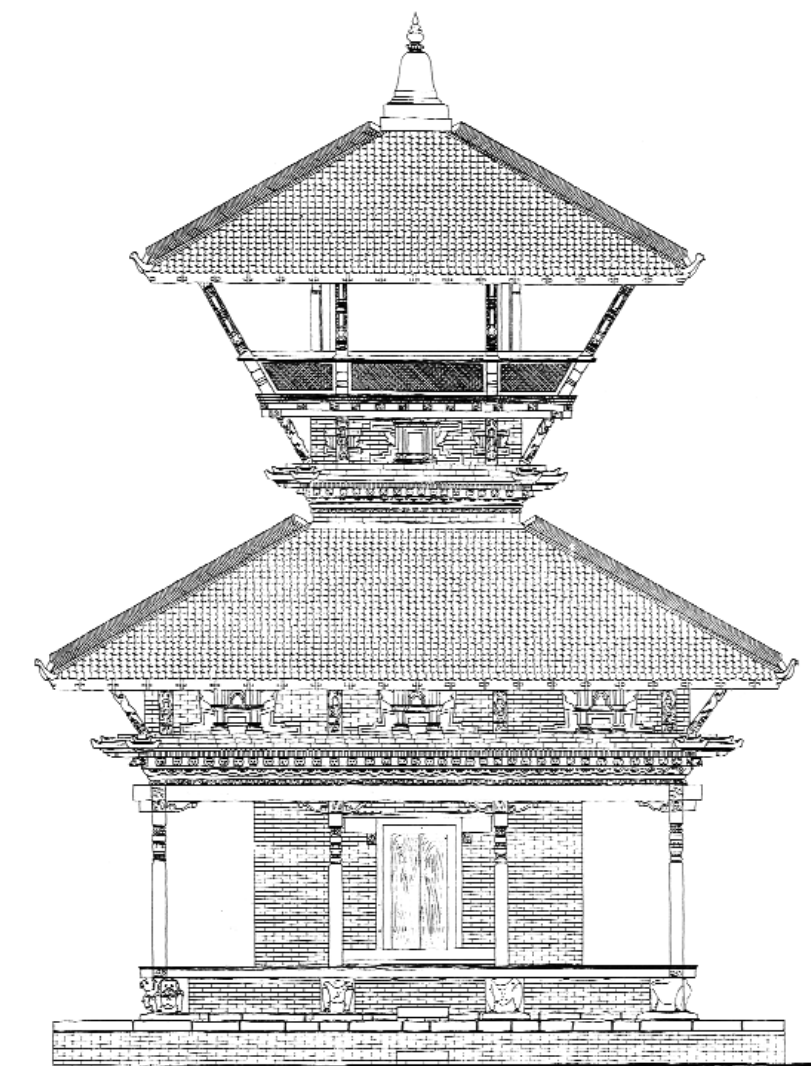




INDRAPUR TEMPLE

KATHMANDU DURBAR INITIATIVE 2000-2004

A JOINT PROJECT OF
HMG DEPARTMENT OF ARCHAEOLOGY
AND
KATHMANDU VALLEY PRESERVATION TRUST

FINAL REPORT

ROHIT RANJITKAR * RAJU ROKA
KATHMANDU VALLEY PRESERVATION TRUST
DECEMBER 2002

The Kathmandu Valley Preservation Trust is proud to announce the completion of the restoration of Indrapur Temple; one of the many projects of “Kathandu Durbar Initiative 2000-2004”, on September 2002. On behalf of the Trust, we wish to thank all our generous supporters.

With generous support from

Soaltee Hotel Ltd.
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Implemented by

Kathmandu Valley Preservation Trust

In cooperation with

His Majesty's Government Department of Archaeology (DoA)
Kathmandu Metropolitan City, Kathmandu

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Mr. Robert Silman, Robert Silman Associates (USA)

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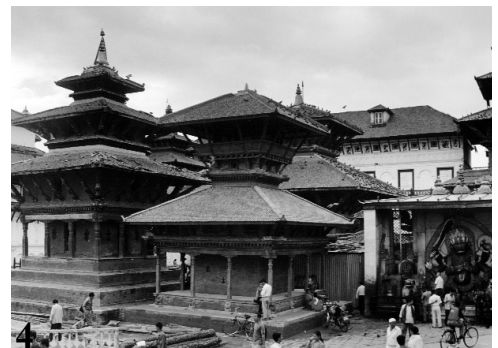
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1. Introduction

This traditional two-tiered Shiva temple was constructed in about 1764. It's built on a square base with an additional structure adjoining the central sanctuary. Simple carved struts support the upper balconied roof in unique form, completely open, with an extraordinary shape in comparison to typical temples.

The upper tower of the Indrapur temple collapsed during the great earthquake of 1934. During the repair, the former shape of the upper structure was completely changed. Several photographic records helped restore the tower to its historical configuration, however, there are no close up photographs to identify the details.

Before KVPT initiated the restoration in December 2001, the structural condition was very poor even though its appearance looked respectable. For example, the ground floor wall and the wall above the timber arcade were not scheduled to be demolished, but due to the inadequate condition it became necessary to reconstruct.

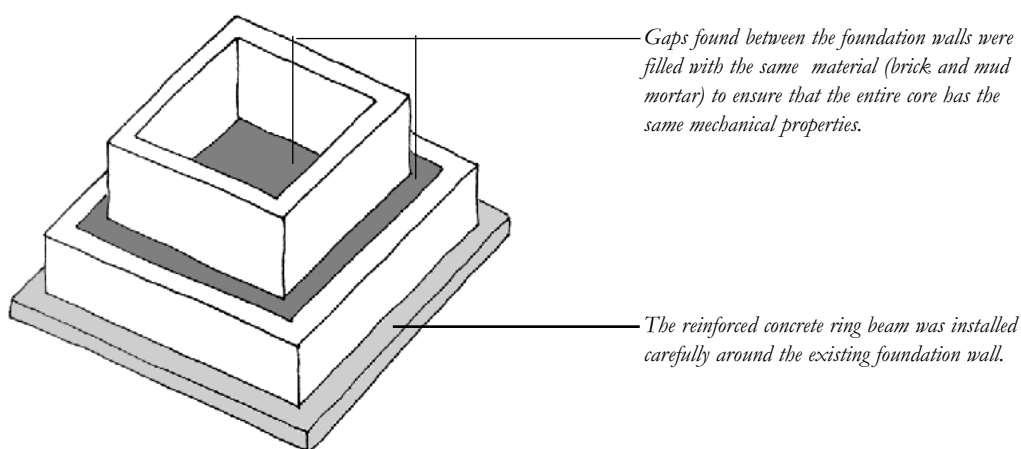


1. A sketch by Lebon before the 1934 earthquake, which was evidence of historical configuration. 2. A photograph showing the condition of the monuments after the great earthquake. 3. The figure of Indrapur Temple in an altered form, restored shortly after the earthquake. 4. The recently restored Indrapur Temple in its historic figure.

2. Restoration

Foundation Level:

For the first time in Nepal existing foundations of pagoda temples have been investigated and analyzed. Earlier attempts had been hindered by religious apprehension. Prior to design, all of the foundations were thoroughly inspected to understand what problems lie ahead. To our surprise the depth and width were unequal. To protect the structure from further damage we proposed to tie all the uneven walls with a ring beam below the ground level. As per suggestion



of seismic engineer, Mr. Mathias Beckh from Robert Silman Associates, New York, USA, a concrete ring beam was introduced at the foundation level. Gaps found between the foundation walls were filled with the same material (brick and mud mortar) to ensure that the entire core has the same mechanical properties, therefore creating homogenous behavior during a seismic movement.

Seismic Strengthening:

To strengthen the Indrapur temple against earthquakes, Robert Silman Associates manufactured the idea of an independent interior frame made of reinforced concrete. This frame would require a new foundation mat below the existing foundation wall, bracing the temple against the lateral loads induced by a seismic movement. This design was based on the American Uniform Building Code. If the above design were applied, the temple could withstand an earthquake. It was definitely the best possible solution. In order to save historical fabrics *insitu*, we didn't carry out this concept. Instead we used a reinforced concrete ring beam (30x50cm wide) around the outer foundation walls as an alternative result, tying them like a belt. The ring beam was carefully installed without damaging the historical wall, designed with the full base shear in one direction, so that in the event of a seismic movement the walls will not drift apart. (For more details please refer to the report "Seismic Strengthening of the Temples on Kathmandu Darbar Square" by Mathias Beckh).

