts and beams does not necessitate any destruction of historical walls. The new skeleton will be executed in the most durable sal timber and will contrast the extant, repaired, and rebuilt historical timber framing in pine. Because of this design solution, research and design work to develop (a) stranded metal tensile strength reinforcements and (b) metal rods for general wall reinforcement have been suspended (see Technical update 2/94 in the appendix.)

(1) Stiffening plates

(a) Concurrent design work by the project team for the Palace of 55 Windows with international seismic engineer Walther Mann employed the strategy of inserting rigid plates, in this project, reinforced concrete slabs above floor joists in the historic structure. This process is relatively uninvasive as the floors generally must be rebuilt in historical structures in the Kathmandu Valley. The principal alternative would be the insertion of perimeter ring beams.

(b) We adopt this strategy of stiffening plates at floor levels for general lateral reinforcement. Given the small size of the Agam, it will be structurally feasible and aesthetically preferable to use two layers of timber planking as this stiffening plate (laid at 45 degrees to the walls, the two layers perpendicular and nailed to each other).

(c) The timber plate has the advantage of being more compatible with the mud, brick, and timber structure into which it is being inserted. This substitution of timber planking for r.c.c. was suggested by Sir Bernard Feilden.

(d) Planking is two layers of one inch thickness sal planking. The planking is framed by a sal perimeter beam 5"x 3".

(2) Timber auxiliary frame

(a) The new timber skeleton is designed to carry floor and tower loads in the event of wall collapse, but it also provides critical reinforcement to the masonry walls, acting as a brace. Post locations directly under the masonry walls of the upper pagoda increase critical vertical continuity.

(b) Using the intact and impressive timber tie structure of the structure's upper pagoda as a starting point for the design, the introduction of timber members to increase the vertical structural continuity seems logical and aesthetically unintrusive. Timber has the clear advantage of being more compatible with the existing mud mortar walls (in terms of mass, flexibility, and strength) than steel and reinforced concrete alternatives.

(c) To achieve sufficient strength (while maintaining a size for the new timber members which will not interfere with head clearance and be similar in proportions to historical framing)

a two pile solution was developed, that is 3 posts across in cross-section. Posts are inserted against the east and west walls of the principal interior rooms and against the masonry wall of the rear gallery.

(d) Post sizes are 11 cm. by 11 cm. Locations correspond to the upper pagoda wall locations and interior corners of the building.

(e) The skeleton is made stiff laterally by the rigid plate of angled planking nailed to it. The planking system has allowed calculation of frame sizes based on the lower floors skeleton having "locked" or rigid joints. The skeleton is linked to wall plates, joists, and rafters with bolted connections.

(3) General improvement of structural connections

(a) The introduction of timber posts in eight locations per floor will be joined to the extant and replaced tie members (at wall plate level) with mortise and tenon joinery (where possible) or with concealed steel plates.

(b) The rebuilding of the rear timber gallery will incorporate the following structural improvement: every 3-5' (and wherever possible) floor joists will be made longer to allow connections to the wall plates and/or vertical posts of the main building. In effect this gallery structure will act as a buttressing structure.

(4) Additional reinforcements-pagoda beams

(a) At the meeting of the upper and lower structures, strengthening of critical timber joints with steel angles is recommended where the upper pagoda is carried on timber beams. Given this interior location use of steel with anti-corrosive paint is acceptable.

(b) Given two inch deflection of the principal beams carrying the upper pagoda, precautionary reinforcement with beams just beneath and perpendicular to these beams is recommended.

(5) Additional reinforcements-upper pagoda

(a) In the interior of the uppermost pagoda, diagonal bracing in timber will be introduced as a precautionary measure. This portion of the interior is not habitable and little visible, accessible only via a hatch near the second floor shrine.

Introduction: *in situ* repairs and damp-proofing

As a model for ongoing and future conservation work in Nepal, the project team opts for the most conservative of strategies to maximize retention of historical fabric. Key strategies and techniques to this end include:

- (1) Repair and rebuilding will be done in very small areas at a time to minimize dismantling. It is believed that many floor joists can be left *in situ* if great care is taken. Similarly, with a few notable exceptions (discussed specifically under structural wall damage 5.01), little of the intact masonry wall area will have to be dismantled.
- (2) Seismic reinforcement (discussed above) consisting primarily of an interior timber skeleton, a distinct and reversible structural layer.
- (3) This seismic skeleton's bracing of the masonry walls are used instead of invasive reinforcements installed inside the wall.
- (4) A new damp-proofing course will not be inserted based on the following considerations. It appears structural damage caused by this insertion of such a course in copper or reinforced concrete (to name two alternatives considered by the project team) may be greater than the very minor surface damage to bricks caused by lack of protection over the last three hundred years. It is clear rising ground-dampness is not a critical problem in this location and structure.

Foundation

Engineer Joshi's inspection of the excavated foundation found it sufficient for the building loads. Six inch settlement recorded in the middle longitudinal wall is historical and shows no signs of recent movement. This settlement has not been explained, but poses no present threat to the building.

No repair or rebuilding work is proposed for the foundation.

Lower base structure

The major structural collapse of the middle wall will be remedied in the following way. First, the remaining portion of the wall which was added (behind the 2nd floor shrine and which caused the structural collapse) will be dismantled. Removal of this wall will reduce the risk of further deterioration or collapse.

Once emergency roof cover is secured, the damaged portion of the wall will be rebuilt in matching materials, fired common brick and mud mortar, with great attention to bonding with undamaged adjacent wall areas.

Structural cracks on the principal facade

From the exterior brick fragments will be pieced in order to maintain adjacent historical bricks.

From the inside these serious cracks merit dismantling of an area one foot to each side of the opening to allow sufficient interlock of rebuilt patches with adjacent undamaged areas. In all cases, historical materials will be matched.

Rebuilding of the small area of masonry wall (approximately 3'x3') above the collapsed lintel of the south window, second story window will be necessary.

At the two locations where spaces have developed between the project building and adjacent buildings (north edge of principal facade, eastern boundary of wall adjacent to stair) these cracks will be filled, as rebuilding to achieve plumb and matching walls will necessitate major rebuilding. In the wall area adjacent to the stair hall damaged sundried brick will be replaced with more durable fired common brick.

Upper pagoda

The wall is in excellent condition; slight outward displacement of the walls poses no structural threat and will be maintained.

6.02 Wall fabric

Summary

Where patches are necessary to the historical *daci apa* surface of the principal facade (about 20-30 bricks), historical brick of identical size and similar color will be scouted to match historical patina. They will be fitted in using yellow mud mortar to match the existing.

In an effort to preserve rather than restore, the 17 year old projection of the southern bay of the principal facade will not be dismantled and rebuilt flush with the historical facade, nor will the southern facade of the same age in chimney brick be rebuilt. The original southern facade may have been *daci apa*, but probably was in common brick more carefully laid than the present construction. Scoured joints in this facade will be pointed with yellow mud mortar; the repaired roof will prevent future scouring.

Missing cornice bricks will be custom ordered from a local brick factory. This production will be closely monitored by the project team in order to control quality, particularly in length of firing. Chipped historical corner cornice bricks (*lhahka*) will be maintained rather than replaced as new replacements would be of much inferior quality.

Upper pagoda

No work necessary.

6.03 Wall openings and decorative elements

Repairs will be made to the extant historical timber components to allow maximum conservation of historical material. In the case of the damaged latticework or *jhali*, for example, new pieces will be fitted in to match while retaining any historical material possible.

The focal element, san jhya 70 %. New pieces in sal

South elevation

The original door of the principal facade will be removed from this elevation and re-installed in its historical location with repairs. A door of similar design, with details reduced, will be fabricated for this location to provide access to the ground floor rental space proposed by the Guthi. No signage or non-historical openings will be allowed on the principal facade.

A blocked and damaged timber-framed opening in the 17 year old south facade, first floor, will be replaced with new window of simplified historical design. This window was requested by the Guthi on this floor and the floor above. Given the lack of historicity on this facade, as well as its side alley location, these changes to make the building more liveable (all other windows are latticed!) was judged acceptable.

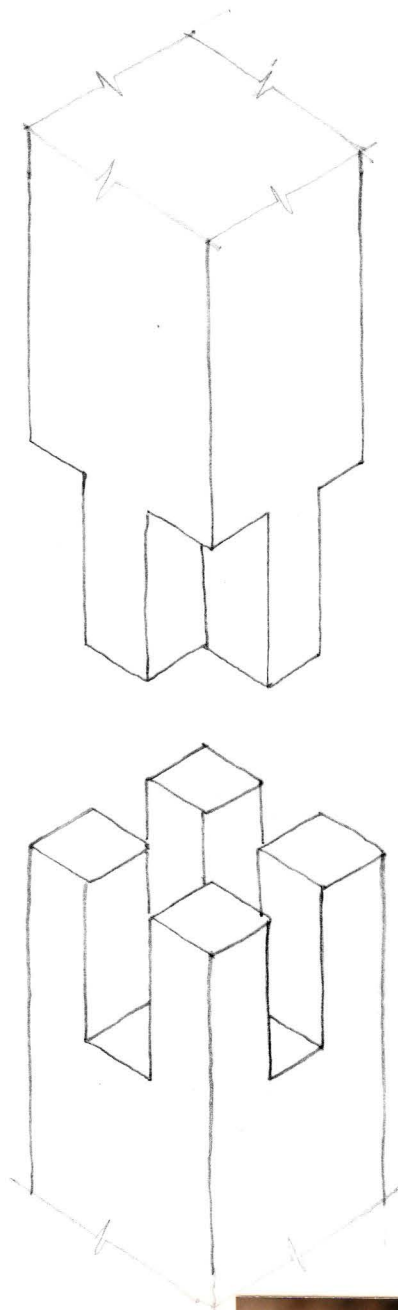
Rear courtyard elevation

Repair will be made to the five damaged timber-framed openings. On all of these openings, the lower third of the structural frame and lintels are damaged by wet rot. These damaged areas and elements will be repaired or replaced while maintaining the sound areas of the timbers.

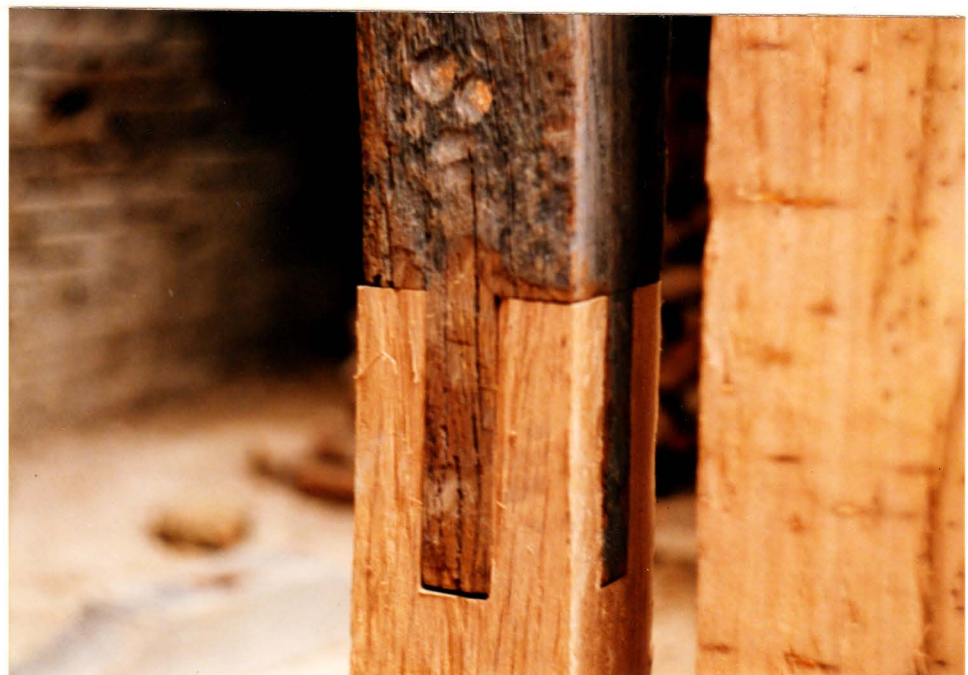
Columns will be repaired in a similar way, cutting off the lowest damaged portions and joining new timber feet to the historical elements. Jointing between new and old timbers are shown below. The restored rear gallery will require new railings. Working from extant examples of similar age, and with approval from the Department of Archaeology, new visually appropriate elements will be designed and installed.

Timber treatment

All sal timber openings and decorative elements will not be treated with preservative per the recommendations of the 1992 ICOMOS Wood Conservation Mission to Kathmandu. During that mission the following factors were discussed: (a) the great durability of sal wood; (b) the limited penetration of preservative-- even when soaked; and (c) the necessity to repeat every five years. These arguments recommended against *a priori* treatment with preservative unless clear justification could be found.



Proposed joinery detail of new feet for damaged timber columns uses "cross" design to transfer column loads efficiently. Photo of sample joint, May 1994, and sketch by R. Ranjitkar.



6.04 Timber roof structure

Lower roof

In an effort to restore both the historical configuration and materials of the roof, a roof frame in pine and matching the spacing and sizes of the surviving extant portions will be rebuilt. Only in several critical locations, where additional strength and durability are required, will sal members be used. These locations include: the corner rafters (which carry increased loads) and the purlins, which due to their exposed location are more susceptible to damage and which are especially critical to roof bracing (see related discussion of *chukuls* and roof failure under 5.04). Eavesboards will also be in sal, as are all historical and extant examples.

Local traditional joinery techniques for rafter fixing are limited to peg or *chukul* insertion. To improve structural integrity of the roof frame, which must carry considerable loads (300 kg/sq.meter), rebuilt rafters will be notched to the wall plate. Additionally, every third rafter will be conceal bolted to the wall plate.

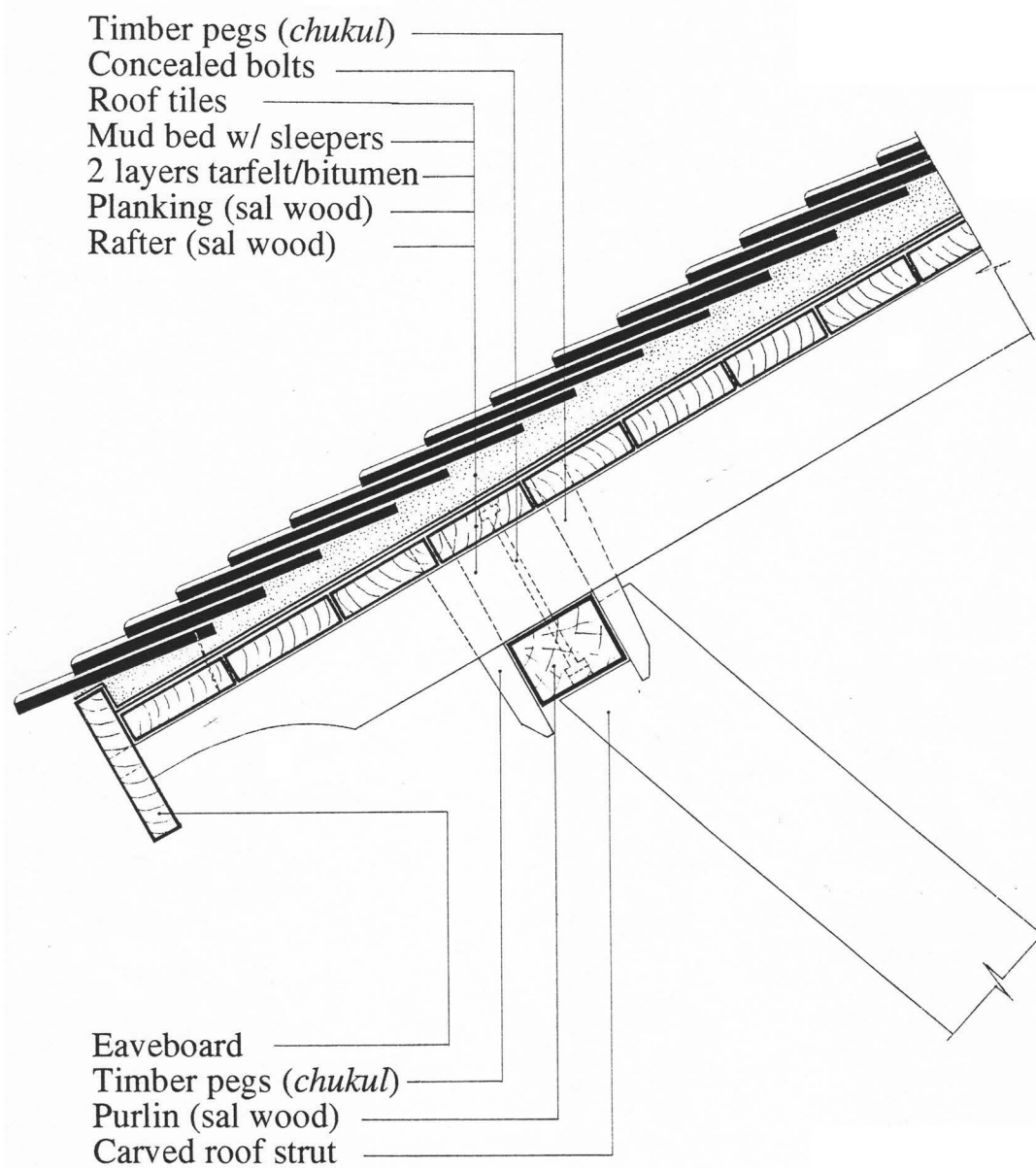
Upper pagoda

The universally damaged rafters will be taken out one at a time, repaired (where possible) and refitted in an effort to maintain the existing angle and level of the roof. This solution requires additional scaffolding and upports (to keep the struts in situ), but has proven successful at the recently completed Radha Krishna Temple.

As on the lower roof, new timbers will match the historical in type, size and finish, that is, pine, 5"x3 on average, and adze finished, repectively.

Timber treatment

Based on the advice of visiting timber conservation expert David Michelmores, the treatment of all pine timber with Wykamol Permetheryn preservative will be undertaken according to manufacturer's recommended application. This recommendation is based on numerous examples in the Kathmandu Valley of termite attack to pine including the principal *sattal* buildings at Pasupatinath and the Ayaguthi Sattal at Patan Darabar Square. At the Pasupatinath example, termites passed over sal columns, leaving them undamaged, to attack and destroy pine lintels.



THE "KEY" PROBLEM

*Section at roof overhang:
Improved detailed*

6.05 Roof cover and decorative elements

Roof tiles/*Jhingati*

Past project experience has demonstrated that the quality of new tiles is so inferior to the old, that scouting of old tiles is worth the effort of hunting as well as cleaning. All used tiles will be first soaked in water and then cleaned with wire brushes. Given their saturation over the years, these old tiles do not need siltrate treatment, which reduces absorption.

Ridge and aviform tiles will have to be custom ordered due to unavailability of historical pieces. The shorter life of these new products can be extended by treatment with siltrate. Tiles are immersed in the siltrate solution for several hours and then allowed to dry before installation per manufacturer's instructions.

As the stacking tiles which run along the ridge and down the ends of the roof are quite vulnerable to slippage, a concealed iron rod with a bend on the end will be inserted underneath, as per techniques first developed at Hanuman Dhoka.

Several details for the attachment of roof tiles, as developed by the project team in the Radha Krishna Restoration Project, will be repeated. First, lowermost tiles are pre-drilled and then attached to the eavesboard with a nail; the trick is to cut the head off of the nail to allow future replacements of broken edge tiles without removal of upper tiles. Another critical location to attach tiles is at the uppermost row adjacent to the tower structure, where pigeons are prone to roost. Here the tiles are pre-drilled and the nail is set in the mud, traditionally thickest (9-11") at this location.

Cover above rafters: lath

As a critical demonstration, the project will undertake to restore the upper pagoda roofs and lower structure roof using lath above the rafters, a traditional practice at least as old as the 19th century layer and probably much older. In order to accomplish this, an alternative waterproof membrane detail will have to be developed, namely, a solution to create a smooth surface above the lath which receives the membrane. In general all historical lath cover has been eliminated in repairs and restoration work of the last two decades.

Battens

An additional goal of the project will be to develop a detail for the fixing of battens (to hold the mud), which does not necessitate piercing of the planned waterproof membrane. In all restoration work in Nepal since the 1972 Hanuman Dhoka project, timber batten keys for the mud bed have been nailed through to the timber planking below the waterproof membrane, generally tar felt. An alternative design under development proposes to hang the battens off of the ridge line using a corrosive resistant wire. This would provide the necessary key for the mud bed, while eliminating the necessity to nail through the waterproof membrane.

Waterproof membrane

Ongoing monitoring of historical buildings by the Trust has identifies current use of tar felt for the waterproof membrane as the potential weak link in the rebuilt roof cover. This thesis is based on consideration of the life of the highest quality Indian tarfelt which is less than fifteen years. As an alternative, the Trust will seek to identify specialty membranes with longer life. Such products include man-made pond lining materials joined at the seams with resin or heat guns. Searches for appropriate products are underway. Drawbacks to this solution include the great cost of the membrane (\$10/sq. ft) and unavoidable difficulties to import.

Mud bed

Supervision of the digging of the yellow mud and treatment with the herbicide Karmex will be critical to the success of the effort to control vegetal growth. Digging of the mud from more than a meter and a half depth assures lack of vegetal material in the mud; treatment with Karmex, a French product should be done carefully according to manufacturer's instructions. We have been warned that Indian manufactured Karmex has not proven as effective as the original French product.

In an attempt to reduce the top-heaviness of the structure (vis-a-vis earthquake performance), the thicker mud layer towards the upper part of the roofs will be lightened by the substitution of over-fired bricks wherever possible. The thickness of the upper end of the mud bed can easily be determined by the historical cornice location and will be matched. The cornice lies directly above the top layer of tiles, its overhang protecting the joint between top-most tile and building from water penetration.

6.06 Interior floor structure

Wherever possible, intact or partially damaged floor joists will be left *in situ* while being repaired. Careful investigation of each timber will maximize retention or reuse of historical material. New timbers will match historical members in timber type, pine, and finish, that is, rendered with the traditional adze or *basila*. Traditional pegging will be carried out to match visually with extant portions of the structure, while concealed bolting will increase the strength of critical joints.

Every third joist on the second floor floor framing will run continuously through the middle wall, enhancing the anti-seismic skeleton. The floor will of course be enhanced structurally by the angled planking and perimeter beam conceived as part of the seismic strengthening scheme.

Floor planking details are described under seismic reinforcements, section 6.01.

6.07 Interior

Wherever intact, existing mud plaster will be retained necessitating protective measures during construction.

Provide concealed electrical outlet and lighting locations per owner needs. A toilet will be provided under the existing lowest run of stair, easily partitioned off and the standard location in old buildings here.

As the building is used by neighbors all with running water, provision of plumbing lines in the building is not considered necessary.

All new mud plaster will be whitewashed with a traditional lime mixture. Interior timbers will be oiled with linseed oil, another traditional practice.

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APPENDIX A

PROGRESS REPORT

1. Fundraising

UNESCO Emergency Assistance

World Heritage Center Director Alfeo Tonellotto confirmed by telephone yesterday that UNESCO has approved a grant \$US 20,000 to the Patukva project. This money which comes from a fund for emergency assistance to structure in World heritage Sites grew out of discussions during the recent UNESCO mission. The money will be granted directly to the Trust per our request to HMG Ministry of Education. Together with the \$5,000 contribution of the Patukva Guthi, this brings total project funding to a respectable 75% mark.

1994 Fundraising drive-K.V.P.T.

Meanwhile, Board member Mary Slusser (author of *Nepal Mandala*) has secured the voluntary services of a professional fundraiser, a woman who raised millions of dollars for the National Building Museum in Washington D.C. I will brief this woman in the next few weeks during a short reporting trip to Boston.

Other applications in process

Under the guidance of Dr. Sekler, the Trust has submitted the following applications for funding (the 1994 round):

Skaggs Foundation

Warhol Foundation

American Himalayan Foundation

selected individual donors.

Preparations are underway to apply in the coming months to the National Science Foundation for support of seismic reinforcement research, a key component of the Patukva project (see appended report). An application process to register with US AID in Washington, a pre-condition for applying in Kathmandu, is underway.

2. Training

Architectural apprentice

We believe we've found another training candidate as potentially talented as Trust architect Rohit Ranjitkar. Our search for suitable candidates is, of course, always ongoing. Recently, we found a clever recent masters level graduate in architecture, keen to work in conservation. Binay Shrestha, aged 28 of Patan, joins the project this month as part-time trainee. He received his degree from the Belyorussian Polytechnical Institute.

On-the-job documentation

We continue our model efforts at documentation with drawings prepared by Rohit Ranjitkar, Prayag Joshi, and draftsman Sushil Rajbhandari. For documentation, the KVPT team has demonstrated its ability to handle any challenge, see attached sample drawings.

Department of Archaeology

Last spring, our documentation of the Uma Maheswar and Radha Krishna projects, in particular, the historic structures reports were widely distributed to and discussed with members of the Department of Archaeology. As the first conservation projects to prepare such detailed documentation and discussion of conservation issues, these documents are models for future local and international efforts.

KVPT Computer Literacy

Key project team members Rohit Ranjitkar and Raju Roka have studied intensively word processing and accounting software over summer 1993. Together they prepared the first draft of the Patukva Agam Historic Structure report and project financial statement on the computer.

3. Protective covenants-legal agreements to protect a preserved Patukva Agam

After a challenging year of research and negotiations with various lawyers, an agreement has been designed and approved by the various parties. It is expected to be signed this week.

Simultaneous work by the Department of Archaeology with Patan Programme on the extension of the Patan Monument Zone has been successful; the application to gazette an extended zone (including both sides of the street and of course Patukva Agache) is now in process, based on the completion of detailed mapping of the refined boundary and affected properties. The most conservative estimate for how long this will take is one year.

Thus, and most critically, the Patukva structure will be inside the monument zone before restoration is completed. The provisions for control by the Department in a Monument Zone are quite considerable (even if until now they have been under-exercised for various reasons).

Upon signing, another \$5,000 will be contributed to project construction material expenses by the Guthi. This represents the largest donation by a local group to an internationally coordinated conservation project.

4. Construction/construction schedule

Provision of critical materials

Certain custom-made and/or imported materials have been ordered over the last months to assure smooth running of the job. These include: traditional common brick (*maapa*) for interior wall construction; imported stainless steel hardware fittings, specialty terracotta cornice bricks for the principal facade. At present we are securing all of the timber for the project.

Temporary roof to speed up works

Related preparation works have positioned the project to work at maximum efficiency as it takes up the actual construction work this month. Because of delays in start-up, we have decided to provide a temporary roof over the lower three floors. This will allow work which was scheduled to be finished this June to run continuously through the summer. In effect, we intend to catch up to our former proposed schedule by this fall.

Insulation of electrical lines

Critical insulation of electrical lines in front of the building took place this week, allowing construction workers free access to the facade and roof.

Budget

The construction budget submitted summer 1993 is still effective; revisions will be made after construction work has been taken up.

PATUKVA AGACHIE

REVISED PHASE 1 CONSTRUCTION COMPONENTS AND SEQUENCE FEBRUARY, 1994.

S.N	Description of Works 1993	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
0.	Dismantling									
1.	Negotiate legal agreement.									
2.	Signboard.									
3.	Insulation of electric wires.									
4.	Insert damp proof course									
5.	Repair of masonry walls upto level 3.									
6.	Insert seismic reinforcements in masonry structure.									
7.	Timber order/scouting dev't of preservative.									
8.	General timber consolidation incl. beams, joists, gallery, wallplates.									
9.	Scaffolding for lower roof repair.									
10.	Lower roof repair (rafter, wallplates).									
11.	Temporary zinc sheet on lower roof rafters to protect from monsoon rain.									
12.	Timber framework developed as seismic reinforcement.									
13.	Provide new toilet + stair.									
14.	Repair of front facade (replace broken bricks, repair cornices, lintels etc.).									
15.	New plinth + stone pavement on edge of plinth.									
16.	Electrical wiring.									
17.	Install timber floor planking.									

This page from summer 1994 correspondence to Department of Archaeology and British Ambassador, for comparison. Please note that by fall, 1994, we plan to be back on original schedule.

KATHMANDU VALLEY PRESERVATION TRUST
24 QUINCY STREET CAMBRIDGE, MA 02138
TELEFAX (617) 495-8197

Patukva Agam Restoration Project

Implementation schedule

July 20, 1993

Spring-summer 1993

- *Legal negotiations to secure "Deed of responsibility under Ancient Monuments Act".
- *Documentation, preparation of historic structures report esp. design of structural consolidation and seismic improvements.
- *Design and implementation of fund-raising campaign
- *Emergency shoring up of lower structure to prevent further damage. Site clearance.
- *Small repairs and emergency cover to upper pagoda to prevent further damage.
- *Relocation of electrical lines to allow work to proceed.

October 1993

Submission of historic structures report for review .

November 1993-June 94 -

Construction Phase I

Structural consolidation and seismic improvements to lower three storeys up to 3rd floor rafters with temporary roof cover. Interior arrangements of lower three stories.

October 1994-June 1995

Construction Phase I

Restoration of pagoda superstructure. Principal facade restoration including repairs of openings.

June 1995

Completion of project. Preparation of project report.

7. Deed of Responsibility, the Ancient Monuments Act, and the protection of monuments in Nepal

Nb. this section is omitted from a report submitted in parallel to the Department

Patukva Agam Chronology

February 28, 1994

In the past two years, a general strategy has been identified by the author together with Patan Programme to take advantage of an existing provision in the Ancient Monuments Act to protect monuments under private ownership. This provision, called in its English translation a "deed of responsibility", defines a legal relationship between the owners of a building of artistic, historical or archaeological importance and the Department of Archaeology. Although enforcement procedures are not made explicit by the Act, a general proviso for the Department to intercede to protect any structure of great importance also exists.

Spring 1993

Legal consultant Divarkar Pant in spring 1993 supported an hypothesis that the Act in general--although imperfect--was strong enough that energies should focus rather on clarification of enforcement procedures than on revisions to the law. A critical quirk in the existing Act is a focus on monument *areas* rather than on the monuments themselves. In sum, one can only protect something that is inside a *zone*--the law says nothing in particular about the historical fabric itself. Nevertheless, like the Nepalese building bylaws for new construction, one can say that if existing law had been enforced even fifty percent of the time, then much of the recent destruction of the Valley could have been avoided.

Thus, Pant, a senior legal advisor in the Law and Justice Ministry, developed several drafts of the Deed of Responsibility in spring 1993. He had been recommended by the present Director General of Archaeology. Additionally, a brief on how enforcement procedures and mechanisms could be clarified and strengthened to assist the Department of Archaeology was requested of Pant.

Pant's draft submission in May 1993 of the deed of responsibility and the brief were rejected on the grounds that they tended to cloud rather than clear up the critical issues of enforcement. During discussion of these drafts, the destruction of a resthouse at the east end of Patan, the Tyagah *capah*, took place and formed a basis for discussion of the Department's ability and will to enforce the law. The Tyagah *capah*, a nineteenth century structure standing outside of the protected monument zone, incorporated some of the finest carved timber roof truts in the country dating to the 13th century. Given the location outside a monument zone, the building provided a litmus test about how far the Department would go to enforce its non-specific mandate to protect artistic heritage of national importance.

Unfortunately, this was not very far. The Director General did not show up at a meeting arranged by the author (with the Director General's consent and after having been briefed about the importance of the structure) to discuss what to do about the dismantled Tyagah *capah* with the Patan Town Controller and Chief District Officer. A general tendency to avoid short term confrontation at any cost characterized the Department's actions. (The legal advisor even conceded that the non-committal quality of his recommendations had been expressly *requested* by the Director General.)

One month later, the Nepalese government received a formal warning from the World Heritage Commission regarding the lost Tyagah structure (which the Commission mistakenly construed to be within the World Heritage Site); six months later a visiting UNESCO mission focused its criticism of the Department on its lack of initiative in the Tyagah case.

Nevertheless, trusting that the earlier draft of the deed of responsibility was effective for the protection of individual buildings, Nepali translations and refinements of the English text were completed. By this time, such agreements were under discussion for three monuments in Patan: Patukva Agam, Vabaha, and the northern wing of Patan Darbar, the latter two projects under the auspices of the German-financed Patan Programme. When at the end another lawyer, Mr. P. M. Sakya, was consulted to make a final check of these drafts, new problems and opportunities were identified.

Fall 93

The gist of Sakya's review was that

- (1) the term deed of responsibility would not apply to Patukva as it is technically outside the Protected Monument Zone and thus cannot be called a monument.
- (2) The most effective document for the time being would be an agreement between the Department and the Guthi holding the Guthi financially liable for the cost of the restoration if their negligence or actions affected the preserved state of the monument. This agreement takes its power not from the Ancient Monuments Act, but rather from the general contract law of Nepal.
- (3) Furthermore, Mr. Sakya includes in the agreement a dispute resolution process which depends on Nepali common law and precludes lengthy and unproductive litigation.
- (4) Lastly, as the Department of Archaeology is in the process of applying to gazette an extended monument zone in Patan, it is certain that the Patukva Agam will within one year be protected by the existing provisions of the Ancient Monuments Act for Monument Zones. In particular, this empowers the Department of Archaeology to control any modifications to buildings or construction.
- (5) Meanwhile the Department of Archaeology, in response to criticism from UNESCO is redefining their monument law to include a category of National Monuments which can be inside or outside of protected monument areas.

Winter 1994

A key strategic point of both Pant's and Sakya's drafts for contractual agreements had been to name the Department of Archaeology as the exclusive contracting party, i.e. with a sub-clause that the Department could use an agent (such as the KVPT) to execute its responsibilities. This was seen as a way of strengthening the Department's image as coordinator of executing agencies.

Nevertheless, the present Director General rejected the draft agreement recently, maintaining that the Department might be held liable by the Guthi if the KVPT did not complete the project. Although, it was explained that the agreement between HMG and the Trust (constituted by HMG's 1992 approval of the project proposal) would preclude such an event, the agreement was rewritten to include the Trust as one of the contracting parties.

PATKO AGANCHHEN RESTORATION AGREEMENT

This PATKO AGANCHHEN RESTORATION AGREEMENT made in Patan, Lalitpur, Nepal, as of Baisak 2051 (.5 day of May 1994)

BETWEEN

- (1) DEPARTMENT OF ARCHEOLOGY/HMG, its office located in Maitighar, Kathmandu (hereinafter called DOA)
- (2) KATHMANDU VALLEY PRESERVATION TRUST, a charitable organisation working in Nepal with the approval of HMG (Hereinafter referred to as the Trust)
- (3) PATKO AGANCHHEN GUTHI, located in Patko, Patan, Lalitpur (Hereinafter referred to as the Guthi).

RECITALS

WHEREAS, the Guthi is aware of the fact that the Aganchhen, located in Patko, Patan is a unique cultural heritage of Nepal and has its own historical significance;

WHEREAS, the Guthi is interested in restoration of the Aganchhen with the financial and technical support of the Trust; and

WHEREAS, the Trust is desirous to provide the financial and technical support to the Guthi for the restoration of the Aganchhen:

NOW, THEREFORE, in view of these premises and in consideration of the mutual covenants and subject to proviso hereinafter set forth, DOA, the Guthi and the Trust agree to the following:

ARTICLE I

MUTUAL COVENANT

1. In pursuance of this agreement the Trust undertakes to restore the Aganchhen located in Patko, Patan (proposed by Department of Archeology/HMG to be included in protected monument zone in near future) according to the plans and specifications annexed hereto and the Guthi also undertakes to assist, cooperate and extend all possible means of support in the restoration work of the Aganchhen as agreed upon by the parties. DOA on its part agrees to provide liaison assistance to help the trust to realize and implement the project and continue fundraising. The parties, further, mutually agree to abide by their respective rights and responsibilities enumerated below.

ARTICLE II

RIGHTS AND RESPONSIBILITIES OF THE TRUST

1. The Trust shall execute the programme as agreed above for restoration of the Aganchhen and bear all cost of restoration including cost of construction materials, labours and other directly related incidental expenses, except the financial contribution to be made by the Guthi under section 3 of Article III.
2. The Trust shall present the cost estimate and estimated time frame for the restoration of the Aganchhen before the actual start of the restoration work. The Trust shall notify the Steering Committee and DOA at least one month in advance if it feels that the restoration work cannot be completed without major adjustment in cost estimate and time frame for the completion of the work. The Trust shall inform DOA if it has to make minor adjustments in the cost estimates and construction design. The Trust in any case shall bear all additional expenses, if there is any, under the revised cost estimate.
3. The Trust shall not change the original art, architecture and status of the Aganchhen while carrying out restoration work. DOA shall not do any thing with the Aganchhen which will violate the requirement of Ancient Monument Protection Act 2013 B.S or the rules and regulations made there under. Provided that this clause shall not be construed to restrict the Trust from introducing conservation measures as necessary with the approval of the Department of Archeology.
4. The Trust shall hand over the Aganchhen to the Guthi within the shortest possible time after the restoration work is completed on turn key basis.
5. The Trust shall provide, as long as it is actively working in Kathmandu Valley, technical assistance to the Guthi for the repair and restoration of the Aganchhen in compliance with the requirements of Ancient Monuments Act 2013 and the rules and regulations made there under.
6. The Trust shall have the right to execute its responsibility under the agreement on its own or through its agents including contractors.
7. The Trust shall submit the statement of income and expenditure related to the Patko Aganchhen restoration project) audited by registered auditor within six months after the lapse of the fiscal year to DOA.

ARTICLE III

RIGHTS AND RESPONSIBILITIES OF THE GUTHI

1. The Guthi shall make the Aganchhen and the adjacent courtyard available and accessible to the Trust, its agents and contractors for all kinds of activities related to restoration work on the request being made by the latter to that effect. The Guthi shall also provide other incidental facilities required for restoration purpose.

2. The Guthi shall provide appropriate and adequate space to the Trust for storing construction materials during restoration period. It shall also make necessary arrangement for their safety and protection.

3. The Guthi shall make all the necessary arrangement for the smooth operation of the restoration work and avoid unnecessary disturbances thereof. The Guthi shall make an upfront contribution of Rs.250,000/- as a token of support to the restoration work carried out by the Trust. The amount so contributed shall be kept in a separate account in the Bank and (the amount and interest there of) shall only be used for buying construction materials required for restoration of the Aganchhen.

4. The Guthi shall allow Department of Archeology, Lalitpur municipality, Kathmandu Valley Preservation Trust and their official guests and bonafide scholars to inspect the Aganchhen after its restoration and thereafter as and when it deems necessary. Provided that the inspections shall be subject to ritual restrictions applicable to outsiders.

5. It shall be the duty of the Guthi to look after day to day maintenance of the Aganchhen and carry out necessary minor repairs without changing the art, architecture and state of preservation of the Aganchhen. The Guthi shall not do any thing with the Aganchhen which will violate the requirement of Ancient Monument Protection Act 2013 B.S or the rules and regulations made there under. The Guthi shall not sell, lease or change the status of the Aganchhen. It shall be the obligation of the Guthi to protect, preserve, and conserve the Aganchhen as a cultural heritage.

Provided that the Guthi shall have the right to lease or use the ground floor only for commercial purpose. The income earned by way of rent or otherwise shall be exclusively used for the future maintainance of the Aganchhen. The use of ground floor for commercial purpose shall not in any case adversely affect the safety or status of the Aganchhen.

ARTICLE IV

RIGHTS AND RESPONSIBILITIES OF DOA

1. DOA shall have the right to monitor, evaluate and inspect the restoration activities work carried out by the Trust. It may give necessary directions to the Trust, including work stoppage order, to ensure the compliance of the Ancient Monuments Act 2013 B.S.

2. DOA shall have the right to review the technical details, procedures and progress of the restoration work.

ARTICLE V

PROVISO AND RESERVATION

This Patko Aganchhen Restoration Agreement shall not be construed or interpreted or used as an evidence to create the rights and duties of the parties other than the ones enumerated in this agreement, either against each other or against any person or institution not a party to this contract.

ARTICLE VI

DISPUTE RESOLUTION PROCESS

1. The parties hereby agree to resolve disputes and differences arising under this contract through negotiation between the Trust or its representative and Chairman, Management Board of the Guthi or his representative.
2. In the event such dispute is unable to be resolved between the parties pursuant to section 1 above, then such dispute shall be settled exclusively by arbitration.
3. Each arbitral tribunal shall consist of three arbitrators. Each disputing party shall appoint one arbitrator for each arbitration and the arbitrators appointed shall appoint the third arbitrator for such arbitration.

ARTICLE VII

EVENTS OF DEFAULT AND REMEDIES

1. Event of default shall occur if a party to the agreement fails to discharge the material obligation under the agreement and such failure shall continue uncured for sixty days after notice thereof by the aggrieved party.
2. If an event of default occurs and is continuing, the non-defaulting party may terminate this contract by giving written notice to that effect and shall have the right to recover all the losses suffered or expenses incurred so far for the restoration of the Aganchhen.

IN WITNESS WHEREOF, the parties hereto have agreed to sign this agreement.

.....
Mr/Ms. Khadgs Man Shrestha
For Department of Archeology,
His Majesty's Government of Nepal

.....
Mr/Mrs. Dr. Pradyumn
For Kathmandu Valley Preservation
Trust.

Witness:
1. Mr/Mrs. Bekha Ratna Sarker
2. Mr/Mrs.
3. Mr/Mrs.
4. Mr/Mrs.
5. Mr/Mrs.
6. Mr/Mrs.

.....
Mr/Ms. Kedar Prasad R. R. R.
For Patko Aganchhen Guthi

Witness: [Signature]
1. Mr/Mrs.
2. Mr/Mrs.

PATKO AGANCHHEN RESTORATION AGREEMENT

This PATKO AGANCHHEN RESTORATION AGREEMENT made in Patan, Lalitpur, Nepal, as of Fagun 2050 (....day of February 1995)

BETWEEN

- (1) DEPARTMENT OF ARCHEOLOGY/HMG, its office located in Maitighan, Kathmandu (hereinafter called DOA)
- (2) KATHMANDU VALLEY PRESERVATION TRUST, a charitable organisation working in Nepal with the approval of HMG (Hereinafter referred to as the Trust)
- (3) PATKO AGANCHHEN GUTHI, located in Patko, Patan, Lalitpur (Hereinafter referred to as the *Guthi*).

RECITALS

WHEREAS, the *Guthi* is aware of the fact that the *Aganchhen*, located in Patko, Patan is a unique cultural heritage of Nepal and has its own historical significance;

WHEREAS, the *Guthi* is interested in restoration of the *Aganchhen* with the financial and technical support of the Trust; and

WHEREAS, the Trust is desirous to provide the financial and technical support to the *Guthi* for the restoration of the *Aganchhen*:

NOW, THEREFORE, in view of these premises and in consideration of the mutual covenants and subject to proviso hereinafter set forth, DOA, the *Guthi* and the Trust agree to the following:

ARTICLE I
MUTUAL COVENANT

1. In pursuance of this agreement the Trust undertakes to restore the *Aganchhen* located in Patko, Patan (proposed by Department of Archeology/HMG to be included in protected monument zone in near future) according to the plans and specifications annexed hereto and the *Guthi* also undertakes to assist, cooperate and extend all possible means of support in the restoration work of the *Aganchhen* as agreed upon by the parties. DOA on its part agrees to provide liaison assistance to help the trust to realize and implement the project and continue fundraising. The parties, further, mutually agree to abide by their respective rights and responsibilities enumerated below. *

ARTICLE II
RIGHTS AND RESPONSIBILITIES OF THE TRUST

1. The Trust shall execute the programme as agreed above for restoration of the *Aganchhen* and bear all cost of restoration including cost of construction materials, labours and other

directly related incidental expenses, except the financial contribution to be made by the *Guthi* under section 3 of Article III.

2. The Trust shall present the cost estimate and estimated time frame for the restoration of the *Aganchhen* before the actual start of the restoration work. The Trust shall notify the *Guthi* ^{and Department} at least one month in advance if it feels that the restoration work cannot be completed without major adjustment in cost estimate and time frame for the completion of the work. However the Trust shall have the authority to make minor adjustments in the cost estimates and construction design without prior information to the *Guthi*. The Trust in any case shall bear all additional expenses, if there is any, under the revised cost estimate.

3. The Trust shall not change the original art, architecture and status of the *Aganchhen* while carrying out restoration work. Provided that this clause shall not be construed to restrict the Trust from introducing necessary structural consolidation to the *Aganchhen*.

4. The Trust shall hand over the *Aganchhen* to the *Guthi* within the shortest possible time after the restoration work is completed.

5. The Trust shall provide, as long as it is actively working in Kathmandu valley, technical assistance to the *Guthi* for the repair and restoration of the *Aganchhen* in compliance with the requirements of Ancient Monuments Act 2013 and the rules and regulations made thereunder.

6. The Trust shall have the right to execute its responsibility under the agreement on its own or through its agents including contractors.

7. The Trust shall execute restoration work of the *Aganchhen* in two phases. The activities and cost estimates in phase I and phase II shall be described in the plans and specifications of the restoration work to be annexed with this agreement. Provided that if incase The Trust, despite of its best effort, is unable to execute phase II of the restoration work due to financial constraint it shall inform the *Guthi* accordingly. In such case the Trust shall be discharged of its obligation for phase II restoration work without any financial liability.

ARTICLE III RIGHTS AND RESPONSIBILITIES OF THE *GUTHI*

1. The *Guthi* shall make the *Aganchhen* and the adjacent courtyard available and accessible to the Trust, its agents and contractors for all kinds of activities related to restoration work on the request being made by the latter to that effect. The *Guthi* shall also provide other incidental facilities required for restoration purpose.

2. The *Guthi* shall provide appropriate and adequate space to the Trust for storing construction materials during restoration period. It shall also make necessary arrangement for their safety and protection.

3. The *Guthi* shall make all the necessary arrangement for the smooth operation of the restoration work and avoid unnecessary disturbances thereof. The *Guthi* shall make an upfront contribution of Rs.250,000/- as a token of support to the restoration work carried out by the Trust. The amount so contributed shall be kept in a separate account in the Bank and (the amount and interest there of) shall only be used for buying construction materials required for restoration of the *Aganchhen*.

4. The *Guthi* shall allow Department of Archeology, Lalitpur municipality, Kathmandu Valley Preservation Trust and their official guests and bonafide scholars to inspect the *Aganchhen* after its restoration and thereafter as and when it deems necessary. Provided that the inspections shall be subject to ritual restrictions applicable to outsiders.

5. It shall be the duty of the *Guthi* to look after day to day maintenance of the *Aganchhen* and carry out necessary minor repairs without changing the art, architecture and state of preservation of the *Aganchhen*. The *Guthi* shall not do any thing with the *Aganchhen* which will violate the requirement of Ancient Monument Protection Act 2013 B.S or the rules and regulations made thereunder. The *Guthi* shall not sell, lease or change the status of the *Aganchhen*. It shall be the obligation of the *Guthi* to protect, preserve, and conserve the *Aganchhen* as a cultural heritage.

Provided that the *Guthi* shall have the right to lease or use the ground floor only for commercial purpose. The income earned by way of rent or otherwise shall be exclusively used for the future maintainance of the *Aganchhen*. The use of ground floor for commercial purpose shall not in any case adversely affect the safety or status of the *Aganchhen*.

ARTICLE IV RIGHTS AND RESPONSIBILITIES OF DOA

1. DOA shall have the right to inspect the restoration activities work carried out by the Trust. It may give necessary directions to the Trust to ensure the compliance of the Ancient Monuments Act 2013 B.S.

2. DOA shall have the right to review the technical details and progress of the restoration work.

3. Carry out its membership role...

ARTICLE V PROVISO AND RESERVATION

This Patko *Aganchhen* Restoration Agreement shall not be construed or interpreted or used as an evidence to create the rights and

duties of the parties other than the ones enumerated in this agreement, either against each other or against any person or institution not a party to this contract.

ARTICLE VI DISPUTE RESOLUTION PROCESS

1. The parties hereby agree to resolve disputes and differences arising under this contract through negotiation between the Trust or its representative and Chairman, Management Board of the *Guthi* or his representative.
2. In the event such dispute is unable to be resolved between the parties pursuant to section 1 above, then such dispute shall be settled exclusively by arbitration.
3. Each arbitral tribunal shall consist of three arbitrators. Each disputing party shall appoint one arbitrator for each arbitration and the arbitrators appointed shall appoint the third arbitrator for such arbitration.

ARTICLE VII EVENTS OF DEFAULT AND REMEDIES

1. Event of default shall occur if a party to the agreement fails to discharge the material obligation under the agreement and such failure shall continue uncured for sixty days after notice thereof by the aggrieved party.
2. If an event of default occurs and is continuing, the non-defaulting party may terminate this contract by giving written notice to that effect and shall have the right to recover all the losses suffered or expenses incurred so far for the restoration of the *Aganchhen*.

IN WITNESS WHEREOF, the parties hereto have agreed to sign this agreement.

.....
Mr./Ms.....
For Department of Archeology,
His Majesty's Government of Nepal

.....
Mr./Mrs.....
For Kathmandu Valley Preservation
Trust.

.....
Mr./Ms.....
For *Patko Aganchhen Guthi*.

Witness:
1. Mr./Mrs.....
2. Mr./Mrs.....

More witnesses for Guthi?

Agreement
Draft, Winter 1994 - Sakya.

PATKO AGANCHHEN RESTORATION AGREEMENT

This PATKO AGANCHHEN RESTORATION AGREEMENT made in Patan, Lalitpur, Nepal, as of Fagun 2050 (....day of February 1995)

BETWEEN

- (1) DEPARTMENT OF ARCHEOLOGY/Ministry of Education and Culture/HMG (hereinafter referred to as DOA); and
- (2) *PATKO AGANCHHEN GUTHI*, located in *Patko*, Patan, Lalitpur (Hereinafter referred to as the *Guthi*).

RECITALS

WHEREAS, the *Guthi* is aware of the fact that the *Aganchhen*, located in *Patko*, Patan is a unique cultural heritage of Nepal and has its own historical significance;

WHEREAS, the *Guthi* is interested in restoration of the *Aganchhen* with the financial and technical support of DOA; and

WHEREAS, DOA is desirous to provide the financial and technical support to the *Guthi* for the restoration of the *Aganchhen*:

NOW, THEREFORE, in view of these premises and in consideration of the mutual covenants and subject to proviso hereinafter set forth, the *Guthi* and DOA agree to the following:

ARTICLE I

MUTUAL COVENANT

1. In pursuance of this agreement DOA undertakes to restore the *Aganchhen* located in *Patko*, Patan (proposed by DOA to be included in protected monument zone in near future) according to the plans and specifications annexed hereto and the *Guthi* also undertakes to assist, cooperate and extend all possible means of support in the restoration work of the *Aganchhen* as agreed upon by the parties. Both the parties, further, mutually agree to abide by their respective rights and responsibilities enumerated below.

ARTICLE II

RIGHTS AND RESPONSIBILITIES OF DOA

1. DOA shall execute the programme as agreed above for restoration of the *Aganchhen* and bear all cost of restoration including cost of construction materials, labours and other directly related incidental expenses, except the financial contribution to be made by the *Guthi* under section 3 of Article III.

2. DOA shall present the cost estimate and estimated time frame for the restoration of the *Aganchhen* before the actual start of the

restoration work. DOA shall notify the *Guthi* at least one month in advance if it feels that the restoration work cannot be completed unless there is major adjustment in cost estimate and time frame for the completion of the work. However DOA shall have the authority to make minor adjustments in the cost estimates and construction design without prior information to the *Guthi*. DOA in any case shall bear all additional expenses under the revised cost estimate.

3. DOA shall not change the original art, architecture and status of the *Aganchhen* while carrying out restoration work. Provided that this clause shall not be construed to restrict DOA from introducing necessary structural consolidation to the *Aganchhen*.

4. DOA shall hand over the *Aganchhen* to the *Guthi* within the shortest possible time after the restoration work is completed.

5. DOA shall provide technical assistance to the *Guthi* for the repair and restoration of the *Aganchhen* in compliance with the requirements of Ancient Monuments Act 2013 and the rules and regulations made thereunder.