The following reasons are why seismic strengthening is important/needed for these structured monuments:

- 1) To protect from earthquake disaster.
- 2) In the event of an earthquake heritage preservation work will be given low priority. It is natural to give higher priority to infrastructure, medical and relieving work.
- 3) There is a 90% chance of losing the monument indefinitely because it may not be restored or reconstructed after a disaster.
- 4) At the same time we lose 100 years of carved timber elements that we may not be able to replicate.

Upper Structure:

The existing timber beams that carried the upper walls of the second floor were in bad condition and partly damaged. These beams were supported with steel channels running on both sides, protecting the outer brick wall above the timber arcades.

Wall Structure:

In the proposed planning we had thought of repairing the damaged area of the wall, but when the damaged area was dismantled, we found that the wall was greatly damaged inside. Therefore, the wall was completely reconstructed using traditional brick (*dachi-apa* and *ma-apa*) in mud mortar at the ground level as well as the first floor outer wall. Four load bearing timber posts were replaced on four corner of the ground floor wall.

Lower Roof:

The roof was completely reconstructed using new (*sal*) timber members. Before the reconstruction work began the roof was in inadequate condition. But as the mud bed and roof tiles (*jhingati*) were removed for repair, we found that none of the timber members were reusable.

Middle Core Wall:

The middle core wall, which bears the load of the upper tower, was in superior condition. It was repaired and strengthened for stabilization.

Floor and Interior:

At the ground floor, new traditional (*telia*) tiles were paved in lime and surkhi. A new drainage system was installed as well. The interior walls were re-built with traditional methods (*dach apa* and *ma-apa*) to match the original. On the first floor one level above the arcade new planking was laid to the joist.

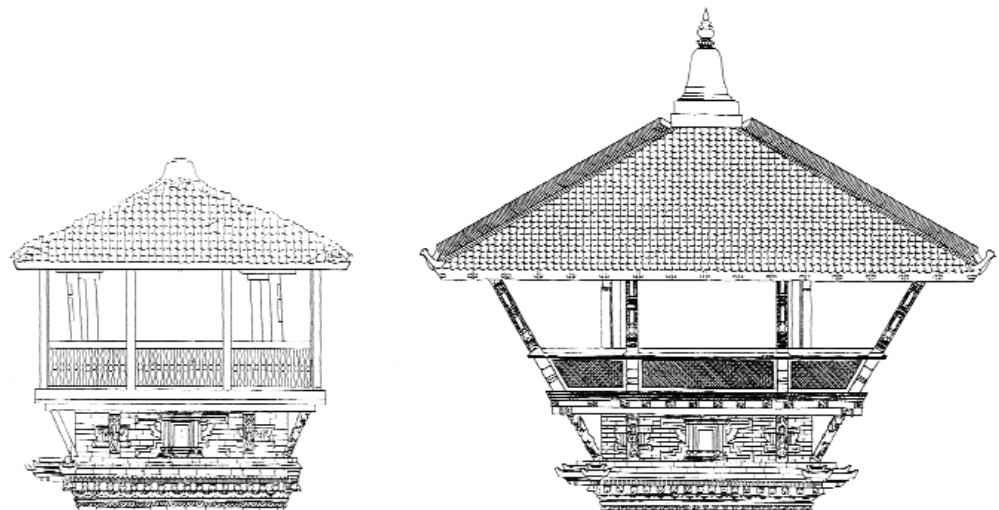
Upper Tower:

After 1934 the tower was not reconstructed in its historic form using original elements. New carvings and timber components were based on the visual documentation of other buildings from the same period.

3. Other Activities, Relevant Developments

a) Training Activities

Architect Lumanti Joshi, along with two carpenters are training to work with historical buildings. Lumanti has completed the documentation of the restored condition of the temple. She is also handling the final documentation of other KVPT projects. She completed her architecture study at the Nepal Engineering College, Changuarayan, Bhaktapur.



The elevation of the upper tower before and after restoration.

Typically carpenters are not skilled to work with historical buildings. Our goal is to train them to be able to work with historical monuments. Extensive training allows these carpenters to expand their knowledge; use their eyes and minds to create exceptional wood carvings and the general understanding on how to replicate the damaged historic elements.

b) Docent Program

The Docent Training Program was established in March 2002, with the objective of providing an architectural tour in Patan City. Within this training program, eight people from various academic fields have been qualified to give historic architectural preservation tours to our treasured donors and visitors who frequent KVPT headquarters seeking information regarding the Trust's activities.

c) Technical Exchange

German Development Service (DED) offered KVPT to host a carpenter for two months. Christian Bosselmann worked on site learning about traditional Nepalese techniques. During the technical exchange period Christian and our own carpenter carried out the construction and assembly of the upper tower and roof. After the experience the thoughts Christian expressed were very useful in our daily work. “While working with the local carpenters I observed explicit details in the execution of their carpentry work. During the past two months I have learned a great deal about working with historical structures. The cultural and technical exchange with the Nepalese carpenters was very generous. I would like to thank KVPT and the DED for giving me the opportunity to work here in Nepal.”

04. Historic photo documentation



A sketch by Lebon before the 1934 earthquake, which was evidence of historical configuration.



The photograph by the Calcuttan firm Bourne and Shepherd showing the principal monuments- Indrapur, Narayan, Jagannath and Kalo Bhairav in the early years of the century.

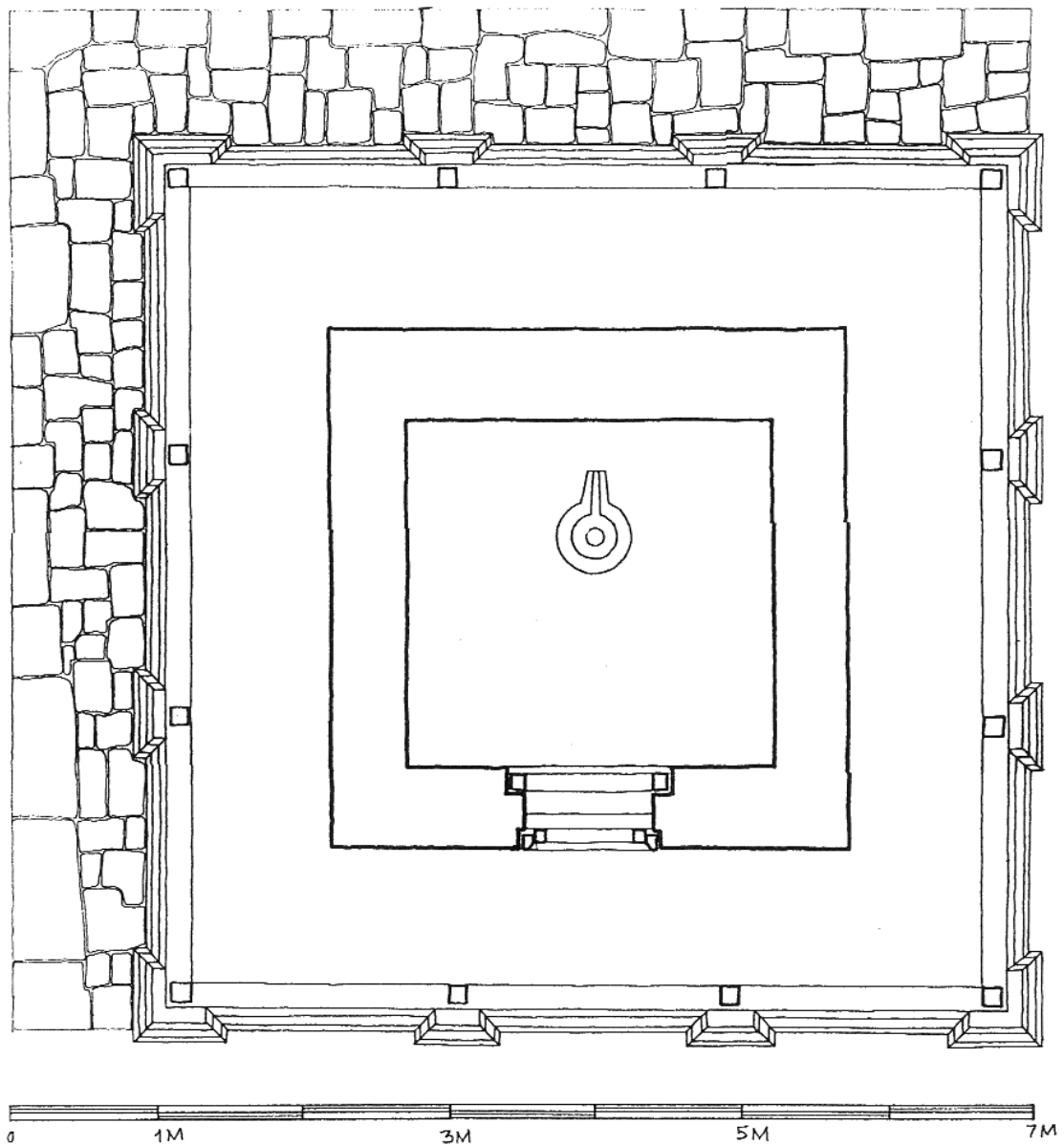


The great earthquake of 1934 devastated the Narayan Temple leaving only the plinth, while partially damaging Jagannath and Indrapur Temples.

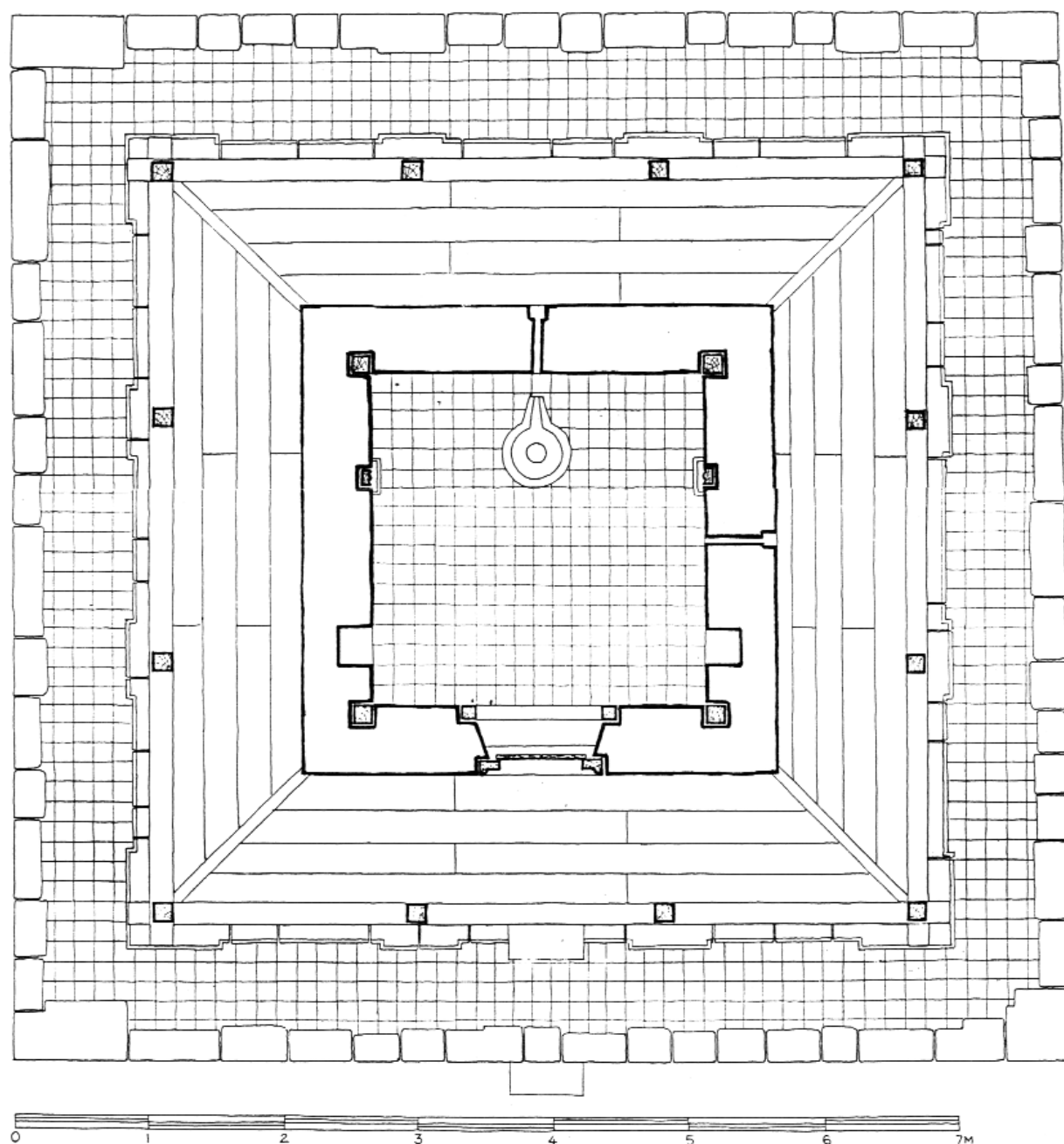


A contemporary view (1995), compared with previous post-1934 earthquake. After the earthquake the upper tower of the Indrapur Temple was completely restored in a different configuration.

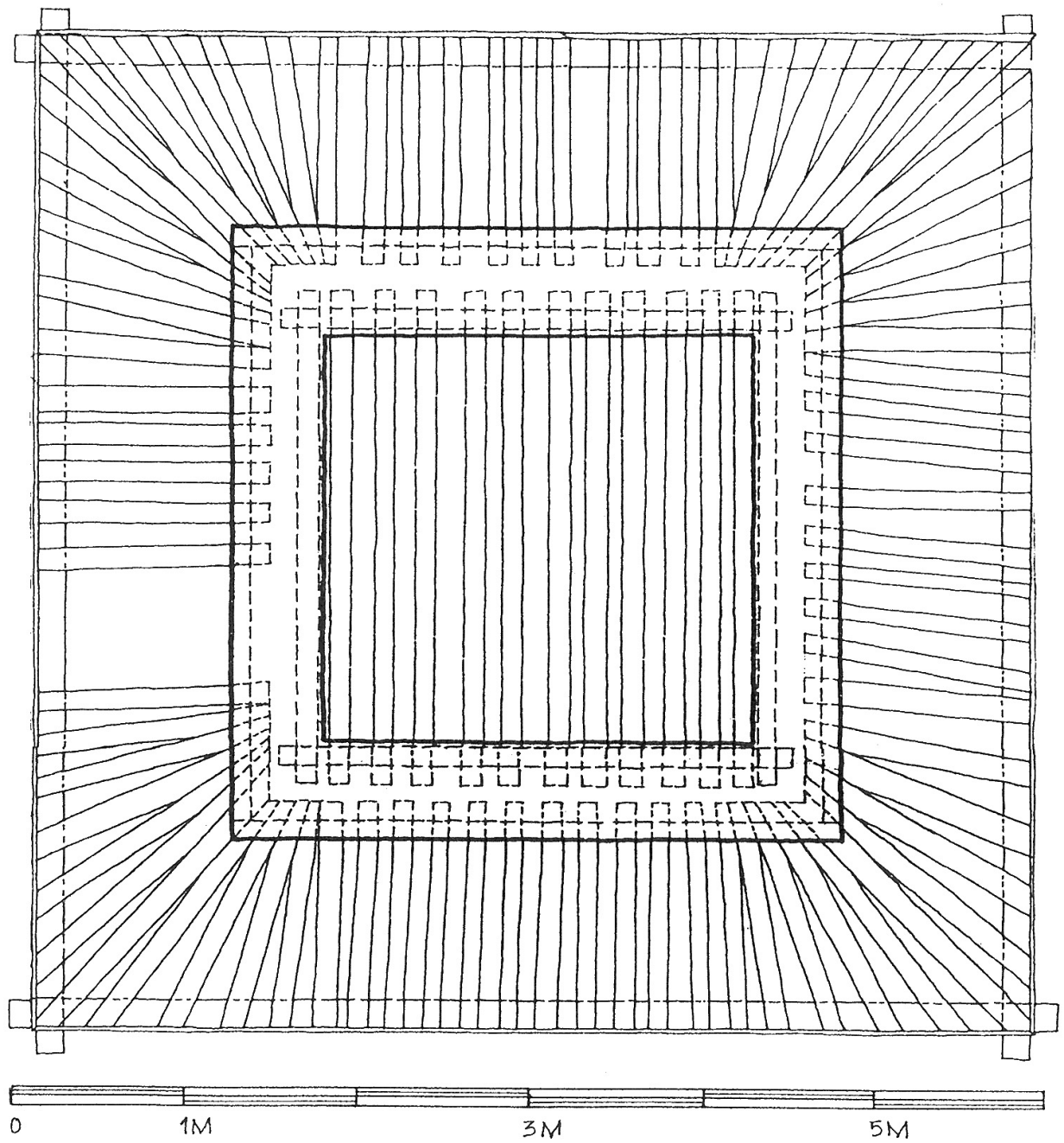
05. Drawing documentation of existing and restored condition