6. DOA shall have the right to execute its responsibility under the agreement through Kathmandu Valley Preservation Trust, a charitable organisation working in Kathmandu with the approval of DOA.

7. DOA shall execute restoration work of the *Aganchhen* in two phases. The activities and cost estimates in phase I and phase II shall be described in the plans and specifications of the restoration work to be annexed with this agreement. Provided that if incase DOA, despite of its best effort, is unable to execute phase II of the restoration work due to financial constraint it shall inform the *Guthi* accordingly. In such case DOA shall be discharged of its obligation for phase II restoration work without any financial liability.

ARTICLE III

RIGHTS AND RESPONSIBILITIES OF THE *GUTHI*

1. The *Guthi* shall make the *Aganchhen* and the adjacent courtyard available and accessible to DOA, its agents and contractors for all kinds of activities related to restoration work on the request being made by the latter to that effect. The *Guthi* shall also provide other incidental facilities required for restoration purpose.

2. The *Guthi* shall provide appropriate and adequate space to DOA for storing construction materials during restoration period. It shall also make necessary arrangement for their safety and protection.

3. The *Guthi* shall make all the necessary arrangement for the smooth operation of the restoration work and avoid unnecessary disturbances thereof. The *Guthi* shall make an upfront contribution of Rs.250,000/- as a token of support to the restoration work carried out by DOA.

4. The *Guthi* shall allow Department of Archeology, Lalitpur municipality, Kathmandu Valley Preservation Trust and their official guests to inspect the *Aganchhen* after its restoration and thereafter as and when it deems necessary. Provided that the inspections shall be subject to ritual restrictions applicable to outsiders.

5. It shall be the duty of the *Guthi* to look after day to day maintenance of the *Aganchhen* and carry out necessary minor repairs without changing the art, architecture and state of preservation of the *Aganchhen*. The *Guthi* shall not do any thing with the *Aganchhen* which will violate the requirement of Ancient Monument Protection Act 2013 B.S or the rules and regulations made thereunder. It shall be the obligation of the *Guthi* to protect, preserve, and conserve the *Aganchhen* as a cultural heritage.

ARTICLE V

PROVISO AND RESERVATION

This Patko *Aganchhen* Restoration Agreement shall not be construed or interpreted or used as an evidence to create the rights and duties of the parties other than the ones enumerated in this agreement, either against each other or against any person or institution not a party to this contract.

ARTICLE VI

DISPUTE RESOLUTION PROCESS

1. The parties hereby agree to resolve disputes and differences arising under this contract through negotiation between the Director General, DOA or his representative and Chairman, Management Board of the *Guthi* or his representative.

2. In the event such dispute is unable to be resolved between the parties pursuant to section 1 above, then such dispute shall be settled exclusively by arbitration.

3. Each arbitral tribunal shall consist of three arbitrators. Each party shall appoint one arbitrator for each arbitration and the arbitrators appointed shall appoint the third arbitrator for such arbitration.

ARTICLE VII

EVENTS OF DEFAULT AND REMEDIES

1. Event of default shall occur if a party to the agreement fails to discharge the material obligation under the agreement and such failure shall continue uncured for sixty days after notice thereof by the aggrieved party.

2. If an event of default occurs and is continuing, the non-defaulting party may terminate this contract by giving written notice to that effect and shall have the right to recover all the losses suffered or expenses incurred so far for the restoration of the *Aganchhen*.

IN WITNESS WHEREOF, the parties hereto have agreed to sign this agreement this day ofFagun 2050 (...Feb,1995).

.....
Mr./Ms.....
Director General, DOA

For Department of Archeology/
Ministry of Education and Culture/
HMG.

.....
Mr./Ms.....

For *Patko Aganchhen Guthi*.

Witness: 1. Mr./Mrs.....

2. Mr./Mrs.....

How Effic

संस्कृति

Most recent draft
Nepali-text.

ललितपुर नगर पालिका क्षेत्र नं. १ मा स्थित ऐतिहासिक
पुरातात्विक एवं फल्गुलक मन्दिरको संरक्षणको लागि
निजोद्धार गर्नु पर्ने कुरा महसुस गर्दै
यो क्षेत्र सरकार (पुरातत्व विभाग) यस पछि विभाग अनिवार्य
(यस पछि अनिवार्य) देहायका शर्तहरू पालना
गर्ने कुरामा मजबुरी एवं बलवद्द्वारा गर्ने उपरोक्त ऐतिहासिक, पुरातात्विक
एवं फल्गुलक मन्दिरको राष्ट्रिय स्मारकको रूपमा रहेको संरक्षण गर्ने
सन्दर्भमा सम्भावित जोडो सुझावहरू गरिएको छ।

यस संस्कृतिलाई उत्थान गर्न गरिएको सबै सुझाव प्राविन स्तरको संरक्षण र २०१३
सम्मको संरक्षण र स्थापना गर्ने दफा (३) अनुसार गर्ने लिइएको छ। यस संस्कृतिलाई
उत्थान रित्त रैत सो र संरक्षणको परिभाषा बाहिर कुनै शल्लोक मान्न छैन।

शर्तहरू

१. यो अनुसंधान माथि उल्लेखित संरक्षण कार्यको लागि दिइएको
कार्यहरू विभाग आफैले वा अरु कोही गर्न गराउने छ।

कार्यका

२. संरक्षण र उद्धार गुणस्तर कार्यमा गर्नका लागि गर्न पर्ने सबै कुरा फल्गुलकको
अनुमानको जिम्मेवारी विभाग आफैले लिने छ। विभागले दिएको सुझाव, विवरण,
निर्देशन, आदेश पालना, संरक्षणको कुरा फल्गुलकमा जिम्मेवारीको रूपमा
सबै पक्षहरूको फर्दित हुनेछ।

३.

उल्लेखित संरक्षण कार्यको माथि उल्लेखित लागि कुनै आर्थिक सहयोग
निर्माण सामग्री वा अन्य उपलब्ध गराउने बाहेक विभागले सो सहयोग
सिक्का गर्न सक्नेछ।

४.

उल्लेखित स्मारकको संरक्षण पश्चात मजिरी संरक्षण कार्यको
जिम्मेवारी को हुनेछ। यथा स्थितिमा राख्न संरक्षण
अथवा स्थित विस्तृत जानकारी जोडो संस्कृतिलाई साथ संरक्षण गरिने छ।

1. CAN DOA DELEGATE THE AUTHORITY TO SIGN THE DEED OF RESPONSIBILITY TO THE MAYOR ?

2. SHOULD HE NOT INCLUDE AN ARBITRATION CLAUSE WITH AUTHORITY BOTH TO APPEAL TO ----- ?

राष्ट्रिय स्मारक का कन मर्मित स्मारक पर चर आदि गर्नु परेन पुरातत्व विभाग के निरीक्षण इत्यादि पूर्व लिखित कलियुक्त मात्र गर्नु परेन यदि यह सन्दर्भ में विभागले नियमको परिधी मिर रही अथवा दिने आवश्यक निर्देशनको पालना गर्नुको यदि निर्देशन विपरीत काम गर्ना विभाग आफैले वा अरु कोही मर्मित काम संचालि सके सम्बन्ध लजाउको रक्खे - - - - - गर आहुल उपर गर्नु सम्मैद।

६. राष्ट्रिय स्मारक लाई यथा स्थितिमा राख्न - - - - - ला अनुरोध गरेको अवस्थामा विभागले आवश्यकता अनुसार लिक्छ। यथा प्राविधिक सम्बन्ध उपलब्ध गराउन सम्मैद।

७. विभागले आवश्यक काममा राष्ट्रिय स्मारकको निरीक्षण गर्नु सम्मैद र आवश्यकता अनुसार निर्देशन दिनु सम्मैद यसको पालना गर्नु - - - - - को कर्तव्य हुनेछ।

८. यस सम्झौताको हेरफेर - - - - - प्रचलित प्राचित स्मारक हेरफेर गर्नको परिधी मिर रही दुवै पक्षको मन्जुरीमा गर्नु सम्मैद।

९. यो सम्झौता दुवै पक्षको सहिद्वारा भएको भित्ति देखि लागु हुनेछ र यस भन्दा अगाडि अरु सम्बन्धमा गरेको काम कारवाहीहरू यस सम्झौता बमोजिम गरफा भानिनेछ।

पुरातत्व विभागको तर्फबाट सहो गर्नु - - - - - तर्फबाट सहो गर्नु

नाम

नाम

पद

पद

कामालियको छाप

कामालियको छाप

सहो - - - - -

सहो - - - - -

आति निवेत २०२० साल

महिला राज - - - - -

लक्ष्मी

A20

(मार्कितः नाम - - - - -)

Deed of Responsibility

Whereas it has been proposed to preserve the _____,
a building of artistic and historical importance, located in

Ward # _____, _____ Municipality.

Whereas His Majesty's Government Department of Archeology (hereafter referred to as the Department) and _____ (hereafter referred to as _____) are committed and agree to the following conditions in the course of the preservation of said building of historical and artistic importance, hereafter referred to as the National Monument.

All the legal provisions described in this document derive from the Ancient Monuments Act of 1956 and its subsequent amendments, in particular as described under Section 9; in no case does this agreement go beyond the existing provisions of the Ancient Monuments Act of 1956 and its amendments.

Conditions

1. At the request of _____, the Department shall undertake or cause to have executed by its agent of choice the works necessary for the preservation of this National Monument.
2. The Department itself will be responsible for the monitoring of preservation activities according to its standards to achieve high quality. The guidance and specifications ordered by the Department shall be respected by all those concerned in the preservation activities.
3. The Department may accept contributions of funds or contributions in kind (labor, materials, etc.) to be used exclusively for the implementation of said preservation activities.

4. After said preservation work is completed, _____ shall be responsible for maintaining the National Monument in its preserved state. The specifications and description of said preserved state will be elaborated in words and drawings and attached to this document.

5. Any construction, alteration, or renovation work to the National Monument must be approved in writing by the Department of Archaeology before it is commenced. The specifications and instructions of the Department must be followed for this work. If unauthorized work is done, or if work is not completed according to the specifications of the Department, the Department shall correct the work or have such corrections executed through its agent of choice. The cost of such work will be realized as compensation from _____.

6. The Department shall provide advice and technical assistance as requested by _____ to maintain the preserved state of the National Monument.

7. The Department may inspect the National Monument if it deems necessary and may issue a directive .

8. The conditions of this contract may be altered with the consent of both parties.

9. This contract shall come into force from the date of signature of both parties in the contract; any other activities performed previously shall be deemed to hve been performed under this contract.

On behalf of the
Department of Archaeology

Name

Title

Seal

On behalf of the Guthi

Name

Name

Executed in _____ this _____ day
of _____ in the year _____

Deed of Responsibility
Draft, Spring 1993 - Pant.

Whereas it has been felt to renovate Rajopadhya Agan Temple (Building) of historical and archaeological importance place, located in patuko Tole ward No 18 of Lalipur Municipality. Whereas His Majesty's Government Department of Archaeology (herein after referred to as Department) and the Rajopadhya Agan Temple Guthi (herein after referred to as Guthi) have been committed and agreed to follow the following conditions in course of the preservation of the said Building ^{of} historical importance; hereafter referred to as a National Monument

Now, therefore the Department and committee have now entered into the following contract, having the following conditions:-

Conditions

1. At the request of the Guthi, the Department shall do itself or cause to do through any other agency the maintenance works along with the renovation works of the above stated Building Under this contract which has been done Under Section 9 of Ancient Monument preservation Act, 2013 (1956).
2. The Department itself shall look after and control the preservation activities or it shall be get it done through any other agency as designated by the Department. The guidance provided by the Department shall have to be followed by ^{those} ~~the~~ all concerned in this respect
3. In ^{the} course of preservation activities if some sorts of financial assistance or labour donation is intended to be provided by Guthi or by ^{others} ~~somebody~~ else, the Department may accept such types of things

(2)

4. After the completion of Preservation works the Guthi shall have the sole responsibility of keeping the said preserved ^{National Monument} ~~area~~ in its original shape ^{*} and shall manage all sorts of security arrangements in that respect.
5. The Guthi shall regularly perform the cleaning activities and minor maintenance works of the preserved area. But any types of work which have adverse impacts or negative effects on its archaeological shape and importance may not be done or cause to be done. ^{*}
6. In course of maintenance, if some sorts of renovation or alteration is required to be done, the Department shall have to be pre-informed and the said works shall be done or cause to be done according to the guideline, methods provided by the Department, which shall be ultimately finalized by the mutual consent of both the parties. In course of doing reconstruction or maintenance works, if after demolition or maintenance works is left haphazard after leaving the work undone, then such works shall be performed by the Department itself or cause to be performed and the amount incurred on such works shall be realized as compensation from the Guthi.

* specify** specify

(3)

7. No work shall be done or cause to be done, which ~~can~~ have adverse impacts upon ~~archaeological~~, ancient and original shape of the preserved areas.
8. The Guthi shall submit a report alongwith the photos showing full shape of ^{the building} ~~preserved areas~~ and with other details to the Department, every year. Besides, these things, if any other informations are deemed to be provided the Department shall be informed at any time. The Department may issue proper guidance, deemed appropriate.
9. It shall be the liability of the Guthi to keep the preserved area in secured and original condition having full security over it.
10. The religious activities done in the preserved areas, may be continued or caused to be continued as usual.
11. The Department shall ~~render~~ advice and co-operation as requested by the Guthi in relation to preserved areas.
12. The Department if feels necessary may inspect the preserved areas and may issue directive deemed necessary.
13. In case the original shape of the preserved area is altered and as a result there is adverse effects in its archaeological and historical importance or there is some sort of damage, due to not performing of activities which are required to be performed by the Guthi, the

- 4 -

Department shall have right to made decision in matter of compensation along with initiate proceeding Under Ancient Monument preservation Act, 2013 (1956) and other prevailing Nepalese laws.

14. The conditions of this contract may be altered with the consent of both the parties.
15. This contract shall come into force from the date of signature of both the parties in the contract, and any other activities done before in this regard shall be deemed to have been performed under this contract.

On behalf of Department
of Archaeology

Name :-

Designation :

Seal of the office :

on behalf of Gutli

Name :-

Name :-

Done in..... inday of monthof 2050
B.S.(.....AD)

8. Patukva Agam Conservation Project Technical Update

Seismic reinforcement: background

Any monument repair in seismically active Nepal must consider the introduction of additional reinforcements in addition to the consolidation of existing historical structure in order to withstand earthquakes. Previous and parallel work by the project team (Erich Theophile, Rohit Ranjitkar, and Prayag Joshi) has provided certain springboards for the design of reinforcements at Patukva .

Uma Maheswar Temple and Vabaha: development of a timber ring beams

At both Uma Maheswar and Vabaha, seismic reinforcements were undertaken with the following considerations and strategies.

* Strengthening with a ring beam made out of timber was seen as both seismically effective and aesthetically sympathetic to the historical structure. Only in the case of Uma Maheswar was there an existing and historical timber tie structure strong enough and properly configured which allowed simple reinforcement to create the ring beam effect.

Vabaha shock absorber

*At Vabaha (Patan Programme Conservation Pilot Project of a Buddhist shrine house), the most effective location for reinforcement was at the level of greatest load, i.e. just under the pinnacle structure which was to be rebuilt. Based on this analysis, the choice of a conventional perimeter ring beam as the principal reinforcement strategy was logical, the alternative would have been insertion of rigid plate at floor level. Both attempt the development of a more cohesive, rigid, and cell-like structure, the basic principle of all seismic retrofitting.

*The unexpected visit of Sir Bernard Feilden, a world authority on seismic reinforcement of historical structures, led to the discussion of alternative materials for the construction of the proposed ring beam. Sir Bernard argued the generally *under-represented* view that the introduction of reinforced concrete into mud mortar structures would create a potential for battering of the historical structure-- the different materials vibrating at different frequencies. Sir Bernard applauded the use of timber for strengthening at Uma Maheswar.

*His encouragement to develop a more sympathetic solution in timber led to a collaborative design for Vabaha led by Prayag Joshi with inputs from building consultant Thomas Schrom, whose experience in timber ring beams used for adobe construction in the American Southwest was especially relevant. Timber was agreed by all to be psychologically and aesthetically preferable to reinforced concrete; it even continued an historical trend among the Newarss to keep adding layers of reinforcing timber structure to failing buildings.

*The design began as a multi-layered timber beam, i.e. composed of side-by-side and stacked plank-like layers approximately 2"x12" . These different pieces were lapped with staggered joints and all nailed together. The design of several layers in joined lengths was certainly more economical (as a single large section of appropriate length 30' would have been unavailable) but more importantly was conceived as part of the structural design--the many joints of the composite timber ring beam providing it some flexibility. Flexibility is seen as a positive characteristic in earthquake performance, especially in relation to the loose historical walls in mud mortar, the mud providing another *flexibility factor*.

*Joshi's key innovation was to refine this notion of a timber ring beam, a somewhat flexible reinforcing element, into a "shock absorber". To this end the three stacked layers of timber in the beam were fastened in the following way. The lower layer was structurally linked with the walls below by iron reinforcing rods; the top layer linked with above by bolted connections to the large beams of the pinnacle. Most critically, structural connections were not made between the middle timber layer to the upper and lower layers. The hypothesis for this intentional *lack of* connection is that the lateral force of an earthquake could be absorbed by the ability of the timber beam to shift slightly. At the same time, the significant load of the pinnacle above would prevent displacement of more than a few inches.

In sum, the building is structurally reinforced with a new timber tie member whose novel configuration also provides a shock absorbing functioning.

Patukva Agam

These experiences with timber reinforcement at Vabaha and Uma Maheswar have led to ongoing experiments at Patukva which include: (1) use of timber planking to create a rigid plate system and (2) strengthening of building-scale vertical connections through development of a timber framework.

Rigid floor plates

The development of a rigid plate, like the ring beam, is a consolidating measure to help the structure react as a larger whole in the event of an earthquake. At Patukva Agam, unlike past projects in "floorless" temple structures, there are three floor levels which can be easily rebuilt incorporating the great rigidity of two layers of planking laid at 45 degrees and through-nailed. The use of timber planking, much more sympathetic to the historical structure, comes at the suggestion of Sir Bernard Feilden.

Vertical connections

In the West, the technique of drilling continuous vertical rods into historical and "loose" masonry structures is a norm. In Nepal, however, not only is that technology unavailable, but the buildings are extraordinarily "loose", made up as they are of a composite, three-layered masonry wall with very few through connections. (This is why on a great number of historical buildings here walls visibly splay out.)

Here, the project team decided to explore a strategy of making vertical continuity in the Patukva structure by development of a timber framework. On many levels timber posts were found in the historical configuration: what remained was to establish consistent connections between these historical members and adjacent tie beams, as well as to add the missing pieces to make these post and beam elements add up to a kind of reinforcing framework or rigid frame.

This timber rigid frame was modeled and studied by a computerized seismic engineering program, specially imported for the Patukva project. The results confirm that insertion of timber posts, strengthened connections with timber wall plates, and improvement of timber joinery can achieve a state-of-the-art seismic reinforcement.

Seismic reinforcement: appropriate local and imported materials

If one could use reinforced concrete in conservation projects, then metal reinforcements would be fabricated in iron and mild steel, protection against corrosion being provided by the embedding of these members in the concrete. When working with traditional mud mortar, however, anything that is put in the wall and subject to moisture should be made of a metal which resists corrosion. To date, conservation projects in Nepal have not used metal for seismic reinforcements; iron and mild steel hardware has been used for timber joining and miscellaneous applications, generally these pieces are painted with anti-corrosive iron oxide paint.

Stainless steel is the international norm for such metalwork, although experience attempting to import this material from India for Patukva over the last six months has proved challenging and expensive (200% duty, three month delay).

Alternatives include locally available brass and copper, as well as custom-ordered and locally cast brass, copper, and bronze. Available in the market are a range of wire and rods in copper and brass varying in diameter up to 10 mm.

Specific applications for such metal rods, pieces, and wires would include

- (a) thru-wall connections linking the outer wall with a newly reinforced floor structures (rigid plate concept)
- (b) introduction of wire stranding in mud mortar joints to increase overall tensile strength of the traditional multi-layered wall in mud mortar.

Hardware for timber joinery would preferably use corrosion-resistant metal, although as these applications are generally protected from water, non-corrosive materials would not be absolutely necessary.

Ongoing testing

Meanwhile we have had fabricated appropriately sized sample sections in less corrosive copper, brass, and bronze. In early February the tensile strength of these pieces were measured at the Institute of Engineering Materials Strength Testing Laboratory, the goal being to compare locally available sections with each other and with imported stainless steel.

Promising results show that locally available copper and brass wires and rods are up to 40% as strong as imported stainless steel. If appropriately sized, this appears to be sufficiently strong for use in most seismic reinforcement applications, especially in a building the scale of Patukva Agam.

Meanwhile, the Patan Conservation Laboratory (under the Department of Archaeology) is currently and at our request testing silicone coating of brass and copper rods to determine how the limited corrosion of these metals can be further controlled, results forthcoming.

The goal of these experiments are to use locally available materials to achieve international norms of seismic retrofitting.

Timber preservation

To date, no timber preservatives have been manufactured in Nepal. Only internationally-assisted conservation projects have been able to afford costly imports of Japanese and German products including Wykamol, Xylamon, and Xylophene.

There has been criticism that application of the preservatives was often not necessary (a) because the necessary re-application was not anticipated after five years and (b) because the sal wood is extremely resistant if protected by roof cover...i.e. fix the roof rather than treat the wood. Nevertheless, there are times when preservative is appropriate including treatment of ground floor timbers, pine (which is much more susceptible than sal), and historical timbers which have shown signs of insect infestation. The historical interior framing of Patukva is exclusively pine. We propose refitting of pine members and repair of existing members, thus making this preservative extremely critical.

On this and related subjects we have had ongoing discussions with the Conservation Laboratory. Very recently we determined that one especially effective preservative chemical, a copper-chrome-arsenic compound, can be produced locally with chemical ingredients presently available. Tests are underway to produce this chemical compound and make sample applications. If successful, we will produce the preservative not only for the Patukva project, but also for use by the Department of Archaeology.



TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
PULCHOWK CAMPUS
Central Material Testing Laboratory
Pulchowk, Lalitpur.

TENSILE STRENGTH OF BAR

Name : Kathmandu Valley Preservation Trust

Date : 2050/11/5

Location : P.O. Box 5, Bhaktapur Darbar Square, Bhaktapur. Tested by : R.R. Pant

Type of Bar : ~~XXX~~ Brass, bronze, copper, Rods and Wires.

Machine : U.T.M.

S.No.	No.	Ø of Bar mm.	Area Cm ²	Breaking Load kg.	Types of Samples	Final Length m.	Breaking Strength kg/cm ²	Yield Strength kg/cm ²
1.	1	15	1.76	6,325	Copper Rod	-	3,593.75	
2.	1	13.4	1.41	3,050	Bronze Rod	-	2,163.12	-
3.	1	10	0.78	7,850	Stainless Steel Rod	-	10,064.10	-
4.	1	6	0.28	1,120	BRASS Bronze Wire	-	4,000.00	-
5.	1	3.3	0.08	368	Copper Wire	-	4,600.00	-
6.	1	1.5	0.018	88	,, ,,	-	4,888.89	-

Remarks : The Rods & Wires supplied by
Kathmandu Valley Preservation Trust.

[Signature]

APPENDIX B

ENGINEER'S REPORT

Calculation of weight of the structure :-

AUGUST, 1993

① Top Roof El. 11.24 m from plinth level.

② Dead Load

(i) Dead load of Gajur = 8.0 kg

(ii) Dead load from roof = 1848.0 kg (support on wall)

(iii) Dead load from wall = $\frac{1}{2} \times 0.5 \times 0.4 \times 1.4 \times 4 \times 2000 \text{ kg/m}^3 = 1120 \text{ kg}$

Total D.L = 2976 kg

③ Live Load on roof (Taking 45 kg/m²)

i, L.L = 462 kg

② Fourth floor

① Dead Load

i, D.L from top roof = 2944 kg (Transferred from the slant)

(ii) D.L from wall (deduct $4 \times 0.3 \times 0.3 \times 0.35$) = $2000 \text{ kg/m}^3 \times (4 \times 1.72 \times 0.35 \times 1.1 - 4 \times 0.3 \times 0.3 \times 0.35)$
= 5045.6 kg

Total D.L = 7789.6 kg

② Live Load

i, L.L = 686 kg

C. Third floor

① Dead Load

i, D.L from the middle slope roof = 10350 kg

(ii) D.L from the wall = $2000 \text{ kg/m}^3 \times 2.4 \text{ m} \times 28 \times 0.85 \times 4 = 18816 \text{ kg}$

Total D.L = 29166 kg

② Live Load Total L.L = 2587.5 kg

683.5 m
523.901

D. Second Floor :-

① Dead Load

- i, D.L from front roof = 4178 kg
 - ii, D.L from left side roof = 5526 kg
 - iii, D.L from right side roof = 3059 kg
 - iv, D.L from back side roof = 4872 kg
 - v, D.L from 0.75m thick front wall = $2000 \text{ kg/m}^3 \times 0.75 \times 2 \times (4.1 - 1.3) = 8400 \text{ kg}$
 - vi, D.L from 0.55m thick front wall = $2000 \text{ kg/m}^3 \times 0.55 \times (4 \times 2.2 - 2 \times 0.65 \times 0.65) = 8750.5 \text{ kg}$
 - vii, D.L from 0.75m thick middle wall = $2000 \text{ kg/m}^3 \times 0.75 \times 2.2 \times 2.0 = 6600 \text{ kg}$
 - viii, D.L from 0.55m thick middle wall = $2000 \text{ kg/m}^3 \times 0.55 \times 2.7 \times 2.0 = 5940 \text{ kg}$
 - ix, D.L from 0.45m thick back wall = $2000 \text{ kg/m}^3 \times 0.45 \times 6.4 \times 1.8 = 10368 \text{ kg}$
 - x, D.L from floor slab = $300 \text{ kg/m}^2 \times (2.2 \times 7.7 + 1.5 \times 7.7) = 8547 \text{ kg}$
- Total D.L = 66235.5 kg

② Live Load :-

- i, L.L from front roof = 1043.25 kg
 - ii, L.L from left side = 1381.5 kg
 - iii, L.L from right side = 764.4 kg
 - iv, L.L from back side = 1218 kg
 - v, L.L from the floor slab = $200 \text{ kg/m}^2 \times (2.2 \times 7.7 + 1.5 \times 7.7) = 5698 \text{ kg}$
- Total L.L = 10105.15 kg

First floor :-

① Dead Load

- i, D.L from 0.75m thick front wall = $2000 \text{ kg/m}^3 \times 0.75 \times (4.1 \times 2.52 - 1 \times 1 - 2 \times 0.5^2) = 13248 \text{ kg}$
- ii, D.L from 0.55m thick front wall = $2000 \text{ kg/m}^3 \times 0.55 \times (4.0 \times 2.52 - 2 \times 0.65 \times 0.65) = 10159 \text{ kg}$
- iii, D.L from 0.75m thick middle wall = $2000 \text{ kg/m}^3 \times 0.75 \times (4.9 \times 2.52 - 2 \times 0.9 \times 1.2) = 15282 \text{ kg}$
- iv, D.L from 0.45m thick back wall = $2000 \text{ kg/m}^3 \times 0.45 \times (4.6 \times 2.52) = 10482.8 \text{ kg}$
- v, D.L from 0.45m thick side wall = $2000 \text{ kg/m}^3 \times 0.45 \times (3.4 \times 2.52 - 2 \times 0.9 \times 1.2) = 5767.2 \text{ kg}$

(vi) D.L from the floor slab = $200 \text{ kg/m}^2 \times (22 \times 7.7 + 15 \times 7.7) = 8547 \text{ kg}$

Total D.L = 63436 kg

(B) Live Load :-

i) L.L from the floor slab = 5698 kg.