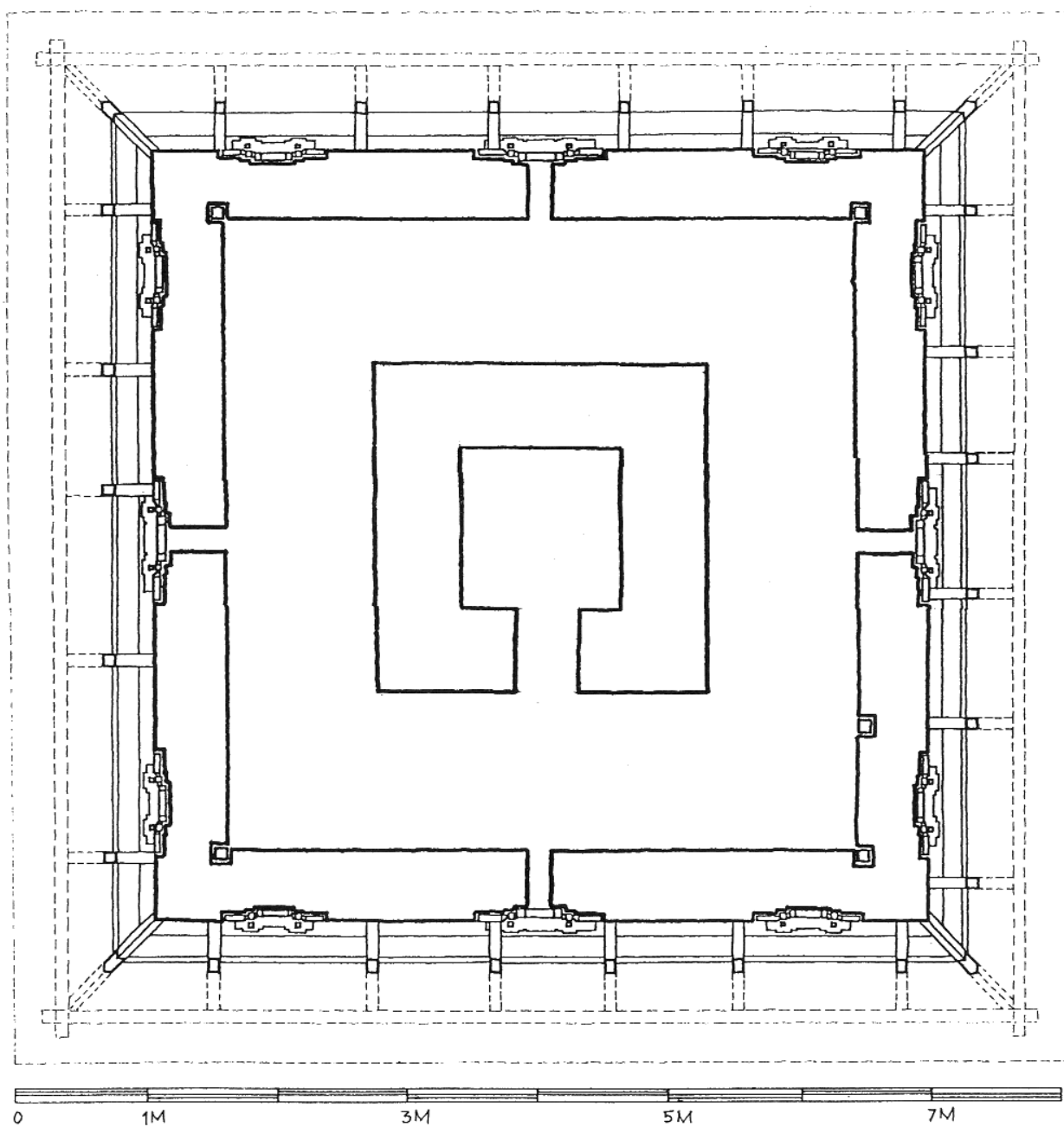
Ground floor plan: existing condition



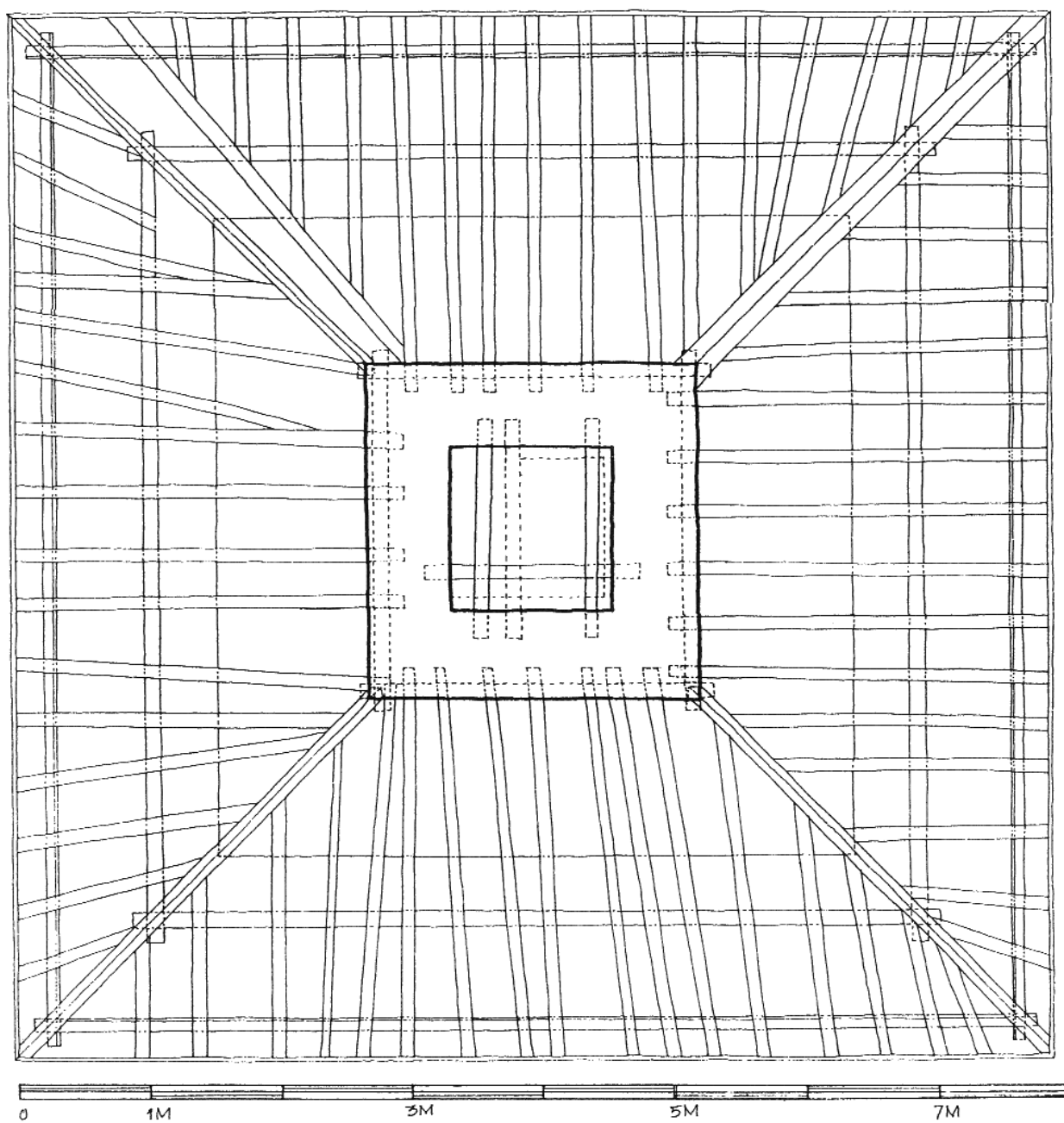
Ground floor plan: restored condition



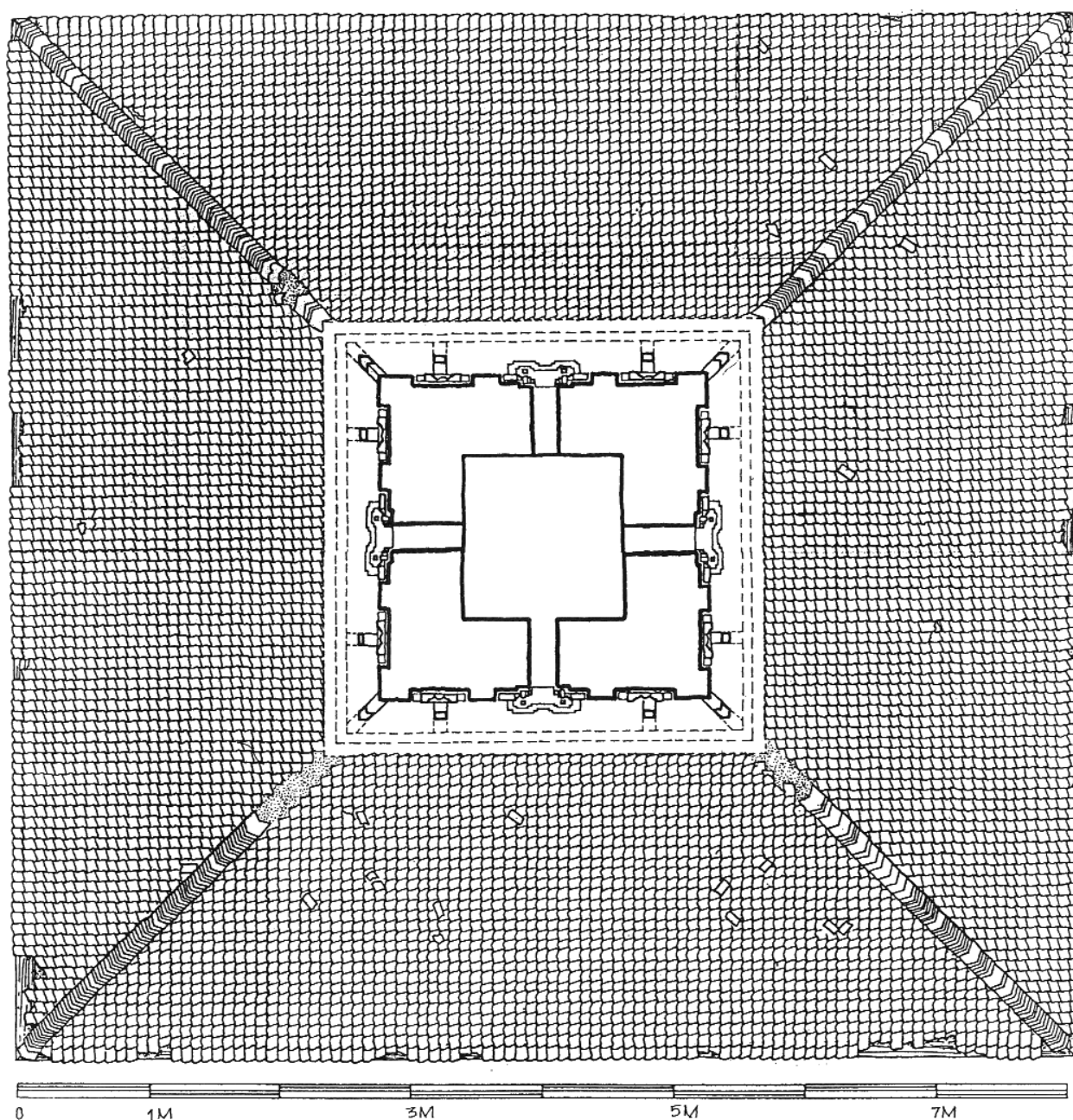
Ground floor reflected ceiling plan: existing condition



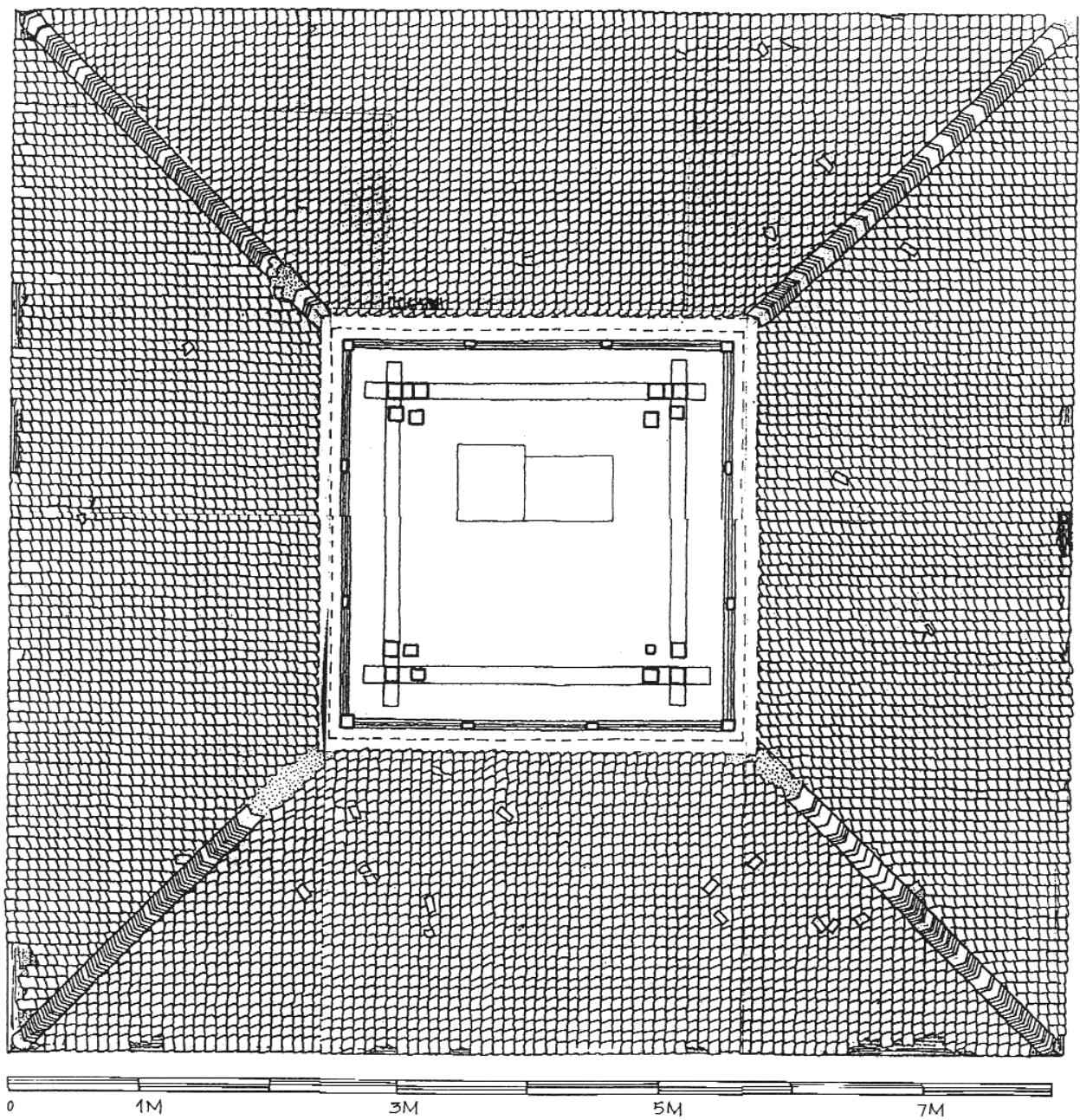
First floor plan: existing condition



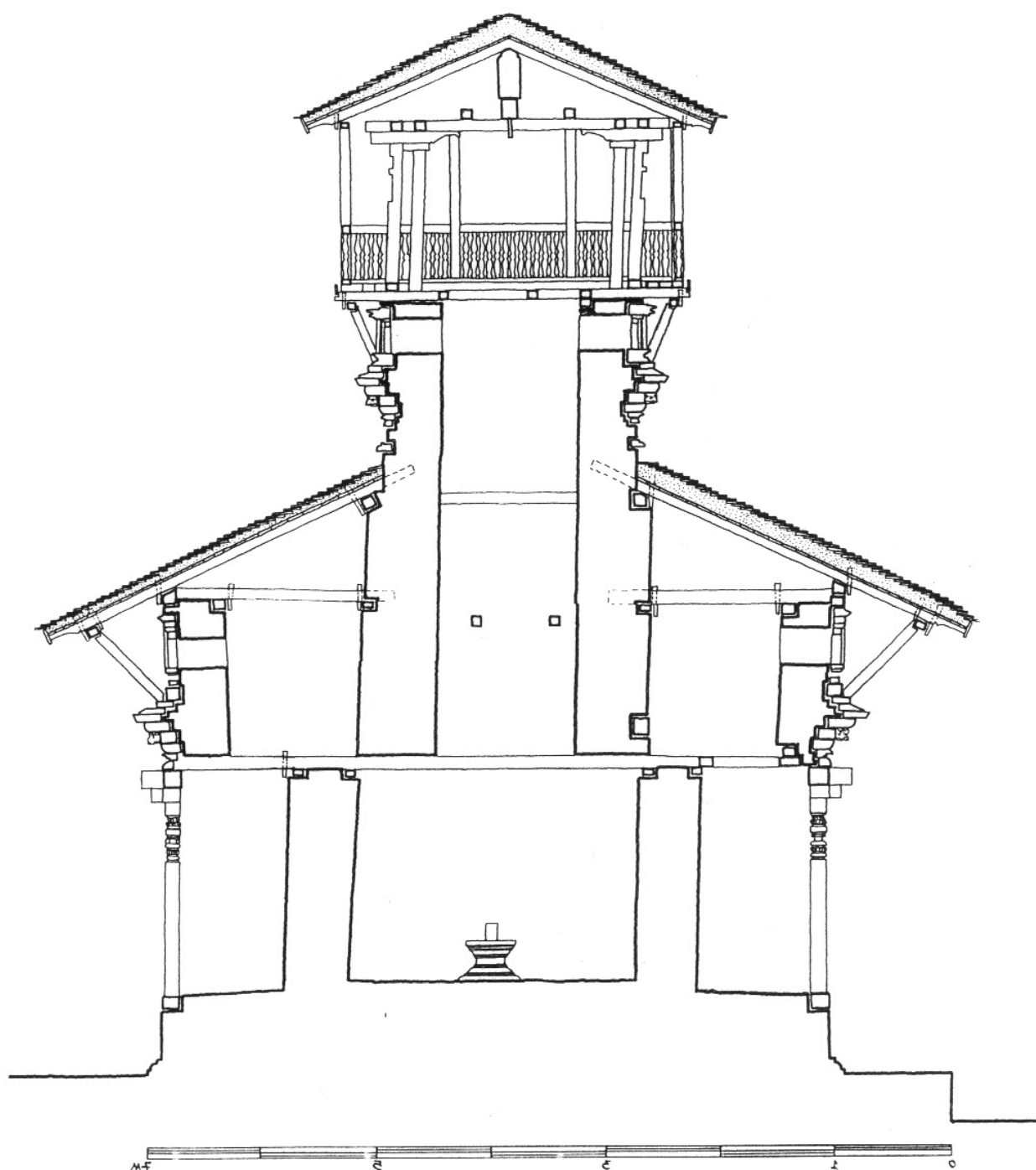
First floor rafter plan: existing condition