F. Ground floor :-

(A) Dead Load

(i) D.L from 0.75 m thick front wall = $2000 \text{ kg/m}^3 \times 0.75 \times (4.1 \times 2.02 - 0.9 \times 1.6) = 10,263 \text{ kg}$

(ii) D.L from 0.55 m thick front wall = $2000 \text{ kg/m}^3 \times 0.55 \times (4.0 \times 2.02 - 2 \times 0.9 \times 1.5) = 5918 \text{ kg}$

(iii) D.L from 0.75 m thick middle wall = $2000 \text{ kg/m}^3 \times 0.75 \times (8.1 \times 2.02 - 2 \times 0.9 \times 1.5) = 20,493 \text{ kg}$

(iv) D.L from 0.45 m thick back wall = $2000 \text{ kg/m}^3 \times 0.45 \times (4.6 \times 2.02 - 2 \times 0.9 \times 1.5) = 5933 \text{ kg}$

Total D.L = 42,607 kg.

(B) Live Load

i) Live Load on the floor = 5698 kg.

Therefore, in summary.

Floor	Dead Load (kg)	Live Load (kg)	Total Load (kg)
1. Roof	2976	462	3438
2. Fourth	7790	686	8476
3. Third	29166	2588	31,754
4. Second	66236	10105	76,341
5. First	63436	5698	69,134
6. Ground	42607	5698	48,305
Total	212,211 kg	25237 kg	237,448 kg

Total building load = 237,448 kg

2. Earthquake Analysis of Structure :-

Method used — Seismic Coefficient Method (Ref NBC-83 Section I, clause 5.4)

$$\begin{aligned} \text{Total weight of structure} - W &= \text{Total dead load} + 25\% \text{ Live load} \\ &= 212,211 + 0.25 \times 25237 = 218522 \text{ kg} \end{aligned}$$

Each floor weight w_i (dead load + 25% Live Load)

$$\text{Roof } w_5 = 3072 \text{ kg}$$

$$\text{Fourth } w_4 = 7962 \text{ kg}$$

$$\text{Third } w_3 = 29813 \text{ kg}$$

$$\text{Second } w_2 = 68,762 \text{ kg}$$

$$\text{First } w_1 = 64,861 \text{ kg}$$

$$\text{Ground } w_0 = 44082 \text{ kg}$$

$$\text{Total} = 218,522 \text{ kg}$$

Seismic Coefficient for zone V, $\alpha_0 = 0.08$

$$\text{Base Shear } V_B = C \alpha_h W$$

$$\alpha_h = \beta I \alpha_0$$

β = coefficient depending upon soil foundation system = 1.0

I = Importance of structure = 1

$$\alpha_h = 1 \times 1 \times 0.08 = 0.08$$

C = Coefficient depending on the flexibility of structure with the increase in number of storeys depending upon fundamental time period.

Time period $T = \frac{0.09 H}{\sqrt{d}}$

$H = \text{Total height of structure} = 11.24 \text{ m}$

$d = \text{maximum box dimension of building in metres in a direction parallel to the applied seismic force.}$
 $= 5.35 \text{ m}$

$\therefore T = \frac{0.09 \times 11.24}{\sqrt{5.35}} = 0.44 \text{ sec}$

$\therefore C$ from fig 15 of NBC-83 (section I Page 16)
 $C = 0.88$

$\therefore \text{Base Shear } V_B = 0.88 \times 0.08 \times 218,522 \text{ kg}$
 $= 15384 \text{ kg}$

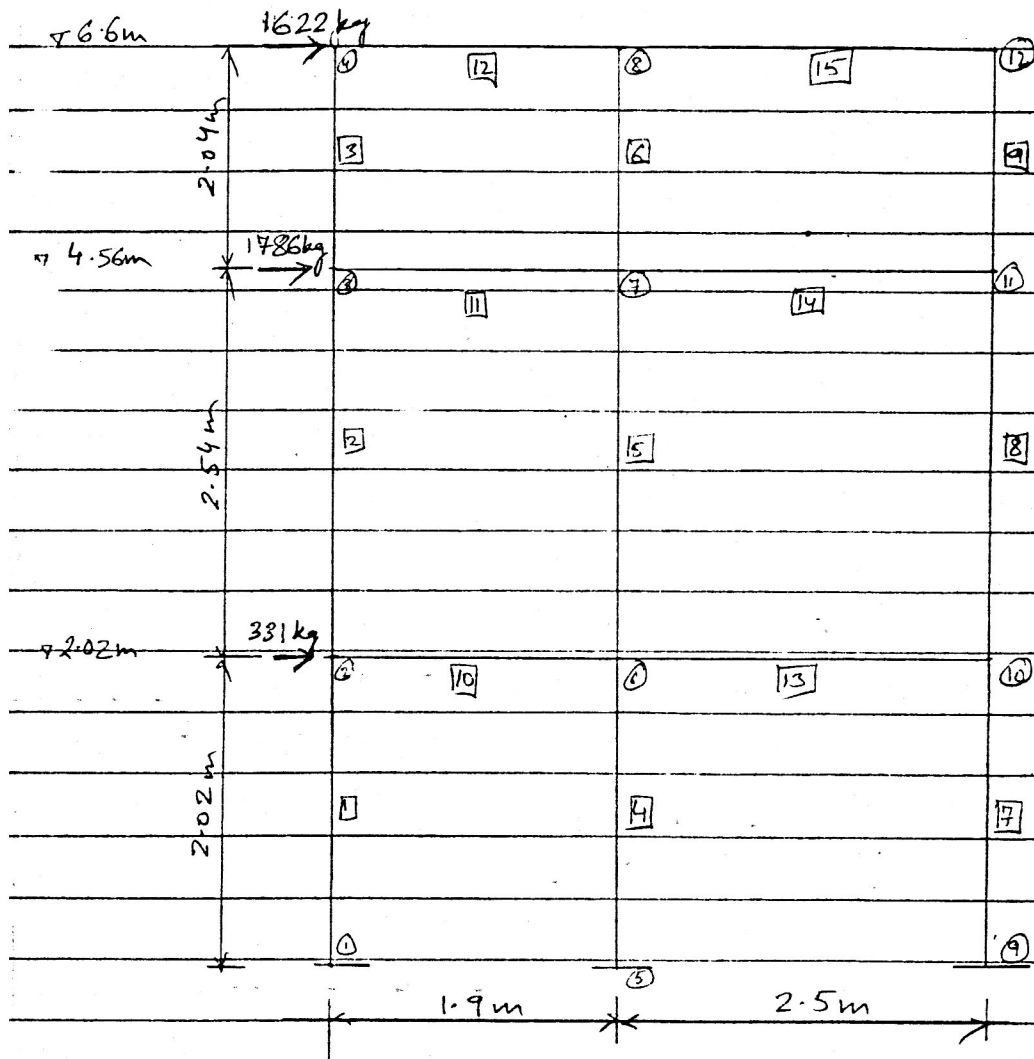
Distribution of forces is given by $Q_i = \frac{V_B w_i h_i^2}{\sum w_i h_i^2}$

Storey	$w_i (\text{kg})$	$h_i (\text{m})$	$w_i h_i^2$	$Q_i (\text{kg})$	Force in Each frame (kg)
5	3092	11.24	390636	1464	488
4	7962	9.52	721599	2704	902
3	29813	6.6	1298654	4866	1622
2	68762	4.56	1429810	5358	1786
1	64861	2.02	264659	992	331

$\sum w_i h_i^2 = 4105358$

Pages 6-11 show design calculations for timber skeleton frame. Frame configuration has been modified, see sample calculation May 1994.

3. Frame Dimension and Applied Lateral Force :-



Assumed Column and beam Size = 150 mm x 200 mm

$$\text{Area} = 0.15 \times 0.2 = 0.03 \text{ m}^2$$

$$\text{Moment of Inertia} = I = \frac{bh^3}{12} = \frac{0.15 \times 0.2^3}{12} = 1.0 \times 10^{-4} \text{ m}^4$$

$$\text{Modulus of Elasticity} = E = 1.26 \times 10^6 \text{ t/m}^2 = 1.26 \times 10^9 \text{ kg/m}^2$$

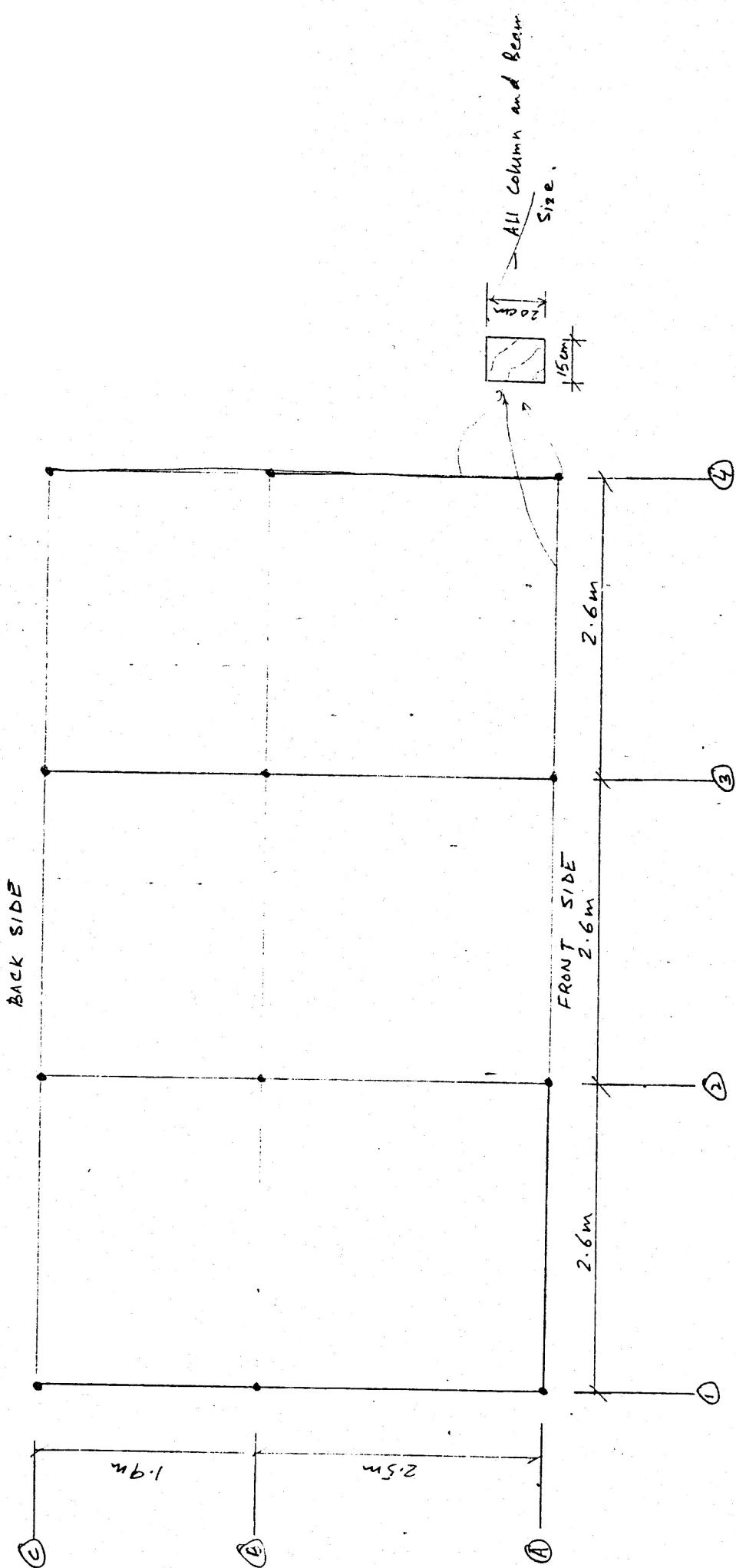
timber type = Salwood.

4.) Analysis and Design :—

Analysis of frame structure of three storey is done by finite element method of analysis by using a computer program called MICROFEAP - P1. Analysed structure and its output is attached.

For the analysis, four frame of each three storey is provided in the building. Frame is analysed only for horizontal static force from earthquake. All the vertical load is considered to be taken by the masonry unit.

The timber columns are spaced in 2.6 m centre to centre in the longitudinal direction. In transverse direction the columns are spaced in 1.9 m and 2.5 m consisting two bay.



A/ Beam design :-

From finite element analysis of 3 story, two bay frame structure

for beam $\rightarrow$ Maximum bending Moment $M = 2.04 \times 10^3 \text{ kg m}$
Maximum shear $V = 1.9 \times 10^3 \text{ kg m}$

Permissible stresses

(a) Bending and tension $\sigma = 182 \text{ kg/cm}^2$

(b) Shear $\tau = 12 \text{ kg/cm}^2$

Above stresses increased by 33% for earthquake analysis.

(i) Check for Moment :-

$$\text{Bending stress } \sigma = \frac{M y}{I} \quad \text{where } y = \frac{d}{2}$$

$$I = \text{moment of inertia} = \frac{b d^3}{12}$$

$$\therefore \sigma = \frac{M \times \frac{d}{2}}{\frac{b d^3}{12}} = \frac{6 M}{b d^2}$$

$$\therefore d = \sqrt{\frac{6 M}{b \sigma}} = \sqrt{\frac{6 \times 2.04 \times 10^3 \text{ kg cm}}{15 \text{ cm} \times 1.33 \times 182}} = 18.36 \text{ cm} < 20 \text{ cm} \text{ provided}$$

ii, check for shear

$$\tau = \frac{3 V}{2 b D} = \frac{3 \times 1.9 \times 10^3}{2 \times 15 \times 20} = 9.5 \text{ kg/cm}^2 < 1.33 \times 12 = 16 \text{ kg/cm}^2$$

$\therefore$ Safe against Shear. //

By Column Design

i) Ground and Second floor column :-

Ground & Second floor column : designed for two cases.

a) Tension with bending

(b) Compression with bending

column is designed as short column, as

$$\frac{L}{d} = \frac{204 \text{ cm}}{20 \text{ cm}} = 10.2 < 11$$

Case a

$$\begin{aligned} \text{Maximum tension} &= 4.2 \times 10^3 \text{ kg} \\ \text{bending moment} &= 1.54 \times 10^3 \text{ kg m} \end{aligned}$$

$$\text{Tension stress } f_{at} = \frac{4.2 \times 10^3 \text{ kg}}{15 \times 20} = 14 \text{ kg/cm}^2$$

$$\begin{aligned} \text{allowable tension stress } f_t &= 182 \text{ kg/cm}^2 \times 1.83 = 242.1 \text{ kg/cm}^2 \\ &\geq \text{bending stress } f_b \end{aligned}$$

$$\text{bending stress } f_{ab} = \frac{6 \times 1.54 \times 10^3 \text{ kg cm}}{15 \times 20^2} = 154 \text{ kg/cm}^2$$

$$\therefore \frac{f_{at}}{f_t} + \frac{f_{ab}}{f_b} = \frac{14}{242.1} + \frac{154}{242.1} = 0.694 < 1 \text{ So O.K.}$$

Case b :-

$$\begin{aligned} \text{Maximum compression} &= 2.7 \times 10^3 \text{ kg} \\ \text{bending Moment} &= 1.46 \times 10^3 \text{ kg m} \end{aligned}$$

$$\therefore \text{compression stress } = f_{ac} = \frac{2.7 \times 10^3}{15 \times 20} = 9 \text{ kg/cm}^2$$

$$\text{bending stress } = f_{ab} = \frac{6 \times 1.46 \times 10^3 \text{ kg cm}}{15 \times 20^2} = 146 \text{ kg/cm}^2$$

$$\text{allowable compression stress, } f_c = 120 \text{ kg/cm}^2 \times 1.33 = 159.6 \text{ kg/cm}^2$$

$$\text{allowable bending stress, } f_b = 182 \text{ kg/cm}^2 \times 1.33 = 242.1 \text{ kg/cm}^2$$

$$\therefore \frac{f_{ac}}{f_c} + \frac{f_{ab}}{f_b} = \frac{9}{159.6} + \frac{146}{242.1} = 0.66 < 1 \text{ so o.k.}$$

(ii) First floor column :-

Column is designed for two cases.

- (a) tension with bending.
- (b) compression with bending

Column is designed as Intermediate column as

$$\frac{L}{d} = \frac{254}{20} = 12.7 > 11 \text{ but } < K_8$$

$$K_8 = \frac{0.702 \sqrt{E}}{\sqrt{f_{cp}}} \\ = \frac{0.702 \sqrt{1.26 \times 10^5}}{\sqrt{120}}$$

$$f_{cp} = 120 \text{ kg/cm}^2 \\ E = 1.26 \times 10^5 \text{ kg/cm}^2$$

$$= 22.75$$

$$\therefore \text{compression stress } f_c = f_{cp} \left[1 - \frac{1}{3} \left(\frac{L}{K_8 d} \right)^4 \right]$$

$$= 120 \left[1 - \frac{1}{3} \left(\frac{254}{22.75 \times 20} \right)^4 \right] = 116.12 \text{ kg/cm}^2$$

$$\text{for earthquake increased by } 33\% \therefore f_c = 116.12 \times 1.33 = 154.4 \text{ kg/cm}^2$$

Case (a) :- maximum tension = 2.2×10^3 kg
 bending = 1.37×10^3 kg cm

$$\text{tension stress} = f_{at} = \frac{2.2 \times 10^3}{15 \times 20} = 7.33 \text{ kg/cm}^2$$

$$\text{bending stress} = f_{ab} = \frac{6 \times 1.37 \times 10^5}{15 \times 20^2} = 137 \text{ kg/cm}^2$$

$$\text{allowable tension \& bending stress} = 182 \times 1.33 = 242.1 \text{ kg/cm}^2$$

$$\therefore \frac{f_{at}}{f_t} + \frac{f_{ab}}{f_b} = \frac{7.33}{242.1} + \frac{137}{242.1} = 0.596 < 1 \text{ so O.K.}$$

Case (b) :- Maximum compression = 1.44×10^3 kg
 Maximum bending = 1.22×10^3 kg cm

$$\text{Compression stress} = f_{ac} = \frac{1.44 \times 10^3}{15 \times 20} = 4.8 \text{ kg/cm}^2$$

$$\text{bending stress} = f_{ab} = \frac{6 \times 1.22 \times 10^5}{15 \times 20^2} = 122 \text{ kg/cm}^2$$

$$\text{allowable compression stress} = 154.4 \text{ kg/cm}^2$$

$$\text{allowable bending stress } f_b = 242.1 \text{ kg/cm}^2$$

$$\therefore \frac{f_{ac}}{f_c} + \frac{f_{ab}}{f_b} = \frac{4.8}{154.4} + \frac{122}{242.1} = 0.535 < 1 \text{ so O.K.}$$

15 cm x 20 cm column size is adequate.

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MICROFEAP-P1          DATE: 09-01-1993          <COMB> P.1
PROJECT : Temple          FILENAME: templ1
AUTHORITY: MAHENDRA RAJ KAYASTHA          ENGINEER: G.M.Joshi
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*                                     *
*   COMBINATION   *
*                                     *
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DISPLACEMENT COMBINATION <2D-FRAME SYSTEM>
LOAD FACTOR : 1

NODE	1-DISP (m)	2-DISP (m)	3-DISP (Rad)
1	0.0000D+00	0.0000D+00	0.0000D+00
2	1.2349D-02	2.2425D-04	-6.0238D-03
3	3.7387D-02	3.7235D-04	-4.8800D-03
4	4.6889D-02	4.0431D-04	-2.0706D-03
5	0.0000D+00	0.0000D+00	0.0000D+00
6	1.2339D-02	-8.0157D-05	-3.8106D-03
7	3.7328D-02	-1.3157D-04	-3.3455D-03
8	4.6829D-02	-1.4153D-04	-1.3332D-03
9	0.0000D+00	0.0000D+00	0.0000D+00
10	1.2330D-02	-1.4409D-04	-6.6365D-03
11	3.7291D-02	-2.4078D-04	-5.2653D-03
12	4.6806D-02	-2.6280D-04	-2.1362D-03

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MICROFEAP-P1                      DATE: 09-01-1993                      <COMB> P.1
PROJECT : Temple                      FILENAME: templ1
AUTHORITY: MAHENDRA RAJ KAYASTHA    ENGINEER: G.M.Joshi
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*****
*                                     *
*   COMBINATION   *
*                                     *
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STRESS COMBINATION <2D-FRAME SYSTEM>

LOAD FACTOR : 1

ELEM	MA	HINGE	SECTION (m)	AXIAL F. (Kg)	SHEAR (Kg)	MOMENT (Kg-m)
1	1		0.00	4.1964D+03	1.1493D+03	-1.5365D+03
			2.02	4.1964D+03	1.1493D+03	7.8505D+02
2	1		0.00	2.2040D+03	1.0325D+03	-1.2545D+03
			2.54	2.2040D+03	1.0325D+03	1.3680D+03
3	1		0.00	5.9248D+02	4.2964D+02	-2.6471D+02
			2.04	5.9248D+02	4.2964D+02	6.1176D+02
4	1		0.00	-1.5000D+03	1.5574D+03	-1.8107D+03
			2.02	-1.5000D+03	1.5574D+03	1.3353D+03
5	1		0.00	-7.6506D+02	1.4671D+03	-1.8402D+03
			2.54	-7.6506D+02	1.4671D+03	1.8863D+03
6	1		0.00	-1.8456D+02	8.4226D+02	-7.3482D+02
			2.04	-1.8456D+02	8.4226D+02	9.8340D+02
7	1		0.00	-2.6964D+03	1.0323D+03	-1.4566D+03
			2.02	-2.6964D+03	1.0323D+03	6.2867D+02
8	1		0.00	-1.4389D+03	9.0839D+02	-1.0856D+03
			2.54	-1.4389D+03	9.0839D+02	1.2217D+03
9	1		0.00	-4.0792D+02	3.5010D+02	-1.6383D+02
			2.04	-4.0792D+02	3.5010D+02	5.5037D+02
10	1		0.00	-2.1417D+02	-1.9924D+03	2.0396D+03
			0.47	-2.1417D+02	-1.9924D+03	1.0932D+03
			0.95	-2.1417D+02	-1.9924D+03	1.4677D+02
			1.42	-2.1417D+02	-1.9924D+03	-7.9962D+02
			1.90	-2.1417D+02	-1.9924D+03	-1.7460D+03
11	1		0.00	-1.1831D+03	-1.6115D+03	1.6327D+03
			0.47	-1.1831D+03	-1.6115D+03	8.6722D+02
			0.95	-1.1831D+03	-1.6115D+03	1.0176D+02


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MICROFEAP-P1          DATE: 09-01-1993          <COMB> P.2
PROJECT : Temple          FILENAME: templ1
AUTHORITY: MAHENDRA RAJ KAYASTHA          ENGINEER: G.M.Joshi
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STRESS COMBINATION <2D-FRAME SYSTEM>

LOAD FACTOR : 1

ELEM	MA	HINGE	SECTION (m)	AXIAL F. (Kg)	SHEAR (Kg)	MOMENT (Kg-m)
11	1		1.42	-1.1831D+03	-1.6115D+03	-6.6370D+02
			1.90	-1.1831D+03	-1.6115D+03	-1.4292D+03
12	1		0.00	-1.1923D+03	-5.9248D+02	6.1176D+02
			0.47	-1.1923D+03	-5.9248D+02	3.3033D+02
			0.95	-1.1923D+03	-5.9248D+02	4.8897D+01
			1.42	-1.1923D+03	-5.9248D+02	-2.3253D+02
			1.90	-1.1923D+03	-5.9248D+02	-5.1396D+02
13	1		0.00	-1.2392D+02	-1.2575D+03	1.4294D+03
			0.63	-1.2392D+02	-1.2575D+03	6.4351D+02
			1.25	-1.2392D+02	-1.2575D+03	-1.4243D+02
			1.88	-1.2392D+02	-1.2575D+03	-9.2836D+02
			2.50	-1.2392D+02	-1.2575D+03	-1.7143D+03
14	1		0.00	-5.5831D+02	-1.0310D+03	1.1920D+03
			0.63	-5.5831D+02	-1.0310D+03	5.4762D+02
			1.25	-5.5831D+02	-1.0310D+03	-9.6757D+01
			1.88	-5.5831D+02	-1.0310D+03	-7.4113D+02
			2.50	-5.5831D+02	-1.0310D+03	-1.3855D+03
15	1		0.00	-3.5013D+02	-4.0792D+02	4.6943D+02
			0.63	-3.5013D+02	-4.0792D+02	2.1448D+02
			1.25	-3.5013D+02	-4.0792D+02	-4.0469D+01
			1.88	-3.5013D+02	-4.0792D+02	-2.9542D+02
			2.50	-3.5013D+02	-4.0792D+02	-5.5037D+02