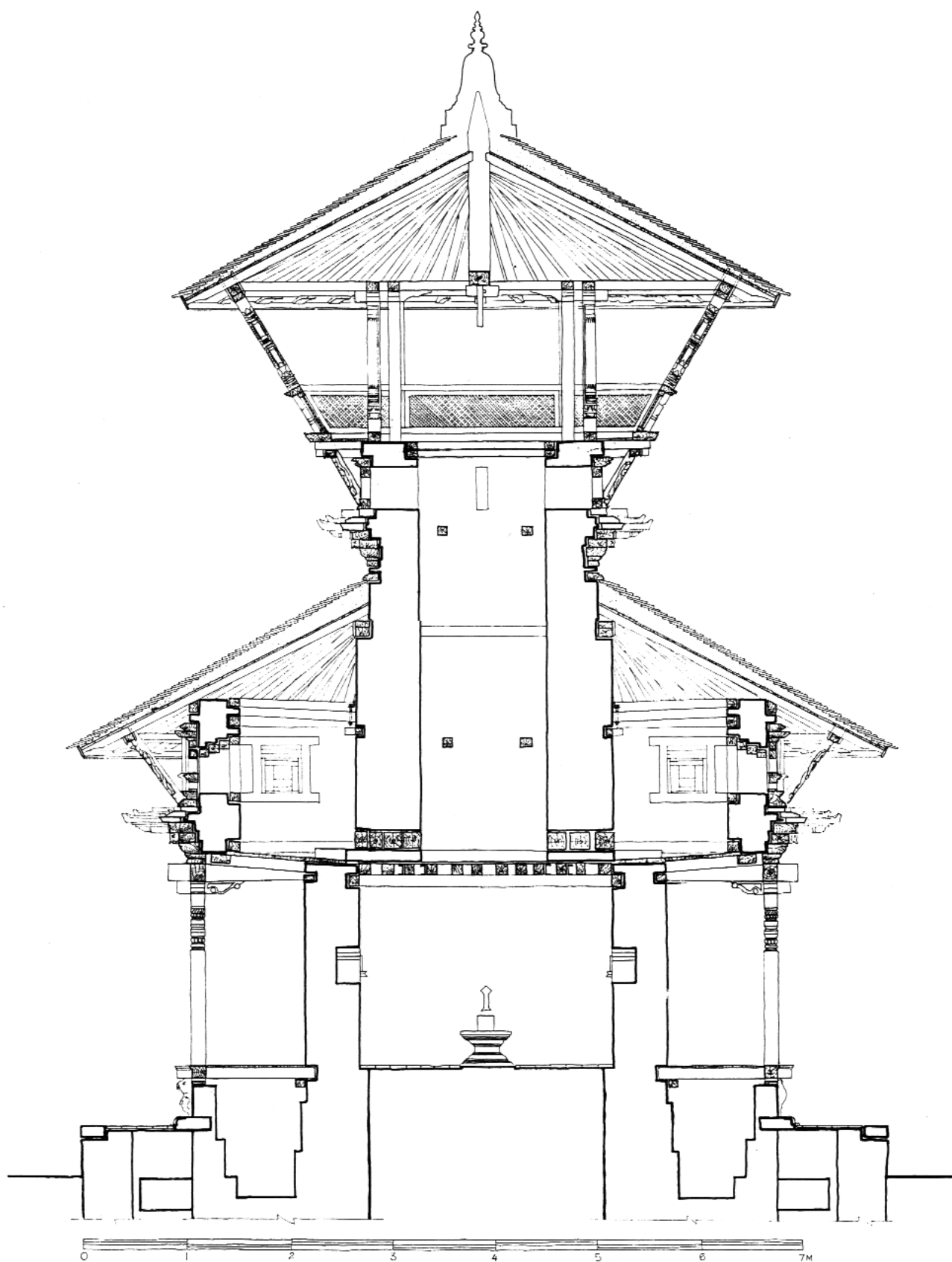
Second floor plan: existing condition



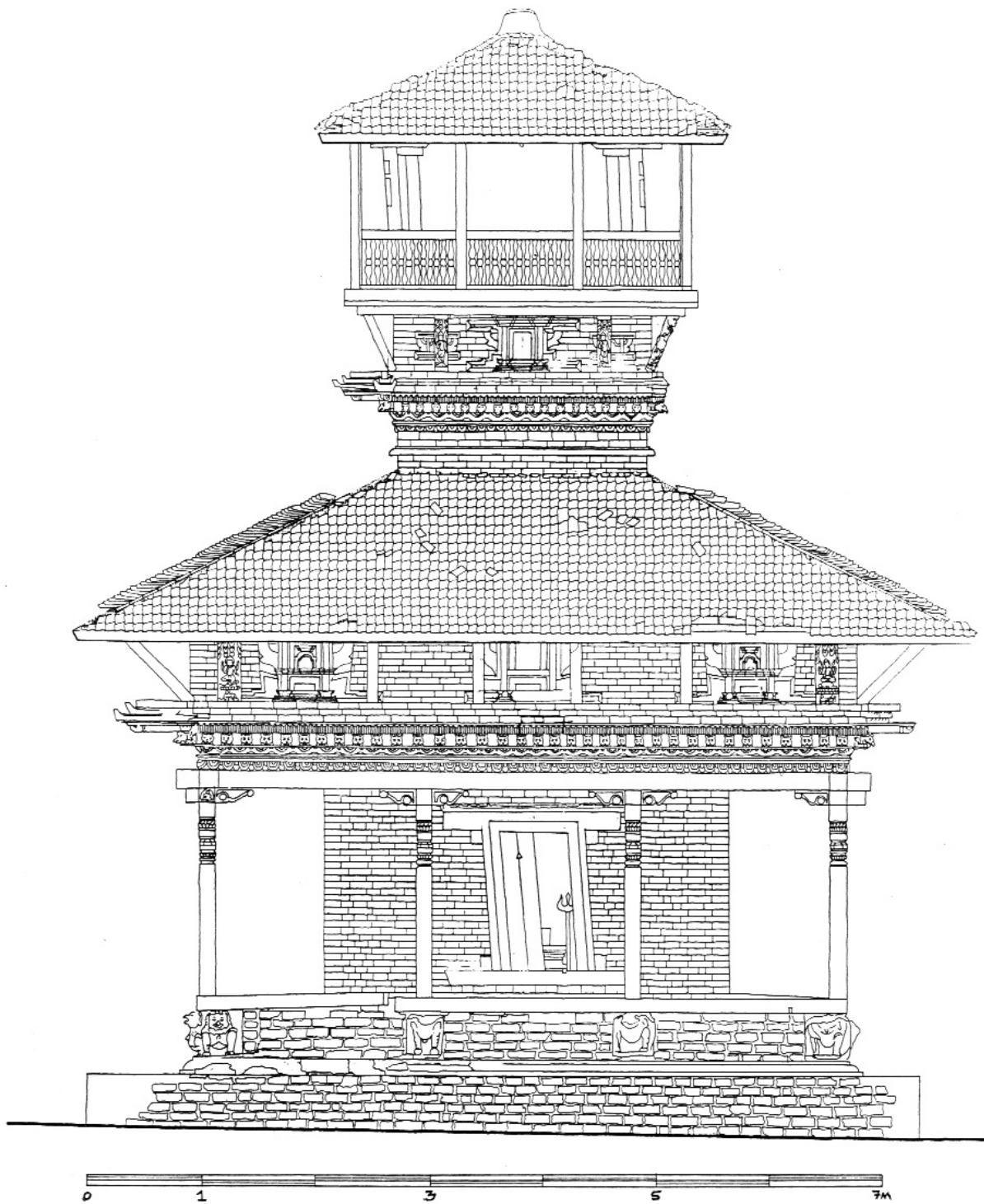
Third floor plan: existing condition



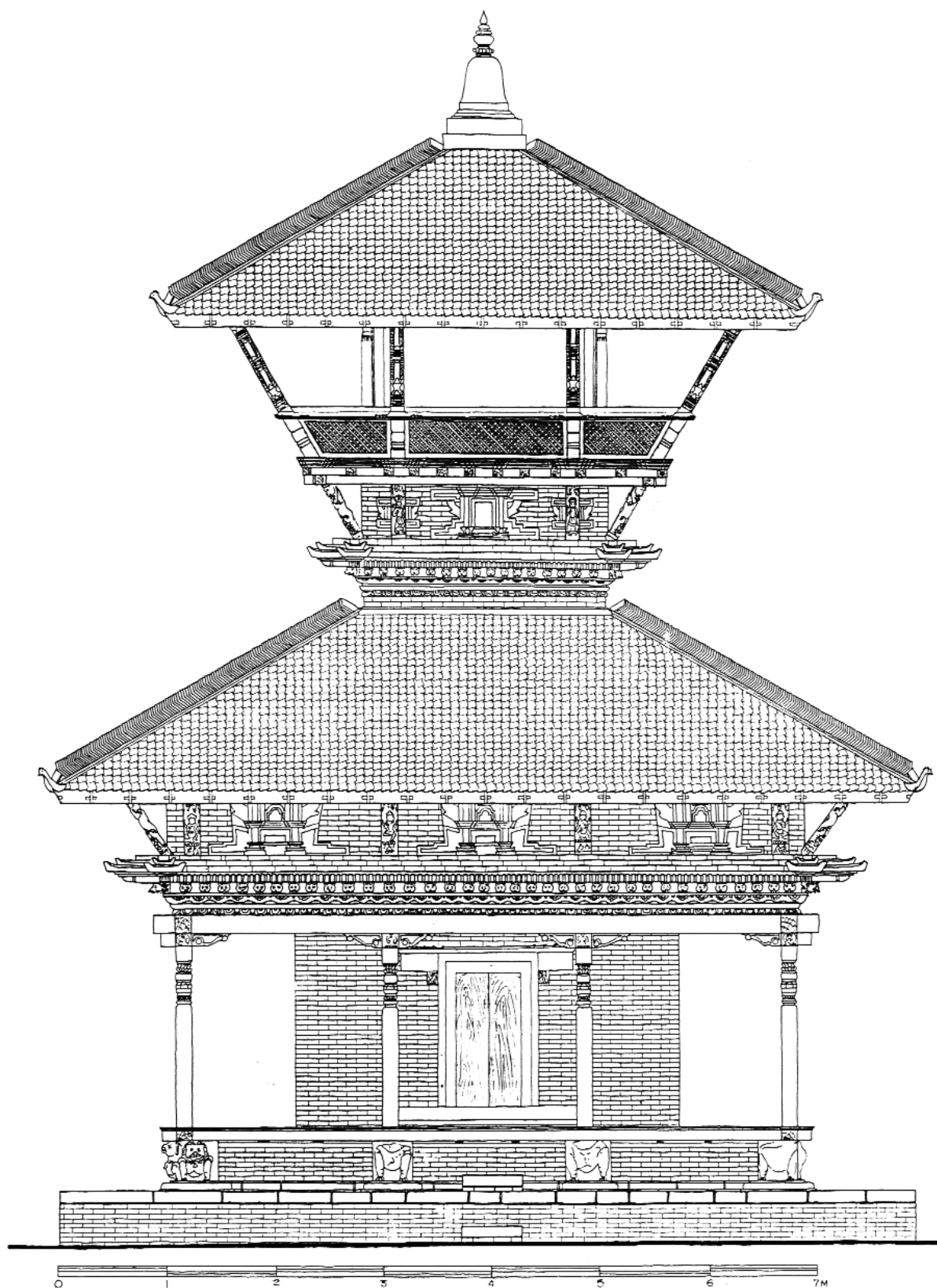
East-west section: existing condition



East-west section: restored condition



South elevation: existing condition



South elevation: restored condition

06. Photo documentation of existing, restoration process and restored.



A view of Indrapur Temple before the initiation of restoration work in September 2002.



A southern view of the Temple showing the poor condition of the arcade and lower roof.



Damaged condition of *lakasi* (base of arcade pillar).



Damaged condition of the plinth level wall where the outer plinth does not exist.



Upper tower dismantled to restore the historical figure.



On the steel angle, nuts and bolts are used at the joint of the purlin, tying them together acting as one unit in the event of a seismic movement.