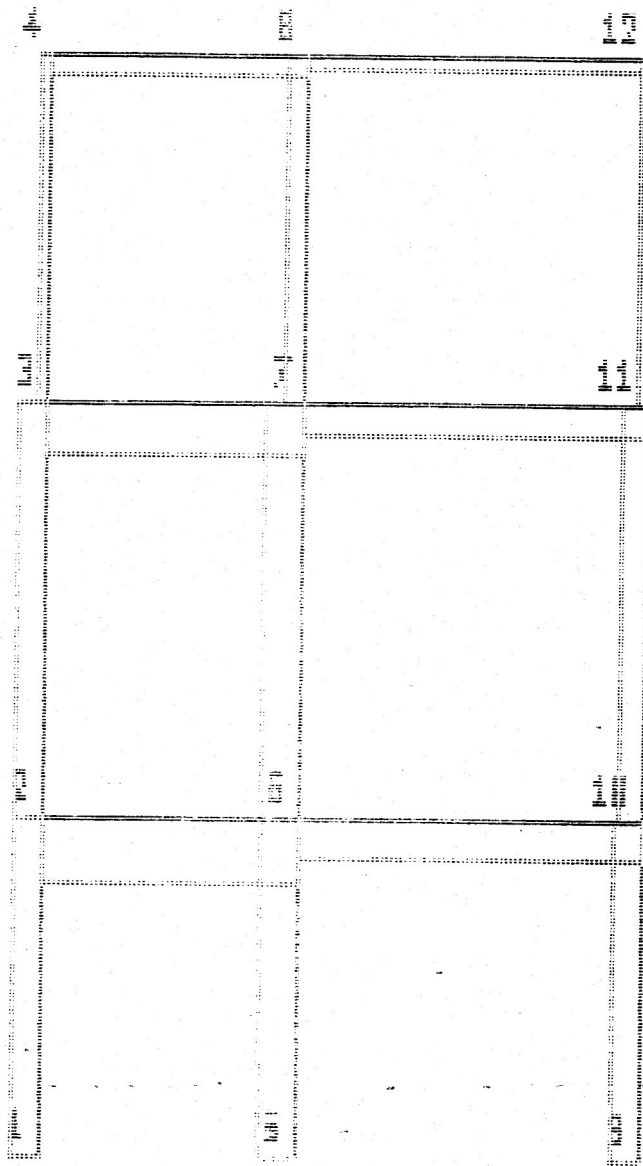
	1-REACTION (Kg)	2-REACTION (Kg)	3-REACTION (Kg-m)
1	-1.1493D+03	-4.1964D+03	1.5365D+03
5	-1.5574D+03	1.5000D+03	1.8107D+03
9	-1.0323D+03	2.6964D+03	1.4566D+03

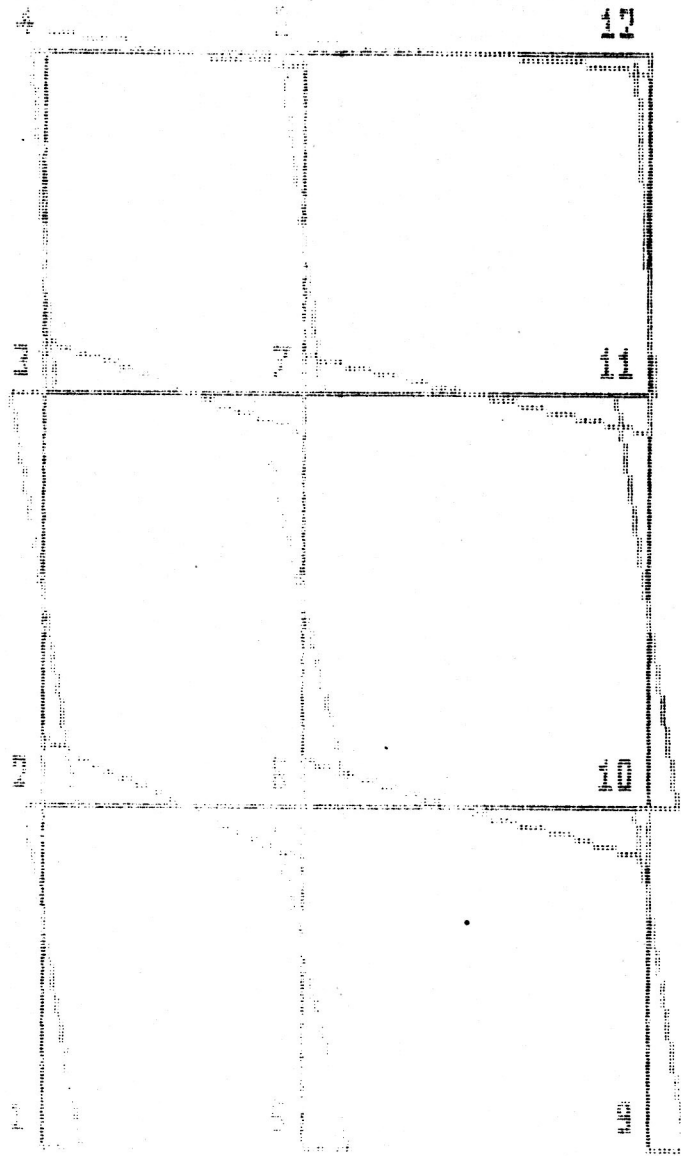
VOLUME OF MATERIALS <2D-FRAME SYSTEM>

SETS VOLUME
 (m³)

1	9.9000D-01
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SHEET FOUR OF TWO 2. 822-032





NOTES

CL = 2.97E+03

MAY, 1994

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MICROFEAP-P1

PROJECT : templ1

AUTHORITY: Manik Ratna Tuladhar

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DATE: 05-13-1994

<COMB> P.1

FILENAME: templ1

ENGINEER: Prayag Raj Joshi

=====

* COMBINATION *

STRESS COMBINATION <2D-FRAME SYSTEM>

LOAD FACTOR : 1

ELEM	MA	HINGE	SECTION (m)	AXIAL F. (kg)	SHEAR (kg)	MOMENT (kg-m)
1	1		0.00	8.5502D+02	1.0363D+03	-1.0467D+03
			2.02	8.5502D+02	1.0363D+03	1.0467D+03
2	1		0.00	8.9844D+02	9.5407D+02	-1.2117D+03
			2.54	8.9844D+02	9.5407D+02	1.2117D+03
3	1		0.00	9.9979D+02	5.0521D+02	-5.8408D+02
			2.04	9.9979D+02	5.0521D+02	4.4655D+02
4	1		0.00	-5.7624D+02	1.0360D+03	-1.0464D+03
			2.02	-5.7624D+02	1.0360D+03	1.0464D+03
5	1		0.00	-6.2033D+02	9.5344D+02	-1.2109D+03
			2.54	-6.2033D+02	9.5344D+02	1.2109D+03
6	1		0.00	-7.2334D+02	5.9915D+02	-6.4790D+02
			2.04	-7.2334D+02	5.9915D+02	5.7436D+02
7	1		0.00	-2.7878D+02	1.0357D+03	-1.0460D+03
			2.02	-2.7878D+02	1.0357D+03	1.0460D+03
8	1		0.00	-2.7810D+02	9.5249D+02	-1.2097D+03
			2.54	-2.7810D+02	9.5249D+02	1.2097D+03
9	1		0.00	-2.7646D+02	4.0064D+02	-5.1312D+02
			2.04	-2.7646D+02	4.0064D+02	3.0419D+02
10	2		0.00	-1.6575D+02	4.3419D+01	-1.7368D+01
			0.80	-1.6575D+02	4.3419D+01	1.7368D+01
11	2		0.00	-9.0613D+02	1.0135D+02	-4.0542D+01
			0.80	-9.0613D+02	1.0135D+02	4.0542D+01
12	2		0.00	-9.9975D+02	-9.9979D+02 ✓	4.4655D+02 ✓
			0.80	-9.9975D+02	-9.9979D+02	-3.5328D+02

```

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MICROFEAP-P1                                DATE: 05-13-1994                                <COMB> P.2
PROJECT : templ1                               FILENAME: templ1
AUTHORITY: Manik Ratna Tuladhar                ENGINEER: Prayag Raj Joshi
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STRESS COMBINATION <2D-FRAME SYSTEM>
LOAD FACTOR : 1

```

ELEM	MA HINGE	SECTION (m)	AXIAL F. (kg)	SHEAR (kg)	MOMENT (kg-m)
13	2	0.00	-8.3203D+01	-6.7361D-01	6.3992D-01
		1.90	-8.3203D+01	-6.7361D-01	-6.3992D-01
14	2	0.00	-5.5181D+02	-1.6481D+00	1.5657D+00
		1.90	-5.5181D+02	-1.6481D+00	-1.5657D+00
15	2	0.00	-4.0069D+02	-2.7646D+02	2.2108D+02
		1.90	-4.0069D+02	-2.7646D+02	-3.0419D+02

1) Beam Design

Sample Calculation

$$M_{\text{max}} = 4.466 \times 10^2 \text{ kg/m}$$

$$F_{\text{max}} = 9.997 \times 10^2 = 1000 \text{ kg/m} \quad \checkmark$$

$$d = \sqrt{\frac{6 M}{b \sigma}} = \sqrt{\frac{6 \times 4.466 \times 10^4}{10 \times 1.33 \times 182}}$$

$$= \underline{10.52} > 10 \text{ cm}$$

Provide 11 cm beam in the upper part or
provide 8 mm thick steel in between timber.

Shear

$$\tau = \frac{3V}{2bd} = \frac{3 \times 1000}{2 \times 10 \times 10} = 15 \text{ kg/cm} \quad \left(1.33 \times 11 = 16 \right)$$

OK.

2) Column

$$l/d = \frac{202}{11.5} = 17.56 > 11 \text{ and } < 18$$

Intermediate column

$$\text{Comp stress} = 120 \left[1 - \frac{1}{3} \left(\frac{254}{22.75 \times 11.5} \right)^2 \right] = 84.46 \text{ kg/cm}^2$$

$$f_{cg} = f_{c_{eq}} = 1.33 \times 84.46 = 112.33$$

$$\text{Max tension} = 8.984 \times 10^2$$

$$\text{Moment} = 1.2117 \times 10^3$$

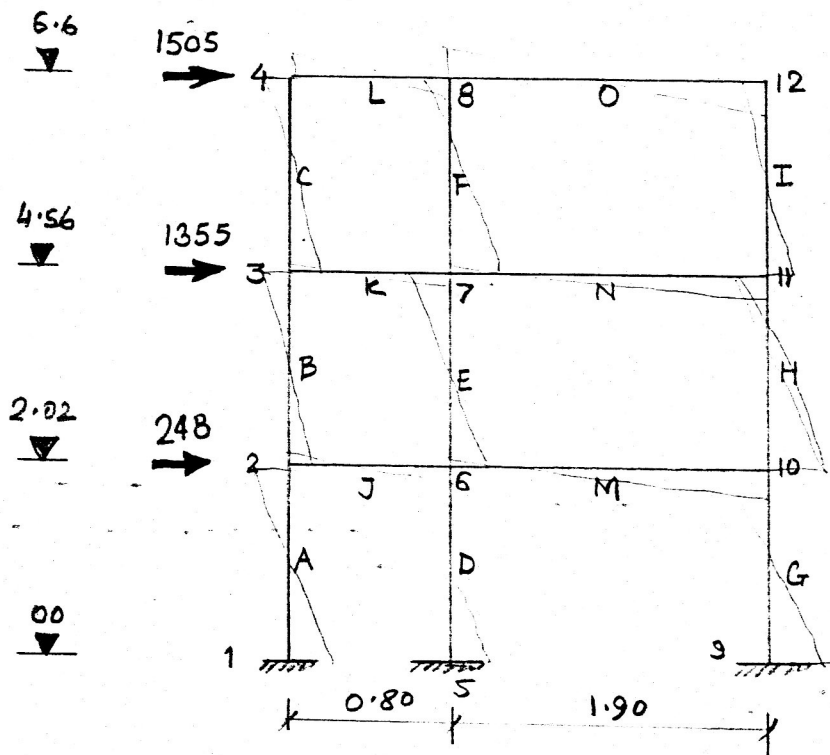
$$T_s = \frac{8.984 \times 10^2}{11.5 \times 11.5} = 6.793 \text{ kg/cm}^2$$

$$T_b = \frac{6 \times 1.2117 \times 10^3 \times 10^2}{11.5 \times 11.5^2} = 65.76 \text{ kg/cm}^2$$

$$\text{Allowable } T \& B_s = 182 \times 1.33 = 242.1 \text{ kg/cm}^2$$

$$\begin{aligned} \frac{f_{at}}{f_t} + \frac{f_{ab}}{f_b} &= \frac{6.793}{242.1} + \frac{65.76}{242.1} \\ &= 0.03 + 0.27 \\ &= \underline{0.3} < 1 \quad \underline{\text{OK.}} \end{aligned}$$

Column Size - $4\frac{1}{2} \times 4\frac{1}{2}$



Moment Diagram

=====

MICROFEAP-P1	DATE: 05-05-1994	<COMB> P.1
PROJECT : templ		FILENAME: templ
AUTHORITY: Manik Ratna Tuladhar		ENGINEER: Prayag Raj Joshi

=====

Case 2 with 30% load

Safe

Column Size - $4\frac{1}{2}'' \times 4\frac{1}{2}''$

Beam Size - $4'' \times 4''$

*
* **COMBINATION** *
*

STRESS COMBINATION <2D-FRAME SYSTEM>

LOAD FACTOR : 1

ELEM	MA	HINGE	SECTION (m)	AXIAL F. (kg)	SHEAR (kg)	MOMENT (kg-m)
1	1		0.00 2.02	1.7162D+02 1.7162D+02	1.3057D+01 1.3057D+01	-8.8509D+00 1.7525D+01
2	1		0.00 2.54	1.8033D+02 1.8033D+02	-4.2413D+01 -4.2413D+01	2.8438D+01 -7.9291D+01
3	1		0.00 2.04	1.2819D+02 1.2819D+02	1.3327D+02 1.3327D+02	-1.4562D+02 <u>1.2626D+02</u>
4	1		0.00 2.02	0.0000D+00 0.0000D+00	0.0000D+00 0.0000D+00	0.0000D+00 0.0000D+00
5	1		0.00 2.54	0.0000D+00 0.0000D+00	0.0000D+00 0.0000D+00	0.0000D+00 0.0000D+00
6	1		0.00 2.04	-4.8250D+01 -4.8250D+01	2.3660D+02 2.3660D+02	-2.7109D+02 2.1157D+02
7	1		0.00 2.02	-1.0549D+02 -1.0549D+02	1.4308D+01 1.4308D+01	-9.5312D+00 1.9371D+01
8	1		0.00 2.54	-1.1105D+02 -1.1105D+02	-4.3305D+01 -4.3305D+01	2.8593D+01 -8.1400D+01
9	1		0.00 2.04	-7.9941D+01 -7.9941D+01	1.1713D+02 1.1713D+02	-1.3335D+02 1.0559D+02
10	2		0.00 1.90	-4.3530D+01 -4.3530D+01	8.7131D+00 8.7131D+00	-1.0914D+01 5.6414D+00
11	2		0.00 1.90	-7.1169D+02 -7.1169D+02	-5.2142D+01 -5.2142D+01	6.6332D+01 -3.2738D+01
12	2		0.00 1.90	-3.5373D+02 -3.5373D+02	-1.2819D+02 -1.2819D+02	1.2626D+02 -1.1731D+02

Max. moment - 1.456×10^2

$$d = \sqrt{\frac{6 M_{max}}{b \phi}}$$

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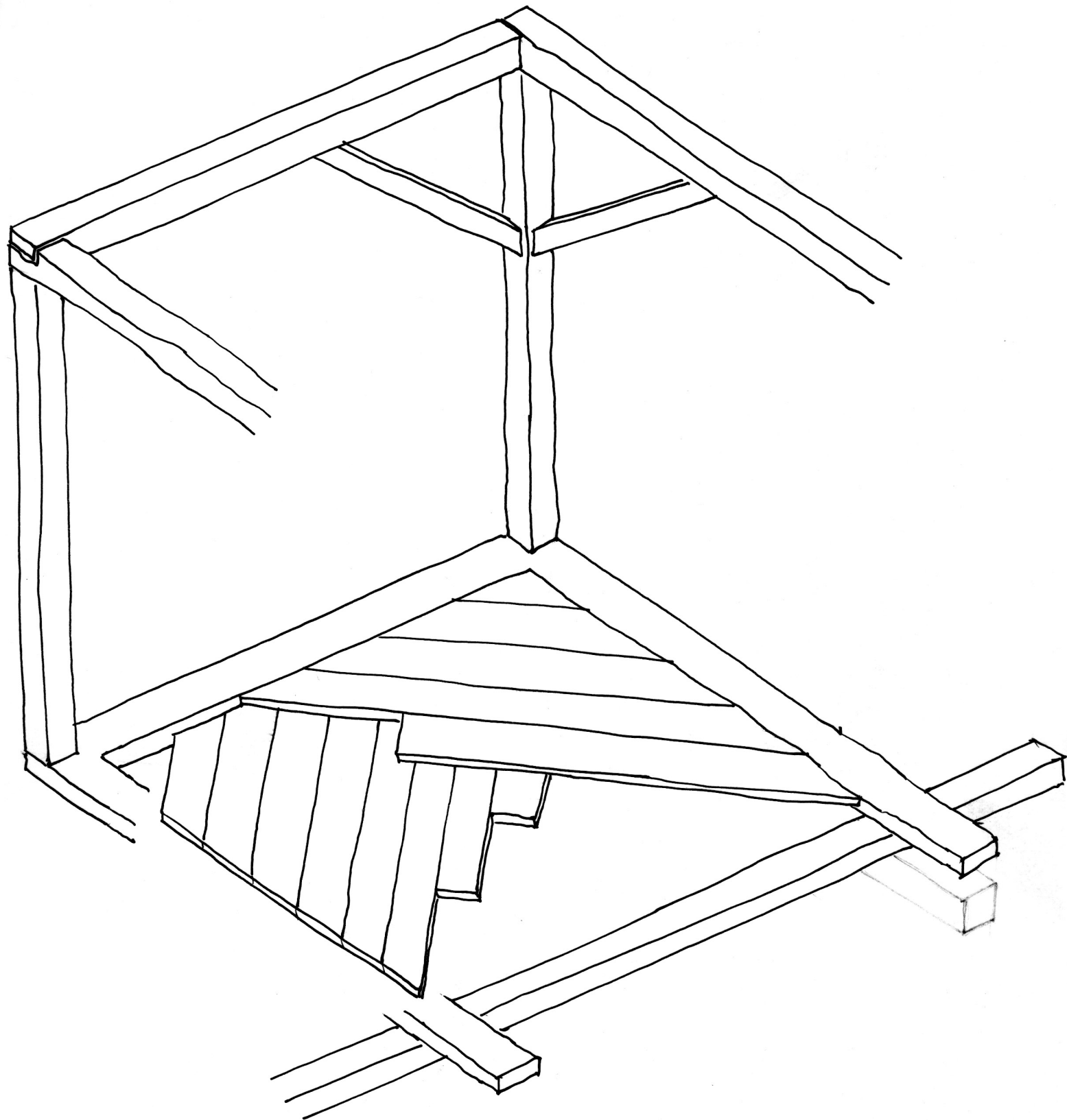
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PROJECT : templ1                                FILENAME: templ1
AUTHORITY: Manik Ratna Tuladhar                ENGINEER: Prayag Raj Joshi
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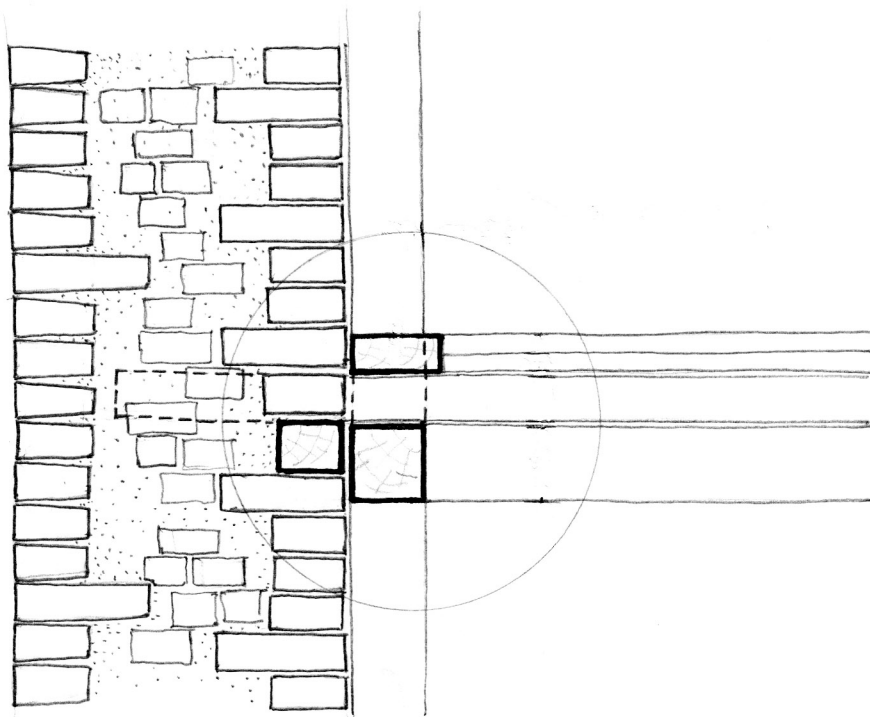
STRESS COMBINATION <2D-FRAME SYSTEM>

LOAD FACTOR : 1

ELEM	MA HINGE	SECTION (m)	AXIAL F. (kg)	SHEAR (kg)	MOMENT (kg-m)
13	2	0.00	-5.7612D+01	5.5595D+00	-4.6766D+00
		2.50	-5.7612D+01	5.5595D+00	9.2221D+00
14	2	0.00	1.6043D+02	-3.1111D+01	2.5824D+01
		2.50	1.6043D+02	-3.1111D+01	-5.1953D+01
15	2	0.00	-1.1713D+02	-7.9941D+01	9.4268D+01
		2.50	-1.1713D+02	-7.9941D+01	-1.0559D+02



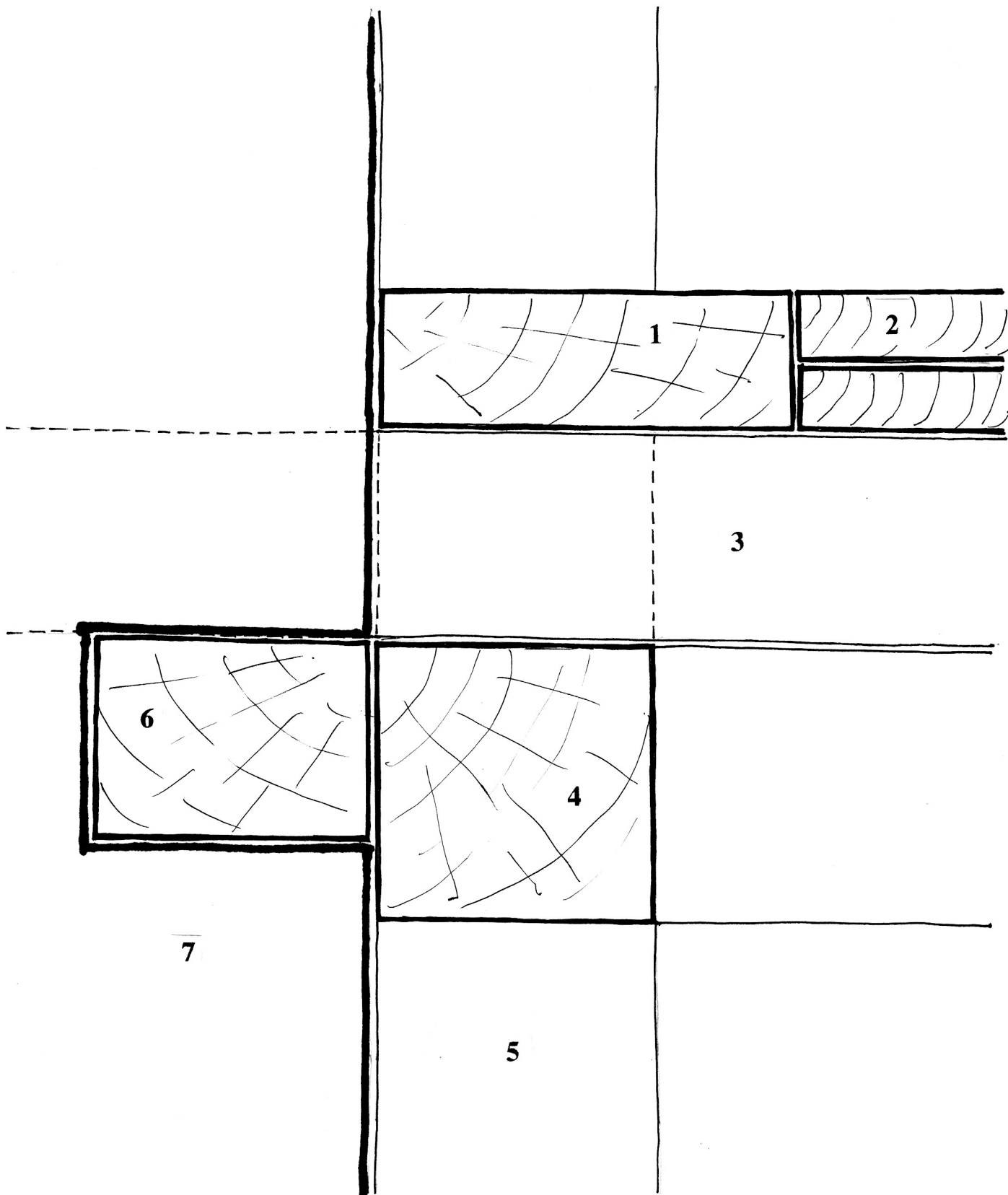
Axon showing new proposed timber structure; beams, posts, two layers of planking above existing joists with 2" X 6" boarder around all corners

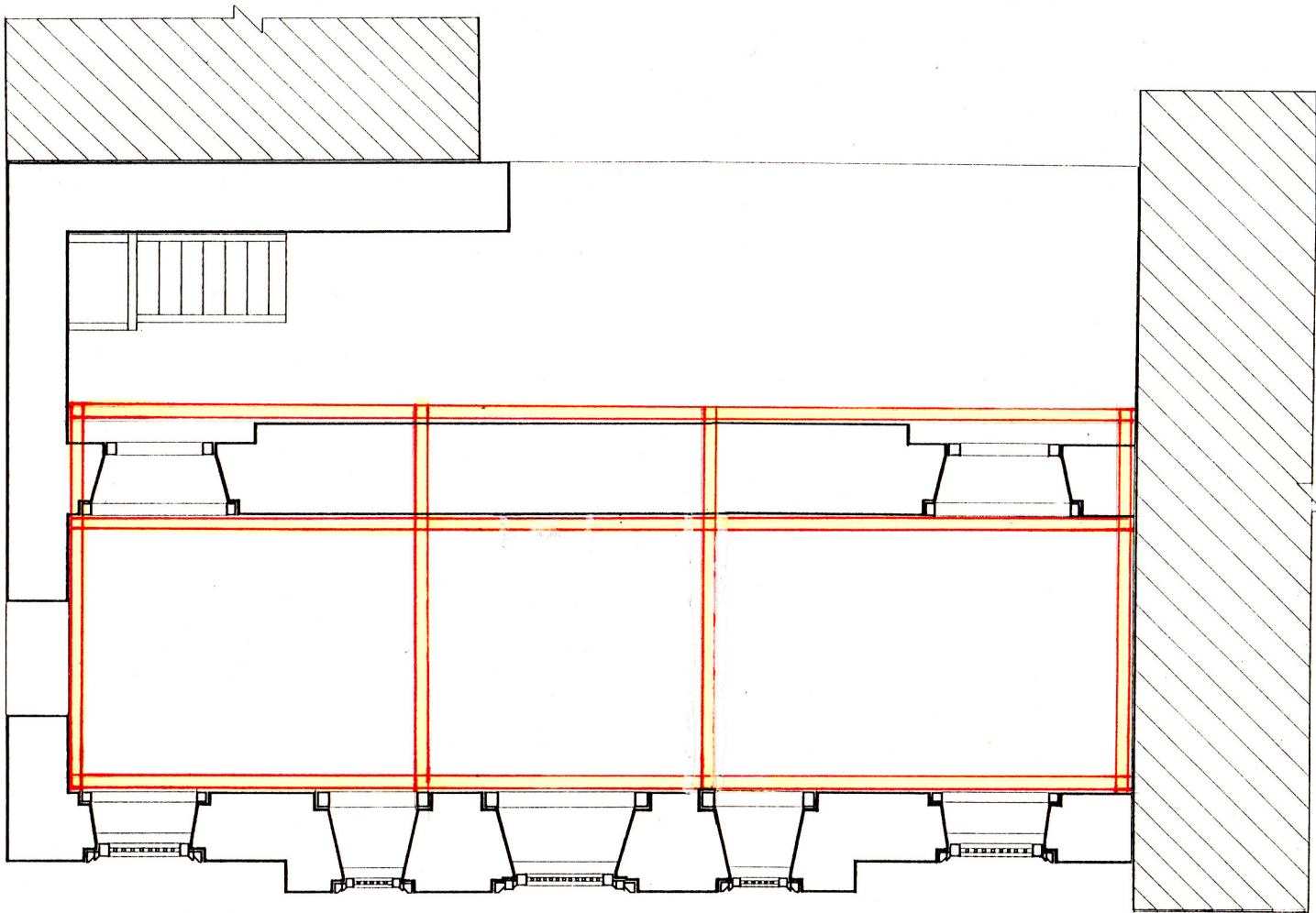


1. Timber boarder 2"X6"
2. Two layers of planking on diagonal (1" thick)
3. Existing joist
4. New sal wooden beam 4.5"X4.5"
5. New sal wooden post 4.5"X4.5"
6. Brick masonry showing inner and outer layers with rubble fill between

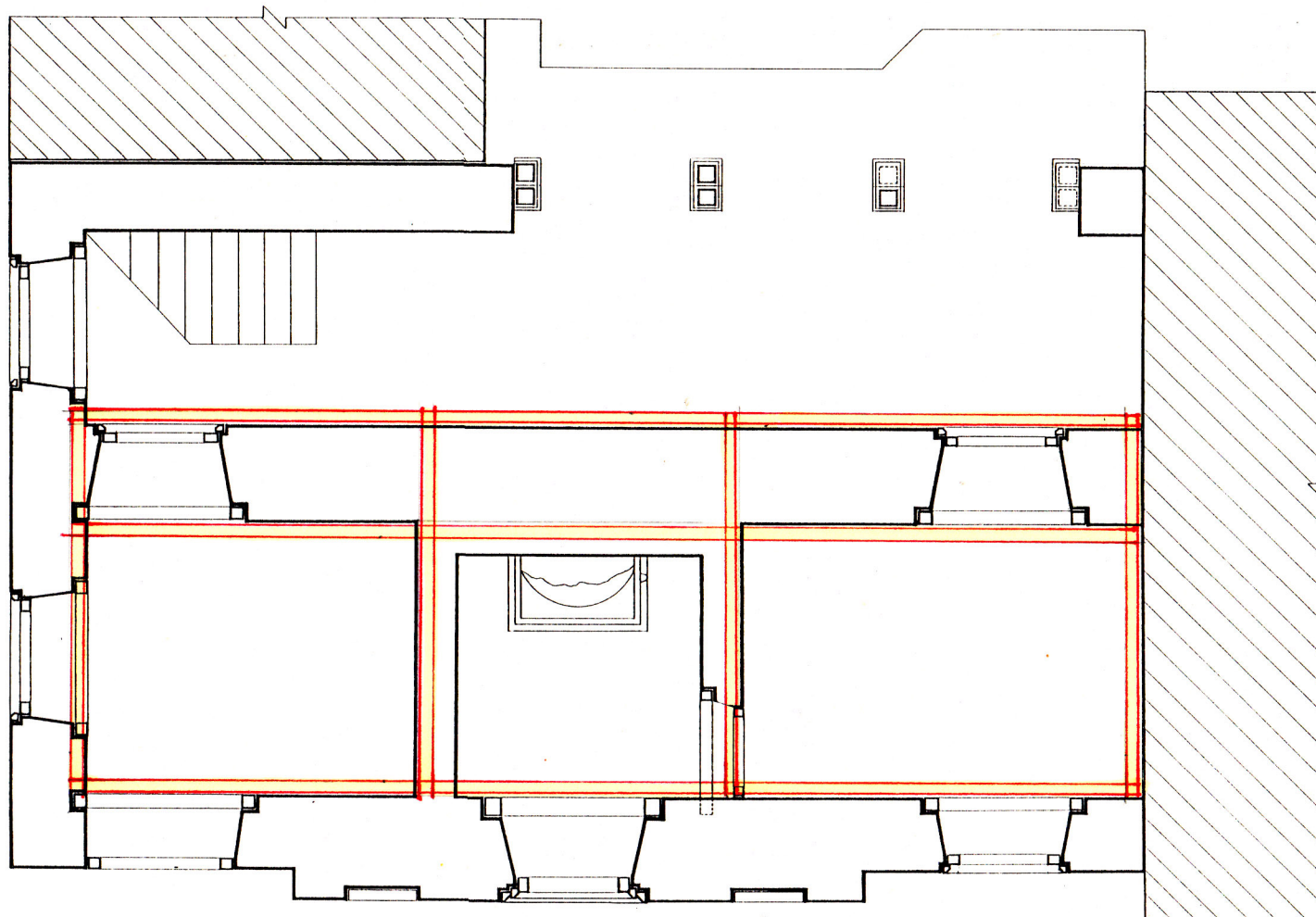
PATUKVA AGACHE :

New timber structure for seismic improvement

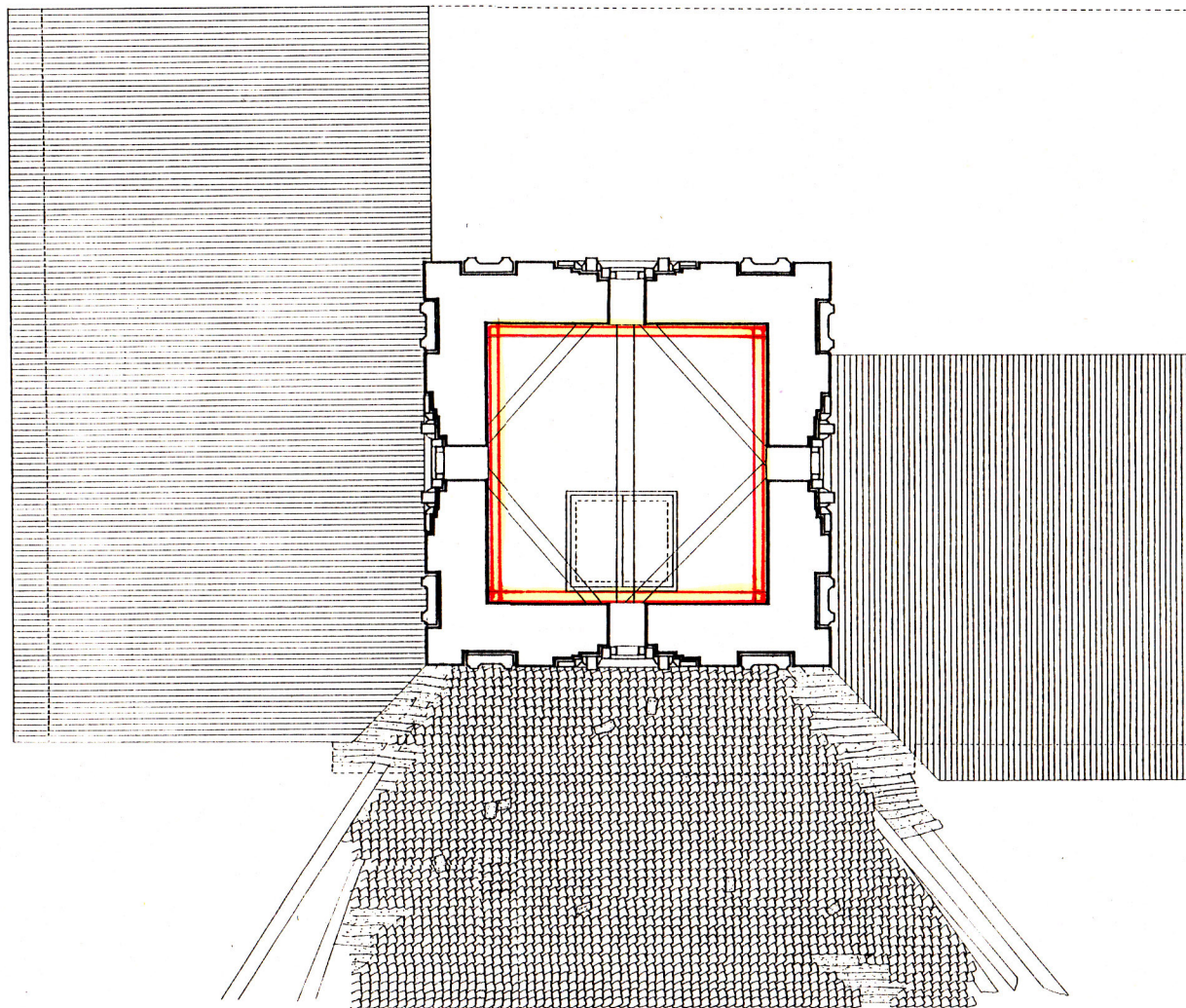




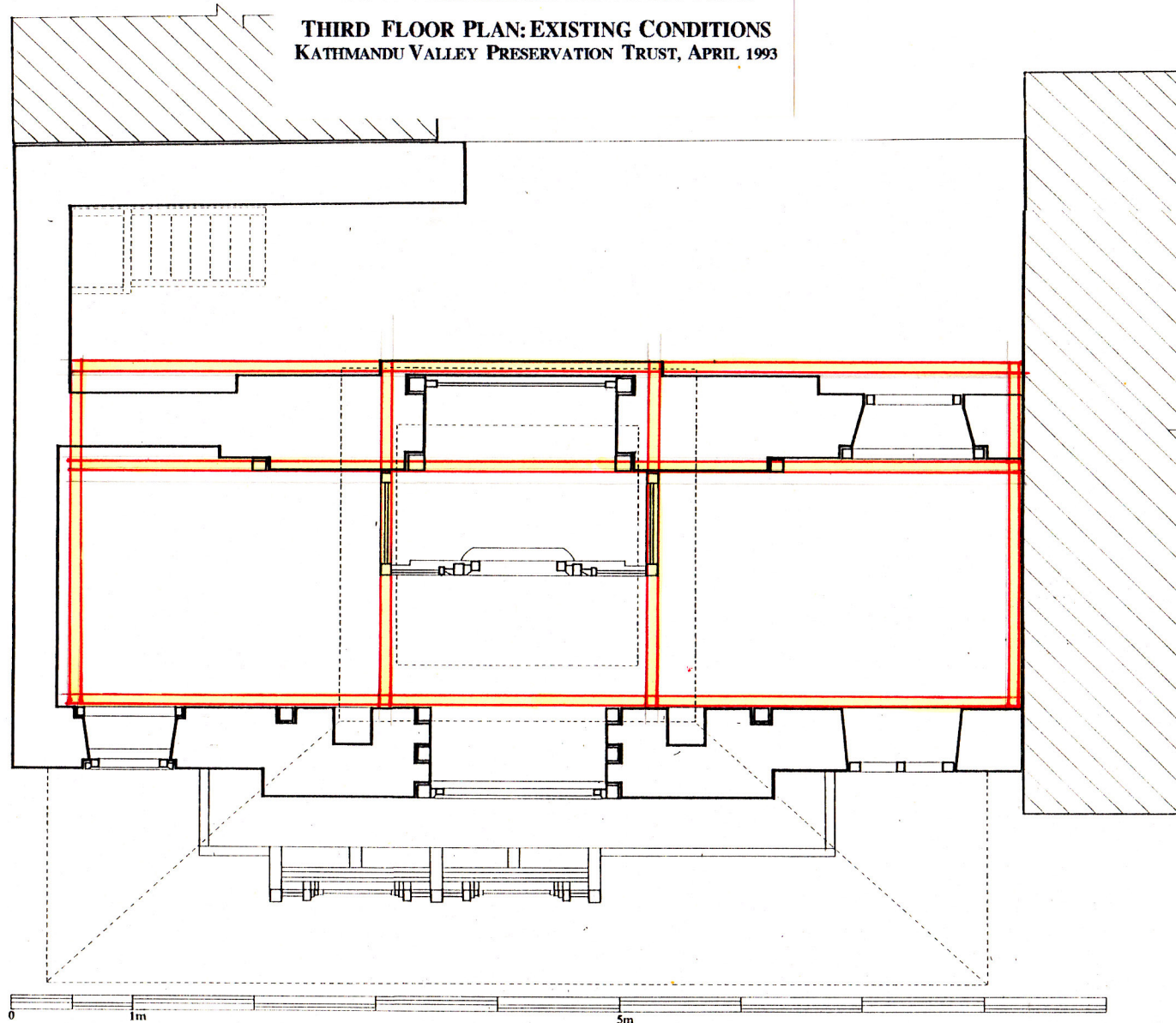
PATUKVA AGAM
 PATUKVA TOL, PATAN
 UNESCO WORLD HERITAGE SITE MONUMENT ZONE
FIRST FLOOR PLAN: EXISTING CONDITIONS
 KATHMANDU VALLEY PRESERVATION TRUST, APRIL 1993



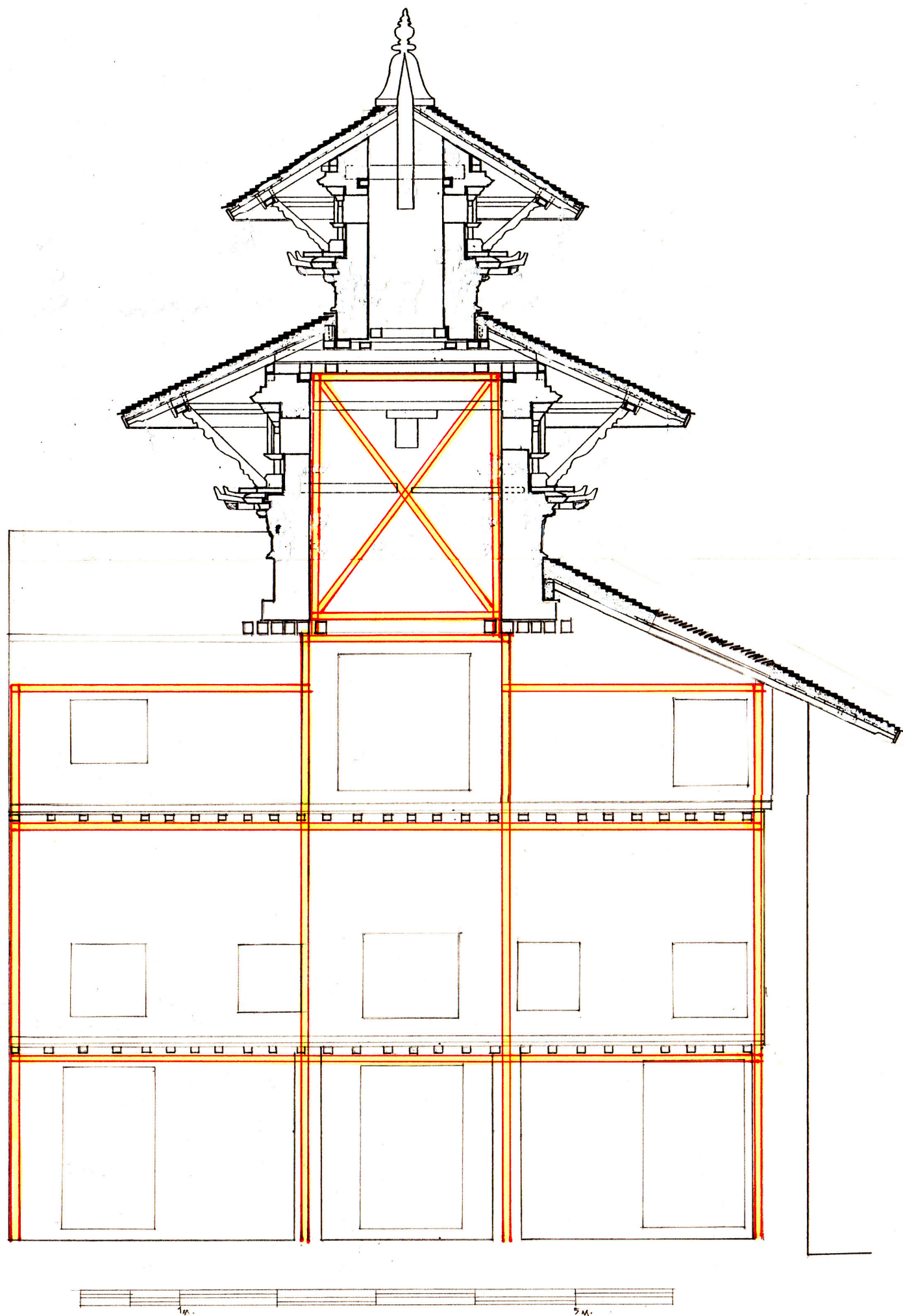
PATUKVA AGAM
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 UNESCO WORLD HERITAGE SITE MONUMENT ZONE
GROUND FLOOR PLAN: EXISTING CONDITIONS
 KATHMANDU VALLEY PRESERVATION TRUST, APRIL 1993



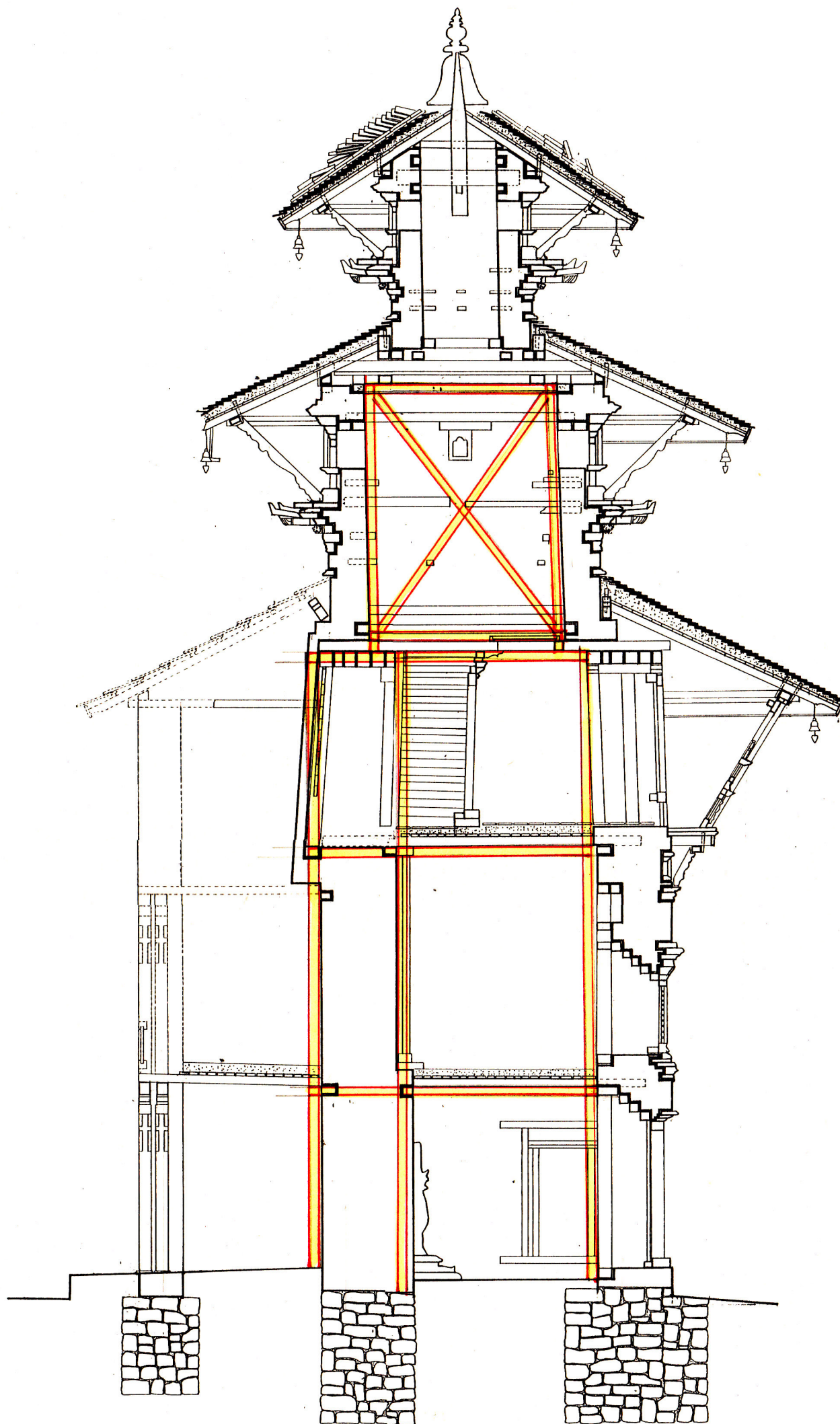
PATUKVA AGAM
 PATUKVA TOL, PATAN
 UNESCO WORLD HERITAGE SITE MONUMENT ZONE
THIRD FLOOR PLAN: EXISTING CONDITIONS
 KATHMANDU VALLEY PRESERVATION TRUST, APRIL 1993



PATUKVA AGAM
 PATUKVA TOL, PATAN
 UNESCO WORLD HERITAGE SITE MONUMENT ZONE
SECOND FLOOR PLAN: EXISTING CONDITIONS
 KATHMANDU VALLEY PRESERVATION TRUST, APRIL 1993



PATUKVA AGAM
 PATUKVA TOL, PATAN
 UNESCO WORLD HERITAGE SITE MONUMENT ZONE
 NORTH-SOUTH SECTION: EXISTING CONDITIONS
 KATHMANDU VALLEY PRESERVATION TRUST, APRIL 1993



0 1m 5m

PATUKVA AGAM
 PATUKVA TOL, PATAN
 UNESCO WORLD HERITAGE SITE MONUMENT ZONE
WEST - EAST SECTION: EXISTING CONDITIONS
 KATHMANDU VALLEY PRESERVATION TRUST, APRIL 1993

APPENDIX C

STRUT INVENTORY

BOTTOM ROOF

STRUT: 101

ELEVATION: EAST

AGE: 19th century ?

MAIN FIGURE:

Ganesh (Male): with six hands.

PEDESTAL: Lotus + two rats

MUDRA: Crossed leg standing

CONDITION:

- Structural condition good
- Three hands are lost

BASE SCENE:

- copulating couple



BOTTOM ROOF

STRUT: 102

ELEVATION: EAST

AGE: 19 century ?

MAIN FIGURE:

Varaha (Male): with eight hands

PEDESTAL: Lotus + Unknown animal

MUDRA: Standing

CONDITION:

- Structural condition good
- All hands are lost

BASE SCENE:

- Copulating couple



BOTTOM ROOF
STRUT: 103
ELEVATION: EAST
AGE: 19th century ?

MAIN FIGURE:
Narasimha (Male): with eight hands

PEDESTAL: lotus

MUDRA: Demon killing with two hands

CONDITION:
- structural condition good
- Four hands are lost

BASE SCENE
- copulating couple



BOTTOM ROOF
STRUT: 104
ELEVATION: EAST
AGE: 19th century

MAIN FIGURE:
Kumana (Male): with eight hands

PEDESTAL: lotus + Unknown animal

MUDRA: standing

CONDITION:
- structural condition good
- All hands are lost

BASE SCENE
- copulating couple



BOTTOM ROOF

STRUT: 106

ELEVATION: SOUTH

AGE: 19th century ?