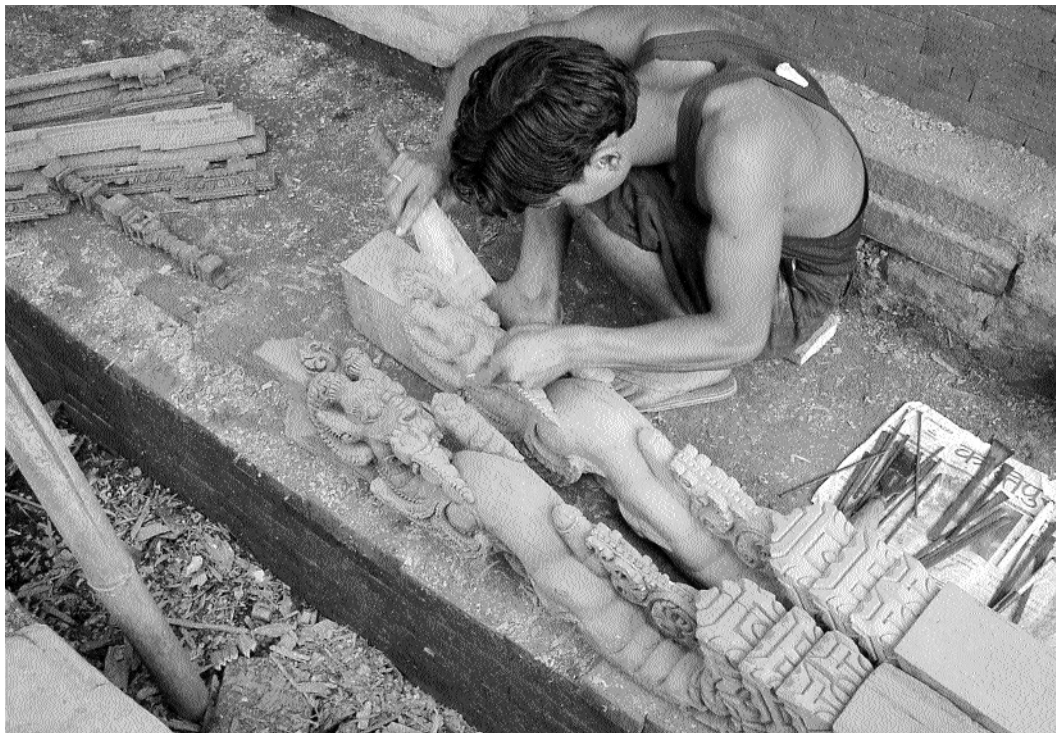
Rebuilding of a masonry wall on the ground floor sanctum with traditional brick (*dachi-apa* and *ma-pa*) which improves brick bonding.



Rebuilding of the outer masonry wall on the first floor level in traditional brick (*dachi-apa* and *ma-pa*) incorporating the historical carved window.



Carpenters work on plain timber fabricating rafters, purlin and wall plates.



A wood carver replicating corner struts as per the historic original.



Carpenters installing the rafters on the lower roof.



New carved inclined struts are in the process of installation on the upper tower.

08. Chronology of restoration work

May 2001

- Documentation completed.

October

- Store room and fence construction.

November

- Checking of inner and outer foundation wall for seismic design.
- Seismic design finalized
- Traditional brick *dachi apa* and *ma-apa* ordered

December

- Out side the outer foundation wall digging was done in four sides for installation of the ring beam.
- Concrete ring beam were installed to prevent damage during seismic movement.
- Lower plinth wall was rebuilt in traditional *dachi apa* and *ma-apa* above the new concrete ring beam.

March 2002

- Timber purchased for plain work.
- Preparation of plain timber work.
- Bamboo scaffolding construction.
- Old roof tiles (*jhingati*), mud bed and rafters dismantled of lower and upper roof.

April

- Existing wall of first floor outer wall and timber cornice dismantled.
- Timber arcade and wall below dismantled.
- Preparation of *lakasi* for arcade.
- Mud and timber purchased.

May

- The gap between the inner and outer foundation wall inside the sanctum was dug out and filled with traditional *ma-apa* in mud mortar.
- The wall below the arcade pillar was rebuilt in traditional *dachi apa* and *ma-apa* and the existing stone base of the lion was installed.
- Recarving of lost elements on windows.
- Installation of *lakasi* and arcade pillar, beam and cornice.
- Sanctum wall rebuilt in traditional *dachi apa* and *ma-apa*.

June

- Installation of steel section on the first floor to support the load of inner wall.
- Preparation of wall plate, inner frame of window, rafter, purlin etc.
- First floor wall rebuilt in traditional brick *dachi apa* and *ma-apa* and *labkab* fitting.

- Upper tower was completely dismantled to build in historical figure.
- Preparation of planking for the lower roof.
- Installation of inner and outer wall plate above the first floor outer wall.

July

- Installation of purlin, rafter and eavesboard on the lower roof.
- Preparation of gajusi, purlin, rafter, eavesboard, beams, pillar etc.
- Preparation of upper tower carved elements.
- Bamboo scaffolding retied.
- Planking laid over the rafter.
- Corner strut carved of upper tower.
- Preparation of lattice window.

August

- Second floor wall repaired and *labkab* fitting
- Preparation of planking.
- Strengthening of inner wall with steel plates.
- Installation of upper tower strut, *kulah*, *lakasi*, inclined strut.
- Installation of purlin, pillar, beam, *gajusi* etc.
- Installation of rafter, eavesboard, etc.

September

- Installation of planking over the rafter.
- Installation of waterproofing membrane, laying of roof tiles (*jbingati*) over the mud bed, onto the upper and lower roof.
- Cleaning of facade *insitu*.
- Dismantling of scaffolding and fence (16 September) for Indrajaatra (22 September 2002).

7. Summary of budget expenditure

1. Bamboo scaffolding/ fencing/ dismantling upper roof structure	131,605
2. Masonry reconstruction	467,329
3. Plain timber work	1,328,593
4. Carving timber	295,491
5. Metal work	120,850
6. Stone work	36,534
7. Conservation chemical	10,000
8. Seismic strengthening/ ring beam	180,000
9. Pinnacle with base	22,000
10. Site clearing/ trash throwing	155,230
11. Water proofing membrane on roof	95,500
12. Jhingati on mud bed & ridge tiles	121,770
13. Interior repair work/ drainage	35,928
14. Miscellaneous	<u>17,466</u>
Total	<u>30,18,296</u>

NOTES:

Work not included in the original estimate:

- Plinth stone work (stone apron).
- Masonry work (ma apa on mud mortar) on the foundation to fill the gap between walls for better earthquake performance.
- Masonry wall on the ground floor estimated for partial repair, but during the restoration it needed to be reconstructed due to the poor condition.
- Masonry wall above the arcade also completely reconstructed.

In spite of all of the extra work, the project has still come in under our budget. The original estimate of the project was NRs 31,68,300.

8. Proposed and actual work schedule

INDRAPUR TEMPLE

PROJECT IMPLEMENTATION SCHEDULE

KATHMANDU VALLEY PRESERVATION TRUST
September, 2001

Execution	Sept. 2001 to Aug. 2002											
	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April	May	June	July	Aug.
Time: Sept. 2001- Aug. 2002												
1. Scaffolding/ Store room construction	■	■										
2. Dismantling upper roof structure to rebuild historical configuration			■	■								
3. Site clearing/ storing usable materials	■	■	■	■	■	■	■	■	■	■	■	■
4. Masonry reconstruction /façade veneer brick repair			■	■	■	■	■	■				
5. Reconstruction of timber structure (post, joists, beams, rafters, etc.			■	■	■	■						
6. Carving of timber struts		■	■	■	■	■	■	■	■	■	■	
7. Repairing of blind windows and timber carved element				■	■	■	■	■				
8. Seismic strengthening of existing structure on three levels	■	■	■	■	■	■	■	■	■	■		
9. Repairing of timber arcade on the ground level		■	■	■	■							
12. Consolidating of existing structure of carved strut and elements				■	■	■	■	■				
13. Installation rafters			■	■	■	■	■	■				
14. Installation of eaves board							■	■	■			
15. Planking above rafters							■	■	■	■	■	
16. Laying waterproof membrane above planking									■	■		
17. Chemical treatment on mud, <i>jhingati</i> and ridge tile										■	■	■
18. Laying <i>Jhingati</i> over mud bed											■	■
19. Laying ridge tile/ installation of metal strips and corner plates on eaves board												■
20. Cleaning of façade and carved elements <i>in situ</i>									■	■	■	
21. Interior minor repair						■	■	■				
22. Plinth repair and rebuilding with <i>dachi-apa</i>										■	■	■
24. <i>Puja</i>												■



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