MAIN FIGURE:

Female figure with four hands

PEDESTAL: Burning corpse

MUDRA: standing

CONDITION:

- structural condition good
- All hands are lost
- Mildew problems on face, partially on chest and back dripping

BASE SCENE:

- Copulating couple



BOTTOM ROOF

STRUT: 107

ELEVATION: SOUTH

AGE: 19th century ?

MAIN FIGURE:

Female figure with four hands.

PEDESTAL: lotus and deer

MUDRA: standing

CONDITION:

- structural condition good
- All hands are lost

BASE SCENE:

- copulating couple



BOTTOM ROOF

STRUT: 108

ELEVATION: SOUTH

AGE: 19th century ?

MAIN FIGURE:

Female figure with four hands

PEDESTAL: Lotus

MUDRA: crossed leg standing

CONDITION:

- structural condition good
- Mildew problem on face and back dripping
- 1/4 Part of right side of strut damaged by wetrot.



BOTTOM ROOF

STRUT: 109

ELEVATION: SOUTH

AGE: 19th century

MAIN FIGURE:

Female figure with two hands and holding two children in two hands

PEDESTAL: Burning corpse

MUDRA: standing

CONDITION:

- structural condition excellent
- Mildew problem on face
-



BOTTOM ROOF
 STRUT: 111
 ELEVATION: WEST
 AGE: 19th century ?

MAIN FIGURE:

Female figure with two hands,
 holding naga and windu in two hands

PEDESTAL: Burning corpse

MUDRA: standing

CONDITION:

- structural condition excellent
- seasoning crack on main body



BOTTOM ROOF
 STRUT: 112
 ELEVATION: WEST
 AGE: 19th century ?

MAIN FIGURE:

Female figure with two hands,
 holding kapala and patra in two hands

PEDESTAL: Burning corpse

MUDRA: standing

CONDITION:

- structural condition good
- Moldow problem above head
 app. 95. in.



BOTTOM ROOF

STRUT: 113

ELEVATION: WEST

AGE: 19th century ?

MAIN FIGURE:

Female figure with four hands, holding hammer, bajra, pasah and camara.

PEDESTAL: Lotus

MUDRA: standing

CONDITION:

- structural condition good
- wet rot damage on upper part of strut.



BOTTOM ROOF

STRUT: 114

ELEVATION: WEST

AGE: 19th century ?

MAIN FIGURE:

Byaghrini (Female) with four hands holding damaru, trident, vajra and patra (water jar)

PEDESTAL: Human figure, lotus on lion

MUDRA: standing

CONDITION:

- structural condition good



BOTTOM ROOF

STRUT: 116

ELEVATION: NORTH

AGE: 19th century ?

MAIN FIGURE:

Female figure with two hands,
holding vanada and jal (net)

PEDESTAL: Peacock

MUDRA: standing

CONDITION:

- structural condition good.



BOTTOM ROOF

STRUT: 117

ELEVATION: NORTH

AGE: 19th century ?

MAIN FIGURE:

Female figure with four hands,
holding stick and jal (net)

PEDESTAL: Burning corpse

MUDRA: standing

CONDITION:

- structural condition good.



BOTTOM ROOF

STRUT: 118

ELEVATION: NORTH

AGE: 19th century ?

MAIN FIGURE:

Narayana (Male): with four hands holding calra (discuss), gada (mace), padma (seed) and Sankha (conch)

PEDESTAL: garuda.

MUDRA: standing

CONDITION:

- structural condition good
- Top 3" and 1/3 part of right side of strut is damaged due to wet rot.



BOTTOM ROOF

STRUT: 119

ELEVATION: NORTH

AGE: 19th century ?

MAIN FIGURE:

Female figure with four hands, holding varanga, trident, abhaya and kamandalu (water jar)

PEDESTAL: lotus and sheep

MUDRA: standing

CONDITION:

- structural condition is o.k.
- Top right side (2"X6") damaged by wet rot.



BOTTOM ROOF

STRUT: 105, 110, 115, 120

ELEVATION:

AGE: 19th Century.

MAIN FIGURE:

Kusalaha. (corner horse)

PEDESTAL: -

MUDRA: -

CONDITION:

- All four corner horses are in excellent condition.



UPPER ROOF
STRUT: 201
ELEVATION: EAST
AGE:

MAIN FIGURE:

..... ? with four hands.

PEDESTAL: lotus.

MUDRA: standing

CONDITION:



UPPER ROOF
STRUT: 202
ELEVATION: EAST
AGE:

MAIN FIGURE:

..... ? with four hands

PEDESTAL: lotus

MUDRA: standing

CONDITION:

UPPER ROOF
STRUT: 204
ELEVATION: SOUTH
AGE:

MAIN FIGURE:

female figure with four hands
holding sword, mace, vajra
and.....?

PEDESTAL: Tiger

MUDRA:

CONDITION:



UPPER ROOF
STRUT: 205
ELEVATION: SOUTH
AGE:

MAIN FIGURE:

female figure with four hands,
holding mace (?), book, abhaya mudra
and vajra (?)

PEDESTAL:

MUDRA:

CONDITION:



UPPER ROOF
STRUT: 207
ELEVATION: WEST
AGE:

MAIN FIGURE:
*Sarasvati: with two hands
holding vina by both hands*

PEDESTAL: lotus

MUDRA: standing

CONDITION:



UPPER ROOF
STRUT: 208
ELEVATION: WEST
AGE:

MAIN FIGURE:
Female figure with four hands

PEDESTAL: lotus and horse

MUDRA: crossed leg standing

CONDITION:



UPPER ROOF
STRUT: 210
ELEVATION: NORTH
AGE:

MAIN FIGURE:

Female figure with two hands,
holding patra and camara (yak
tail)

PEDESTAL: lotus and kalasa.

MUDRA:

CONDITION:



UPPER ROOF
STRUT: 211
ELEVATION: NORTH
AGE:

MAIN FIGURE:

Female figure with two hands,
holding jewel, flower, stick and
patra.

PEDESTAL: lotus

MUDRA:

CONDITION:



UPPER ROOF

STRUT: 203, 206, 209, 212

ELEVATION:

AGE:

MAIN FIGURE:

Kusalah (Corner horse)

PEDESTAL:

MUDRA:

CONDITION:



APPENDIX D
THE RAJOPADHYA OF PATAN

The Rajopadhyayas of Patan

Notes by Nutan Sharm after field work in March 1993.

The Rajopadhyayas of Patan

All Rajopadhyayas who are originally from Patan have Garga Gotra. The Gotra refers to the great saintly sage from whom the descent is spread over.

According to Mahabharata, Garga was the priest during the naming ceremony of Lord Krsna, when Krsna was born. "Krsna" this name was given by Garga Rshi.

These Rajopadhyayas are divided into six clans and closely associated with Agnimatha at Thabuti. During the fire sacrificial ceremony at Agnimatha each representative of the four clans of them have to recite each of the four Vedas, and two have to act as the priest and the client. But as the Sundhara clan became legitimately issueless, the ritual participation has slightly changed.

The Patukva Kavah is considered as a branch of Bakanimha clan. Once this Patukva Kavah became issueless. So the issueless Brahmin adopted a boy who has Bharadvaja Gotra (who was originally connected with Bhaktapur). Since Vratibandha initiation of the boy was already made, the Gotra was not possible to change. So Patukva Kavah has Bharadvaja Gotra. The Rajopadhyaya family who is residing near Yanamula is also shifted from Bhaktapur to stay there. They have also Bharadvaja Gotra. (The Gotra of the Rajopadhyaya of Kathmandu is Kausika.)

APPENDIX E
FUNDING PROPOSAL, AUGUST, 1993

Contents

Introduction.....	page 1
Project justification.....	page 3
Training goals	page 5
Implementation schedule.....	page 6
Construction costs.....	page 7
Local project costs.....	page 9
Total project expenses.....	page 10
Existing conditions and proposed restoration works.....	page 11
Documentation drawings.....	page 16

Introduction

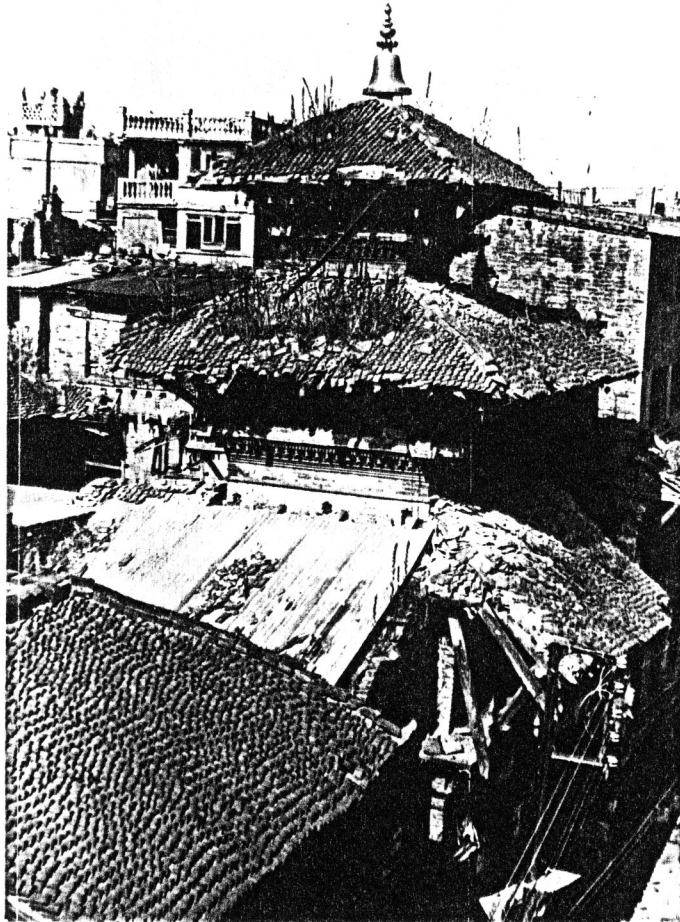
The Kathmandu Valley Preservation Trust, in cooperation with His Majesty's Government Department of Archaeology, proposes to restore the Patukva Agache, a fine 17th century religious structure, in the Patan Darbar World Heritage Site Monument Zone. Following a survey of the monuments in and adjacent to the Patan World Heritage Site, in consultation with the Department of Archaeology and the Patan Conservation and Development Program, the Trust has determined this historical structure to be the most threatened monument of significant historical and artistic value in the area and one whose repair and restoration budget corresponds to the ODA funding limits.

The entire structure of the five storey building is either damaged or endangered: lower portions of the central and rear bearing walls of the structure have deteriorated to make the collapse of the upper stories imminent. The late 17th century religious building is of the highest artistic and historical value: despite structural problems, it retains virtually all of its historical detail and has been little changed over the centuries. It most notably retains all but two of its original woodcarvings--windows, doors and struts--on the principal facade and upper stories, fine examples of the artistic achievements of the Malla period (1400-1780).

This Hindu *agache* (Newari: house *che* of the esoteric shrine *agam*) represents a building type unique to Nepal: a religious building composed of a pagoda type temple, in this case two-tiered, perched atop a three storey base structure, whose form resembles a local residential building. Both Buddhist and Hindu *agache* are found in the Kathmandu Valley, yet it is only among the Hindu *agache* that one finds this intriguing composite structure. The Patkva Agache project will be the first internationally aided restoration of a Hindu *agache* in Nepal and will provide the opportunity to gather long overdue research on this building type. Several such historical structures in Patan alone have disappeared in the last decade.

The *agache* houses shrines and gathering spaces on several levels for use by the religious organization (*guthi*) comprised of some 40 neighboring families. The five storey building, sited on the corner of two small lanes just west of the Darbar Square, defines to its rear one side of a residential courtyard belonging to members of the *guthi*.. Negotiations with the *guthi* have demonstrated their support for the project and willingness to contribute funds and services to the restoration project.

The Kathmandu Valley Preservation Trust has developed expertise and trained local professionals in the restoration of monuments of similar size, age, and construction techniques through work on the nearby Uma Maheswar and Radha Krishna temples in cooperation with the Department of Archaeology. Both of these projects will be completed in the next two months.



Patukva Agache

Spring 1992. View from southeast showing the rebuilt south facade and metal roof over the southern portion of the building.

Project justification

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. Patan is a city on the edge, a city whose rich artistic and architectural heritage is threatened daily by the pressures of development and the rapidly deteriorating condition of its monuments. The restoration of Patukva Agam 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 the ongoing German-aided Patan Conservation and Development Programme and the restoration projects (implemented by the Kathmandu Valley Preservation Trust) of nearby Uma Maheswar and Radha Krishna temples, funded by the British Ambassador's Small Projects Scheme and the Canada Fund, respectively, will focus local and international attention on the urgency of preservation efforts in Patan.

Moreover, as the Patan Conservation and Development Programme has identified, there exists a tremendous gap in the provisions for maintenance, protection, and restoration of monuments which fall under the semi-private ownership of religious trusts (*guthis*). With the degeneration of the historical *guthi* system in the last decades, scores of significant monuments have become threatened as they do not come under the direct jurisdiction of the national agency responsible for conservation of monuments, His Majesty's Government Department of Archaeology. The Department of Archaeology in cooperation with the Patan Conservation and Development Programme, has proposed to designate many of these buildings "National Monuments" and to establish the legal framework to monitor and provide technical and financial support for their maintenance. This proposal naturally includes the fine Patukva Agache. International financial assistance for the restoration of such a monument would therefore establish a critical and necessary precedent for the preservation of the semi-private architectural heritage of Nepal.

Technically, the Patukva Agache lies within the Patan Darbar World Heritage Site Monument Zone, but as the Patan Programme has discovered, the UNESCO delineation of the Monument Zone has been misinterpreted, meriting immediate attention. The gazetted legal boundary, according to His Majesty's Government Ancient Monuments Act, follows the centerlines of streets in the vicinity of the Darbar Square yet includes "all adjacent

buildings". In practice, however, only those buildings closest to the Darbar Square, i.e. on one side of the street, have been monitored. Thus, the restoration of the Patukva Agache, which lies on the side of the street away from the Darbar Square, will help to cement the legal boundary of the World Heritage Site.

Lastly, a monument has been chosen which will allow the Overseas Development Administration funding to mobilize additional contributions. The Trust has recently proven its ability to rally local support for conservation, having raised some U.S. \$10,000 through a local benefit for small-scale emergency repairs to monuments. (From this money protective tarpaulins were supplied to the Patukva Agache in June to prevent additional water damage to the timber structure during monsoon rains.) Moreover, the Trust has raised money internationally to allow completion of the Radha Krishna temple restoration project, whose principal funding by the Canadian government necessitated additional fundraising. The funds necessary to allow project completion of the Patukva Agache, that is, in addition to the O.D.A. contribution, will thus be secured by the Trust from local and international contributors. The Patukva Agache guthi and the Patan Conservation and Development Programme have agreed to contribute in preliminary discussions.

Training goals

The Kathmandu Valley Preservation Trust is committed to the training of local specialists and artisans in both the public and private sectors to preserve Nepal's architectural heritage. Although the Trust works in close cooperation with the Department of Archaeology, in these early years work on small-scale emergency projects has been most effectively executed on a turn-key basis, with training efforts focused on private sector professionals. Such private sector professionals are a frequently overlooked, yet key resource for conservation efforts in a country where government bureaucracy is often inefficient or unpredictable. Thus, while longterm training efforts address the technical and manpower needs of the Department of Archaeology, immediate efforts focus on a team of private sector Nepalese including architects, structural engineers, and draftsmen. This team has been involved at all levels of planning and implementation of projects working closely with the Trust's project officer and conservation architect. Moreover, critical training of and financial support to local traditional artisans--carpenters, woodcarvers, masons, blacksmiths and tile-layers-- is involved in all projects undertaken by the Trust. The Patukva Agache restoration project will continue such efforts.

In addition, during the restoration project on-site training seminars addressing locally relevant technical issues such as the seismic consolidation of historical structures, methods of timber reconsolidation, and restoration project management will be offered to the staff of the Department of Archaeology and local professionals.

Implementation schedule

Fall 1992

Preparation of the historic structures report .

Design and implementation of fund-raising campaign

Spring-Fall 1993

The construction falls logically into two phases: the critical repair, rebuilding, and consolidation of the lower three storeys, executed March 1993-November 1993, will allow construction of upper-level scaffolding for execution of the less urgent work on the pagoda superstructure in a subsequent period .

Fall 1993-Spring 1994

Restoration of pagoda superstructure November 1993 - June 1994.

June 1994

Completion of project. Preparation of project report.

Construction costs

<u>Description</u>	<u>Cost of materials and labor</u>
(Refer attached quantities estimate)	(NRps.)
1. Dismantling of damaged structure and temporary shoring up L.S.	35,000
2. Site clearance (project duration)	55,000
3. Scaffolding	138,000
4. Masonry reconstruction (Quantities item 1) 3,000 cu.ft.@ 55 NRp/cu.ft.	165,000
5. Allowance for structural improvement of foundation	75,000
6. Insertion of dampproofing course in existing walls (Quantities item 5)	61,000
7. Facade veneer brick (Quantities item 4) 180 sq ft @ 90 NRp/sq ft	16,200
8. Plinth stone pavement (Quantities item 2) 20 cu.ft.@ 350 NRp/ cu.ft.	7,000
9. Structural timber reconstruction (Quantities item 8) 413 cu.ft.@ 1300 NRp./cu.ft.	536,900
10. Roof planking (Quantities item 9) 1832 sq.ft.@ 85 NRp./sq.ft.	155,720
11. Roofing tarfelt (Quantities item 9) 1832 sq.ft.@ 45 NRp./sq.ft.	82,440
12. Roof tile, mud, and battens (Quantities item 9) 1832 sq.ft. @ 35 NRp/sq.ft.	64,120
13. Anti-vegetal treatment of roof mud	38,000
14. Roof ridge tile 120 lin.ft.@ 100 NRp./lin.ft.	12,000
15. Aviary roof corner tiles 12 pieces @ 200 NRp.	2,400
16. Exterior doors and windows (Quantities item 12)	173,300
17. Structural consolidation (Quantities items 6,7)	350,000
18. Interior floor planking (Quantities item 11) 955 sq.ft.@ 85 NRp./sq.ft.	81,175
19. Interior telia tile paving (Quantities item 11) 955 sq.ft.@ 30 NRp./sq.ft.	28,650

Construction costs (continued)

<u>Description</u>	<u>Cost of materials and labor</u> (NRps.)
20. Interior doors and fittings (Quantities item 10)	55,000
21. Electrical wiring	30,000
22. Toilet/bath	10,000
23. Replacement of eave bells 85 pieces @ 250 NRp.	21,250
24. Cleaning/repointing of facade	25,000
25. Cleaning/repair of timber facade elements	30,000
26. Preservative/chemical treatment of woodcarvings	<u>50,000</u>
Construction subtotal	2,300,155
15% contingency for restoration work	345,000
12% allowance for inflation	<u>276,000</u>
Total construction costs	2,921,155

Local project costs

<u>Description</u>	<u>Cost (NRps.)</u>
<u>Miscellaneous</u>	
Allowance for temporary relocation/insulation of high tension electrical lines to allow construction	75,000
<u>Local technical support</u>	
Consulting engineer	35,000
Site architects 16 months @ 10,000/mo	160,000
Draftsmen	48,000
Conservation consultant	25,000
<u>Administrative costs</u>	
Bookkeeper 16 months @ 3,000/mo	48,000
Office assistant	24,000
<u>Documentation</u>	
Photographic survey	35,000
Photocopy, blueprints	20,000
<u>Office expenses</u>	
Transportation	12,000
Rent and utilities: site office	32,000
Stationery	10,000
Office equipment	<u>25,000</u>
Total local project expenses	539,000

Total project expenses

Total local project expenses (from previous page)	539,000
Total construction costs (from previous page)	<u>2,921,155</u>
Total local costs	3,460,155 NRp
Coordination by Kathmandu Valley Preservation Trust including provision of international architectural restoration and structural design foreign experts @ 22% of local costs	<u>762,000</u> NRp*
Total	4,222,155 NRp

* payable in convertible currency



Patukva Agache

Rear (west elevation) spring 1992

The photograph shows the courtyard facade several months before its collapse.

Existing conditions and proposal for repair and restoration

1.0 Masonry structure

Existing conditions

The most dramatic damage to the structure consists of the collapse of the middle and rear bearing masonry walls of the lower structure, the bottom three storeys. As is the case with all historical buildings in Nepal, the roof cover proves the Achille's heel of traditional construction technology. It appears the tile and mud roof cover above these walls, the west side of the bottom roof, deteriorated seven years ago, and in this short time, precipitated the deterioration and subsequent collapse of the timber roof structure and masonry walls below. The upper temple-like two floors of the building thus perch on a beam supported by the remnants of these walls.

The masonry construction consists of an interior bearing wall of common brick, an intermediate fill, and an outer veneer brick. The masonry walls of the principal facade and the entire two storey superstructure are in good condition. One diagonal crack in the principal facade is the only visible defect in addition to spalling of the lower courses of brick (approximately 5' high), caused by the traditional lack of dampproofing. Both the principal facade and the superstructure otherwise retain all of the historical veneer brick, *dachi apa*, in excellent condition.

The south facade of the building was rebuilt 14 years ago in common brick laid in mud. No structural defects are visible, but the quality of workmanship is poor.

The foundations of the building are of typical unhewn stone laid in mud: the foundation is visible on the principle facade where the plinth has been removed. There are no signs of major settlement of the building. The building was not damaged in the great earthquake of 1934 according to *guthi* elders.

Repair and restoration

After shoring up of the structure to allow access to the building, complete photographic and measured visual and structural surveys of the building will be undertaken. Review of the structure by an internationally recognized seismic engineer will determine how reconstructed portions of the masonry structure can incorporate appropriate seismic reinforcement as well as how historically intact portions of the building can be strengthened.

The collapse walls will be rebuilt in historical materials and details with concealed seismic and dampproofing provisions. A dampproof course will be inserted in all extant walls.

Further investigation of the structural integrity of the 14 year old south facade will determine if it should be rebuilt.

2.0 Timber roof structure

Existing conditions

The three remaining roofs may perhaps be described as what the collapsed portion of the roof looked like at the beginning of its cycle of deterioration. Many small holes in the tile and mud cover have introduced wet rot to portions of the timber structure below, particularly at the ends of the rafters, many of which have broken off. The timber roof structure consists primarily of a local species of yellow pine which deteriorates very rapidly when unprotected from moisture. Work on similar projects has demonstrated that the extent of damage to the timber roof structure can only be determined when the planking, mud, and tile cover above have been removed. For purposes of cost estimation provision of all new timbers has been calculated as careful reconsolidation of the historical timbers (which will be reused to the greatest possible extent) is comparable in cost to new construction.

Repair and restoration

A survey of each individual timber component will determine which pieces can be re-used and how they must be consolidated and preserved. According to international standards the greatest possible amount of original building materials will be reused. Where new timbers are necessary, historically appropriate and extremely durable sal timber (*shorea robusta*) will be used.

3.0 Interior timber structure

Existing conditions

The interior timber structure cannot be examined at present as the entire building has been sealed off for safety reasons.

Repair and restoration

As the building is still used for the same purpose for which it was built some 300 years ago, the interior configuration and finishes will be maintained.

4.0 Roof cover

Existing conditions

The west portion of the bottom roof has collapsed.

The planking of the roof cover appears to be in very poor condition due to wet rot. The roof tiles are unbroken on the three remaining roofs, although many have been displaced by vegetal growth.

The south side of the bottom roof has been replaced with zinc sheets.

Repair and restoration

The introduction of two layers of tar felt sandwiched between layers of bitumen has proven a successful modification of the traditional construction methods to greatly increase the life of the tile and mud roofs. All intact roofs will be repaired and rebuilt in situ to assure maintenance of the historical form.

5.0 Timber openings

Existing conditions

Principal three storey facade:

One of three bays of the focal bay window (*san jhya*) on the second floor of the principal facade has been dismantled after collapse of the roof structure above. The dismantled components are in storage. 50% of these components were severely damaged by wet rot from water damage before dismantling. All components have been cleaned and stored by the guthi with technical assistance from the Kathmandu Valley Preservation Trust.

One ground floor door frame and one upper storey window have been replaced with inappropriate new elements. Otherwise the historical configuration of timber openings is intact and in fair condition. The northern ground floor door frame has been skewed some five inches from the vertical by wall movement, most likely the result of seismic activity. The latticed panels of the entry door blades have been broken and partly removed.

South facade:

This facade rebuilt fourteen years ago provides only a single door opening of historical appearance in good condition. An additional lintel at door height remains with no opening beneath.

Rear facade:

Only the timber arcade of the rear facade has survived the collapse of this wall, although buried beneath rubble it appears to be in poor condition.

Superstructure:

All of the window and niche openings of the superstructure are intact and in excellent condition.

Repair and restoration

Principal facade:

The openings of the principal facade will be restored to their historical appearance including (a) the repair, reconsolidation, and replacement of missing parts of the carved bay window by local woodcarvers and (b) the replacement of one unoriginal door and one window with elements reproducing historical detail.

South facade:

Further research will determine the historical configuration of the south facade.

Rear facade:

The historical openings will be rebuilt according to their historical appearance incorporating any re-usable components.

6.0 Roof struts

Existing conditions

Principal three storey facade:

The four historical struts have been lost.

South facade:

All struts were lost in this fourteen year old reconstruction.

Rear facade:

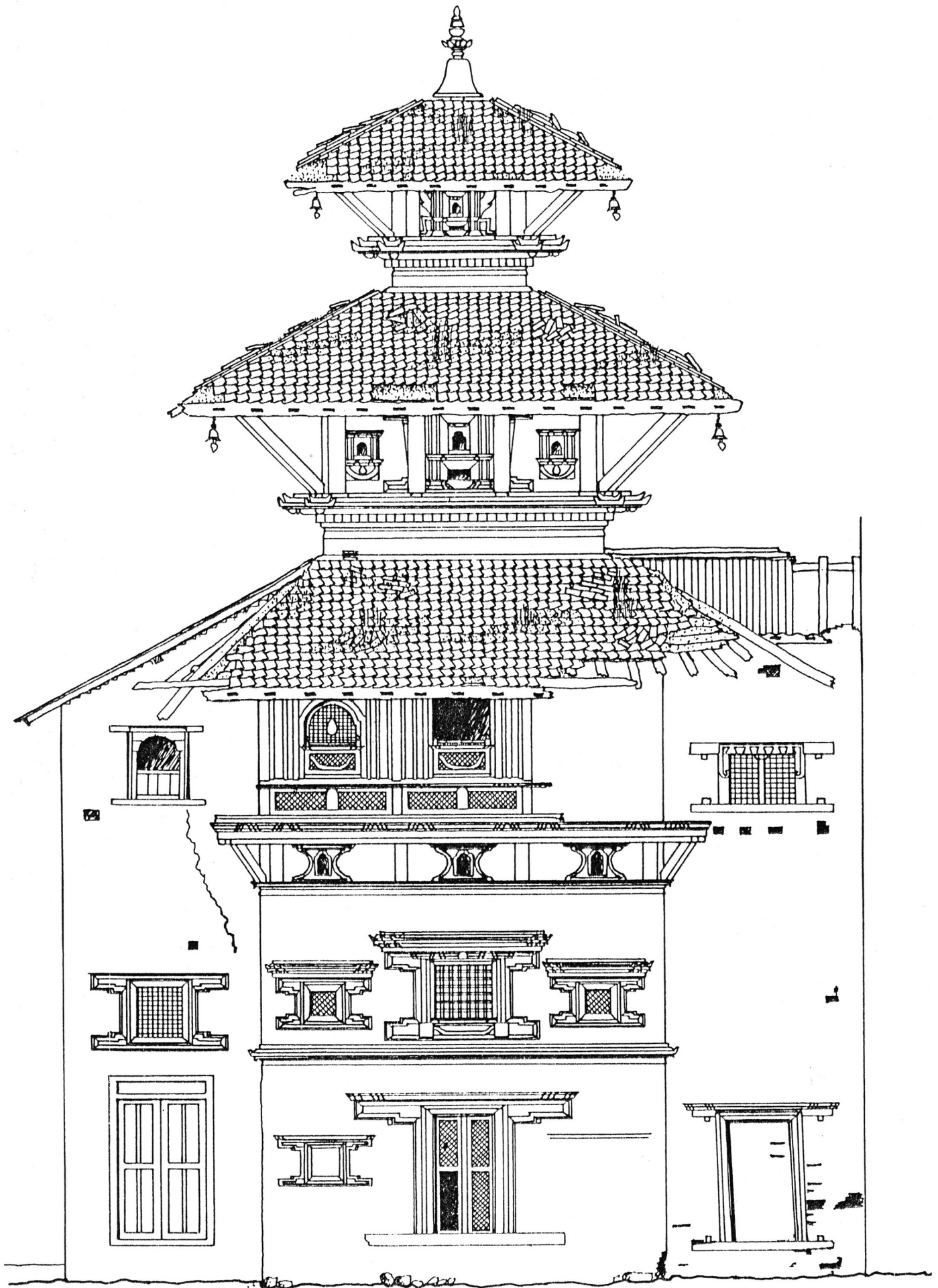
No struts in original configuration.

Superstructure:

All 28 struts are intact and in excellent condition. They depict tantric mothergoddesses (*Astramatrika*). The gilt pinnacle is intact and in excellent condition. About 50% of the historical bronze bells remain hung on the rafter ends.

Repair and restoration

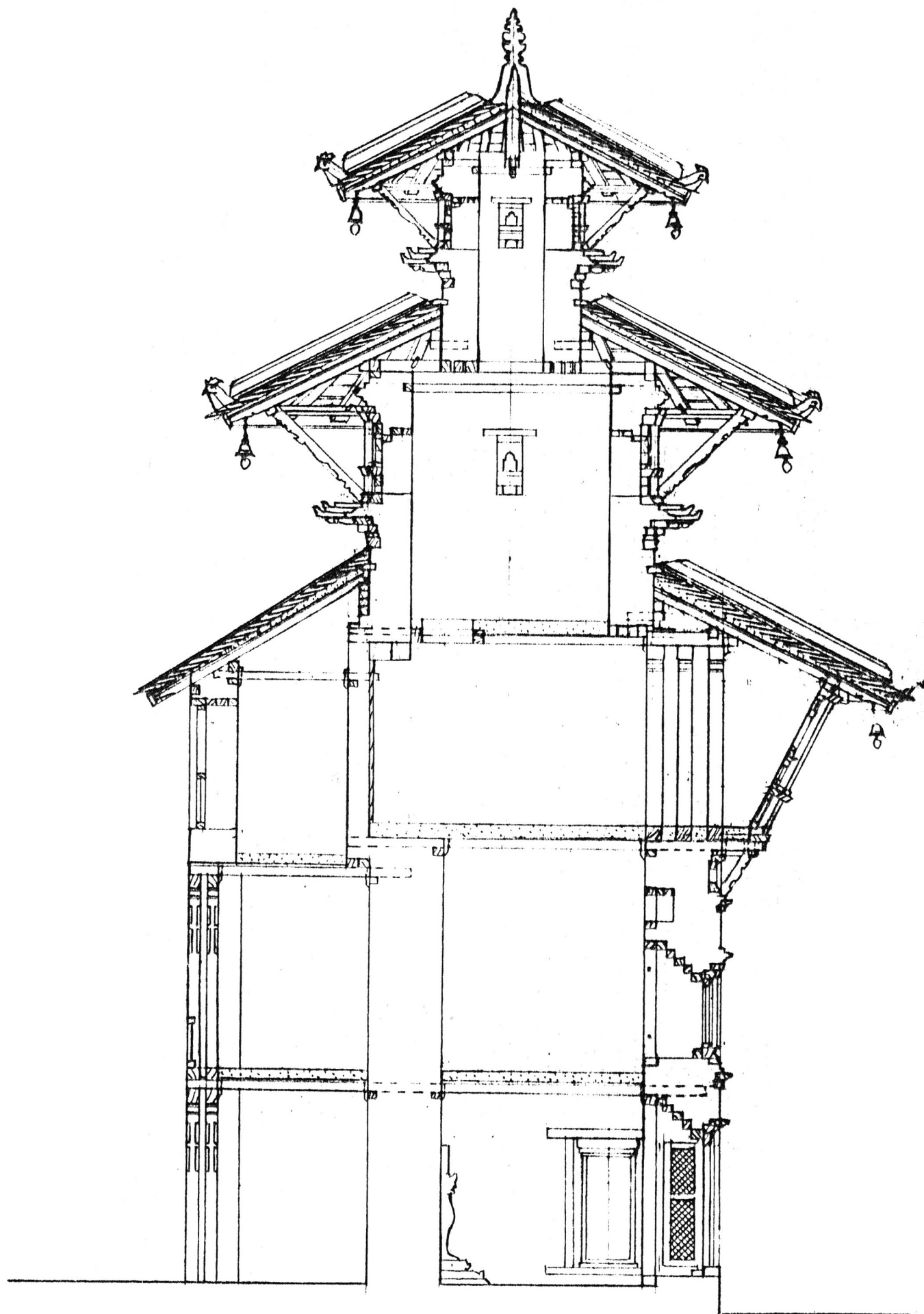
Principal and south facade struts will be replaced with plain timbers as their historical appearance is indeterminate. The struts of the superstructure will be carefully cleaned, and treated with wood preservative.



Patukva Agache (1690)

Principal elevation, existing conditions: scale 1:50

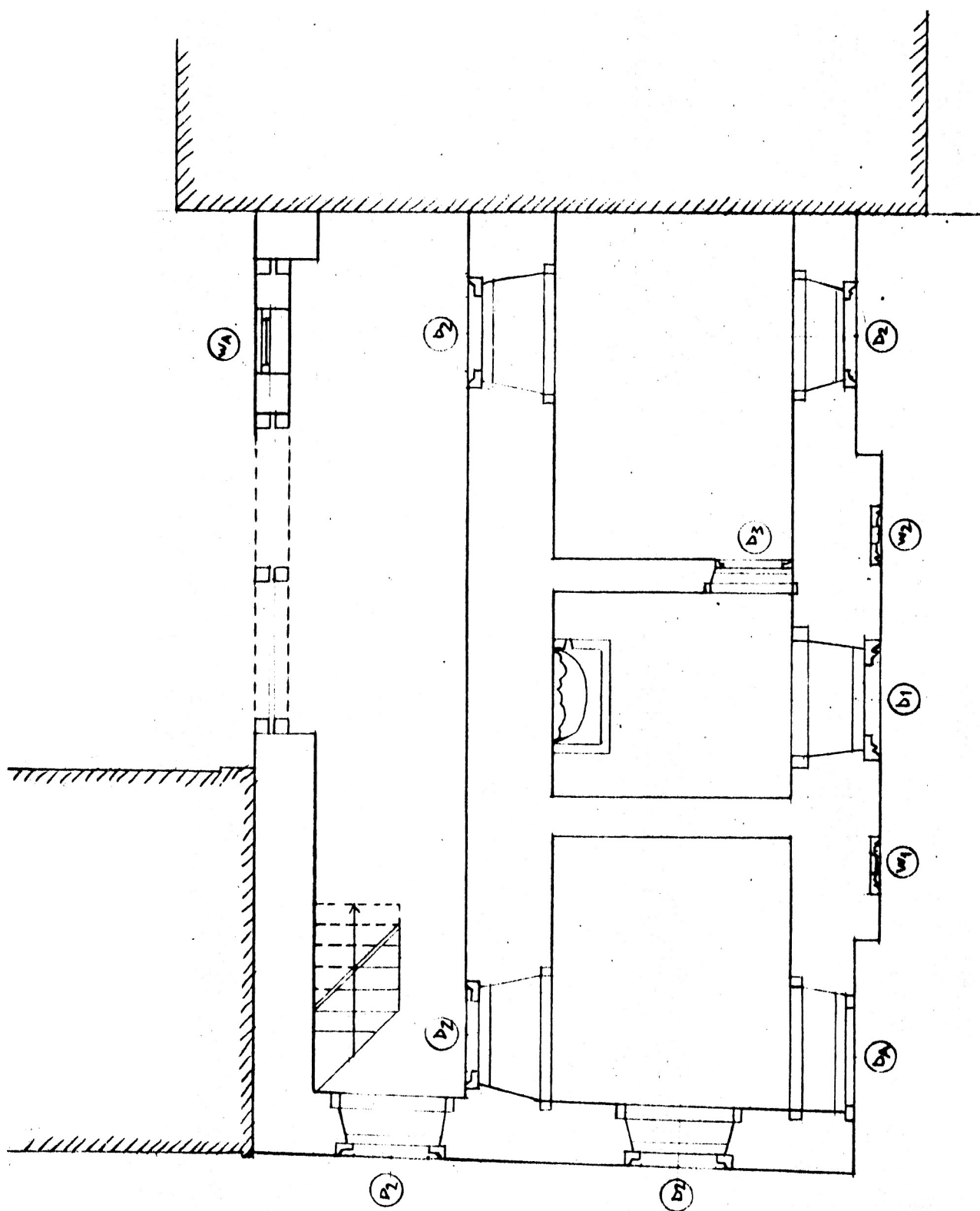
drawing by Gyanendra Joshi, courtesy of Patan Conservation and Development Programme



Patukya Agache (1690)

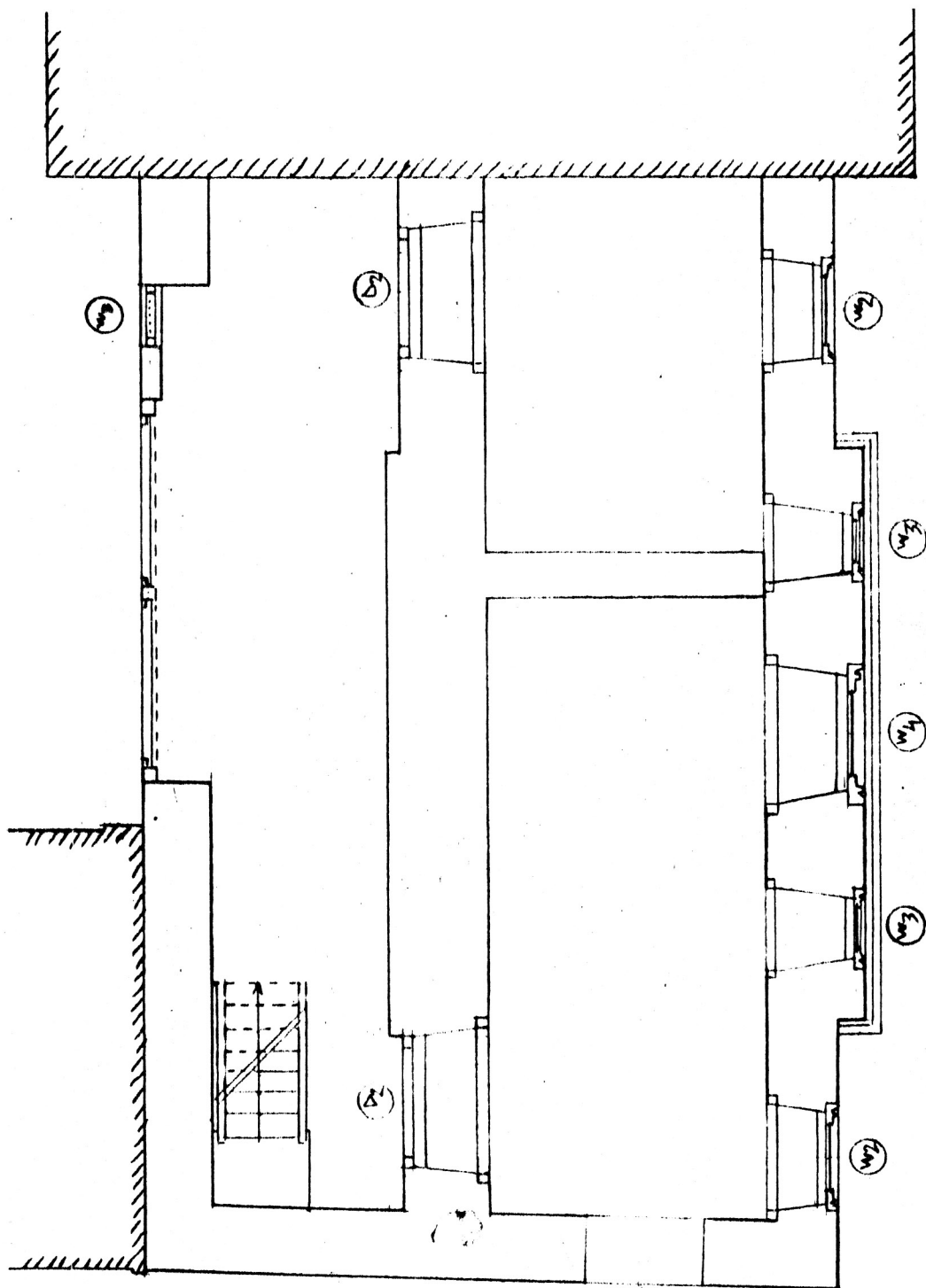
Historical east-west section: scale 1:50

drawing by Gyanendra Joshi, courtesy of Patan Conservation and Development Programme



Patukva Agache (1690)
Ground floor plan: scale 1:50

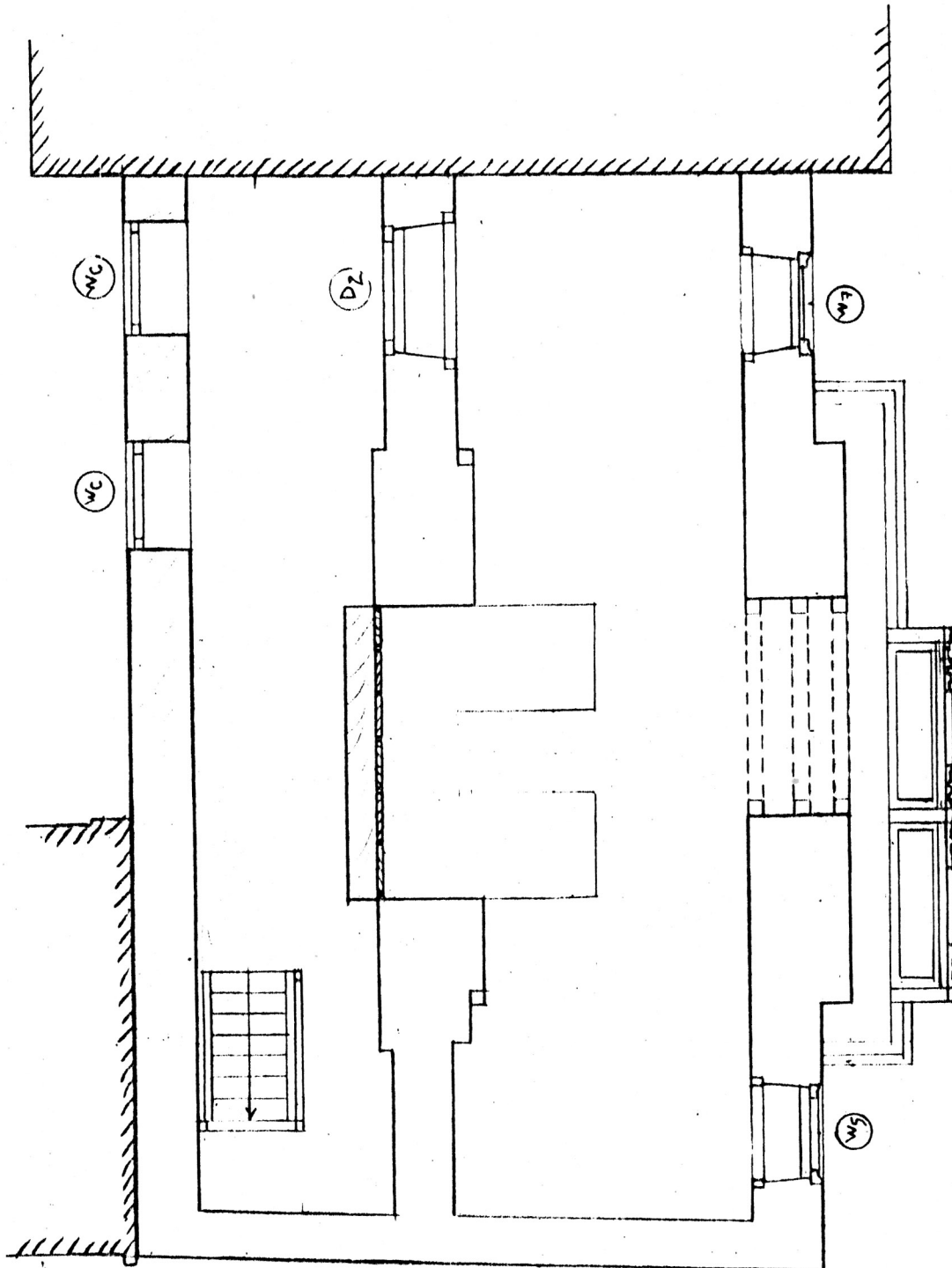
drawing by Gyanendra Joshi, courtesy of Patan Conservation and Development Programme



Patukva Agache (1690)

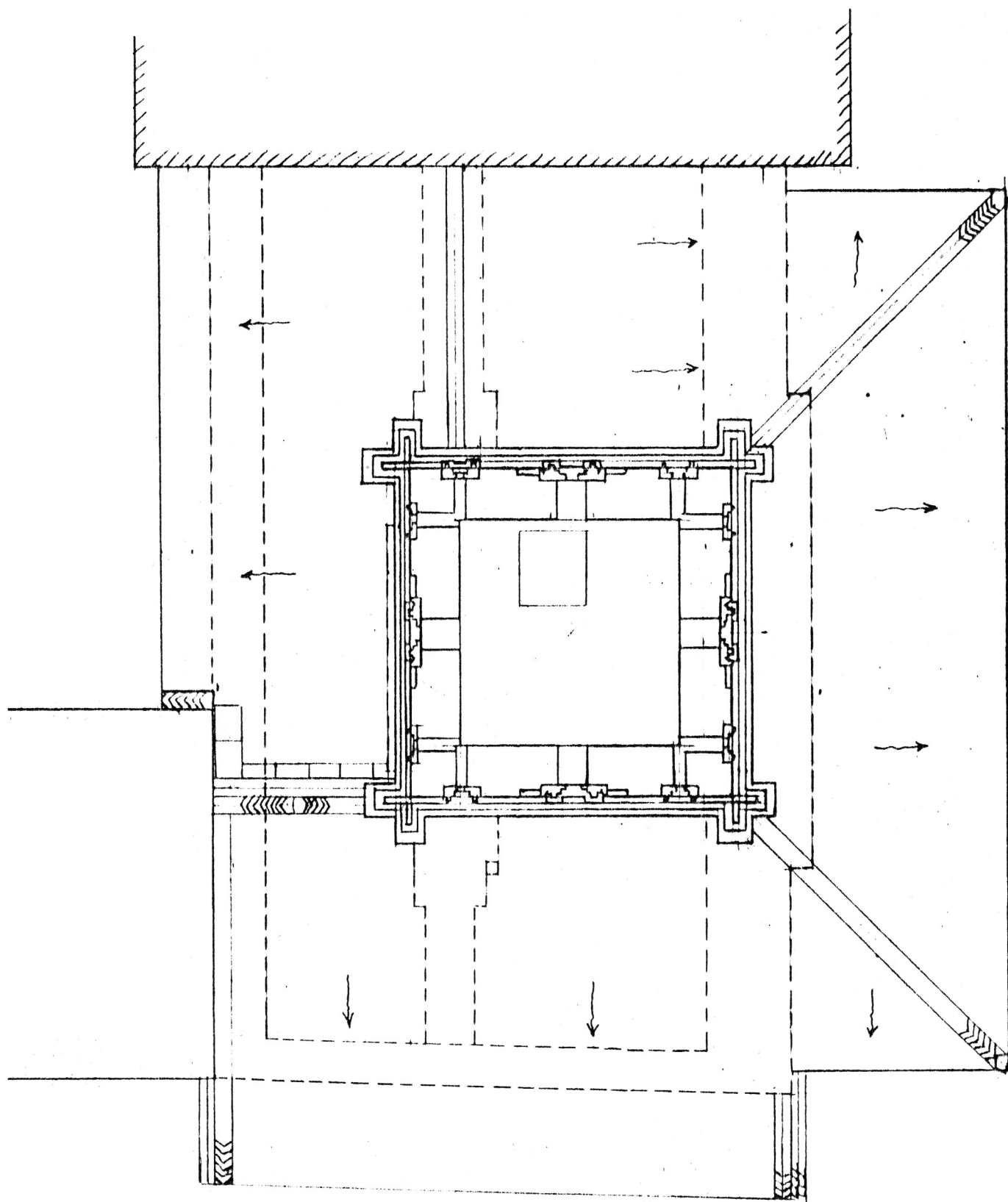
First floor plan: scale 1:50

drawing by Gyanendra Joshi, courtesy of Patan Conservation and Development Programme



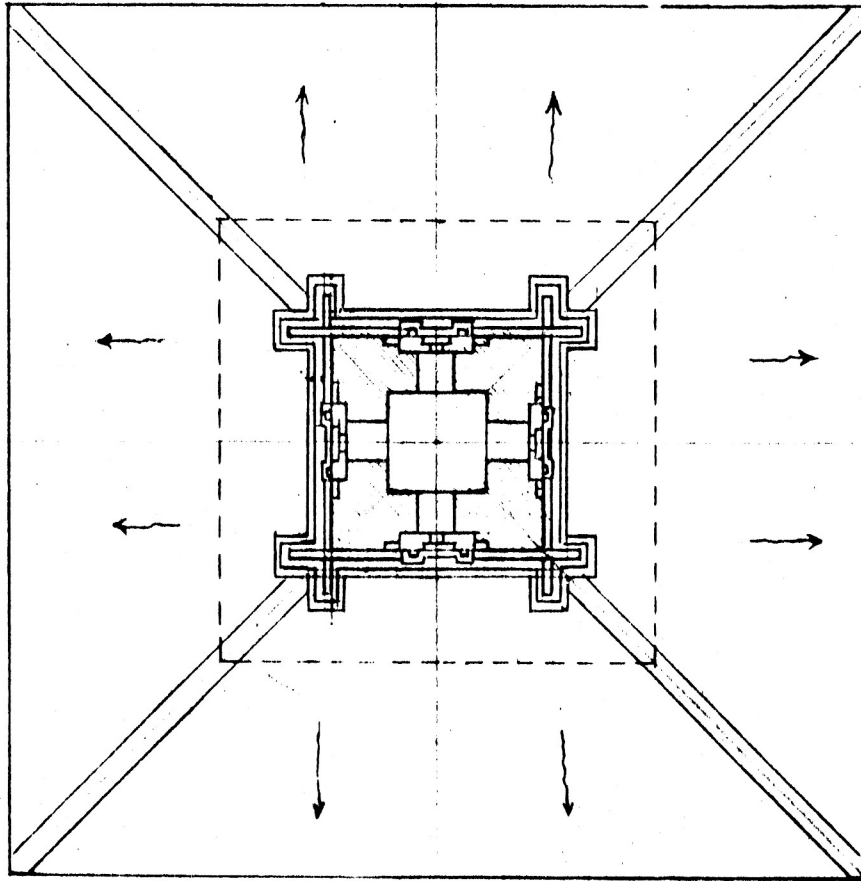
Patukva Agache (1690)
Second floor plan: scale 1:50

drawing by Gyanendra Joshi, courtesy of Patan Conservation and Development Programme



Patukya Agache (1690)

Plan of lower pagoda level showing bottom roof: scale 1:50
drawing by Gyanendra Joshi, courtesy of Patan Conservation and Development Programme



Patukya Agache (1690)

Plan of upper pagoda level showing middle roof: scale 1:50
drawing by Gyanendra Joshi, courtesy of Patan Conservation and Development Programme



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