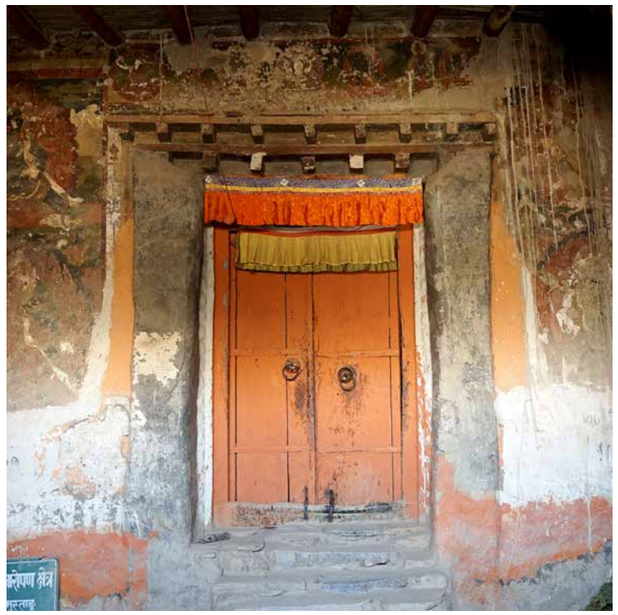
SEISMIC STRENGTHENING AND RESTORATION OF GONPA GANG

DAMAGE ASSESSMENT AND RESTORATION CONCEPT

DECEMBER 2022

SUBMITTED TO THE U.S. AMBASSADORS FUND FOR HISTORIC PRESERVATION



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MUSTANG DISTRICT, GANDAKI PRADESH, NEPAL

Cover image: **PRINCIPAL FACADE, VIEW FROM EAST**
Photo by Christian Luzcanits
2017

above: **VIEW FROM SOUTH**
The deep vertical grooves in the white-washed facade are the results of many years of leaking roof drainage spouts. The gray cement-plastered wall with prayer wheels was recently constructed.
Oct 25, 2022

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Apr 11, 2021

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Oct 25, 2022
The white-washed South-wing on the right is a later addition to the monastery. The gray cement-plastered prayer wheel wall was built by a local donor in 2021.

INTRODUCTION

By Christian Luzcanits

LOCATION

The temple of Gonpa Gang is owned by the community of Chusang (Chuksang, Tshuk) Village in Lower Mustang, Nepal. Its exact location is 28°54'37.13" N 83°48'44.22" E and located on the west bank of the Kali Gandaki river while the village is on the east bank. Thus, when the river was high, from May to October, the temple was cut off from the village. This fact accounts for both the unique state of preservation of the monument as well as its poor architectural condition. Without direct access over the warm months there simply was no opportunity for larger maintenance work. In Summer 2019 a footbridge was built across the river to make the temple accessible year round.

OVERVIEW

This project is designed to:

- address the severe architectural problems of this under maintained but extremely valuable monument,
- strengthen its architecture to continue to withhold seismic events,
- consolidate all original features in the interior of the monument,
- engage the community in planning the future usage and long-term maintenance of the monument,
- prepare the monument for more intensive future usage, and
- plan future painting conservation measures.

THE MONUMENT

The Temple of Gonpa Gang is arguably the most important Buddhist monument preserved in lower Mustang. Completed in the 1680s as a nunnery, it is remarkable for several reasons:

- Remarkably, this temple not only preserves almost the full iconographic program as it was conceived by its founder, but also much of the original architectural features including their painting.
- The architecture of Gonpa Gang is unique within Mustang. Measuring roughly 26 meters by 23.5 meters, the temple is also unusually large.
- The painted program provides unique insights in the religious atmosphere of Lower Mustang in the second half of the 17th century. At that time proponents of the Nyingma School of Tibetan Buddhism played a major role in high Himalayan society, and it is clear from the iconography of the temple and the autobiography of its founder that the local teachers had wide connections, including major Nyingma centers in Central Tibet. On the other hand, Sakya School teachers and topics are represented as well.
- The iconographic program of the temple contains a number of unique features not identified elsewhere so far. These include unique aspiration deities (yi dam) on the ground and first floors as well as an extremely high number of teacher representations on the upper levels. Presumably, these depictions reflect the most current Nyingma teachings at the time, some of which may well have been abandoned later on.
- Unlike earlier monuments, this temple directly relates to the people of Lower Mustang, as the ancestry of the most prominent local families can, at least partially, be traced back to that time.
- Some of these connections are documented in the autobiography of the founder of this monument, Künzang Longyang (kun bzang klong yangs; 1644–1696), a locally sourced text which provides unique insights into the founding of the temple and the religious atmosphere of the time. His legacy has been forgotten until recently.

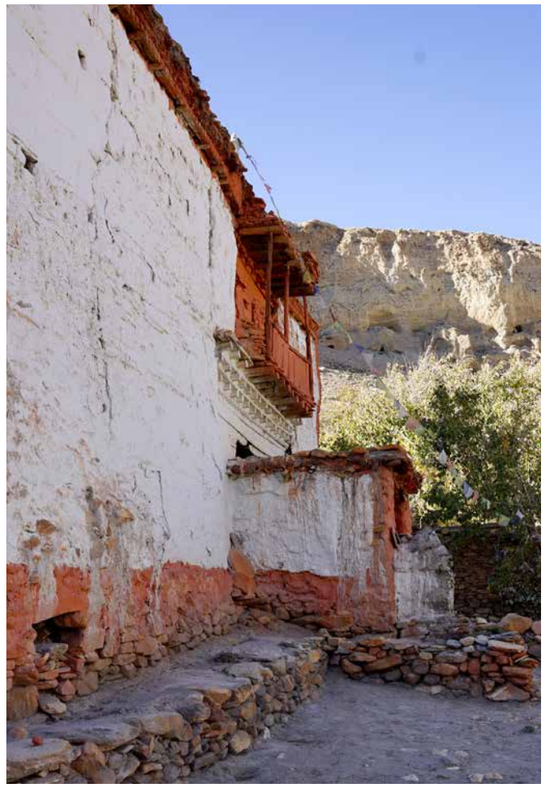
ARCHITECTURAL CONSERVATION

The proposed conservation measures address the main architectural issues facing the monument and include seismic strengthening. They are aiming to preserve the unique character of the monument, in particular the sensation of walking into an ancient, almost unchanged religious and social space. They do, however, improve on aspects of the visit where this original impression is not disturbed, in particular through pavements around the exterior and the introduction of wooden floors in the interior. The measures outlined here are the minimum required for long term preservation and future usage of the monument.

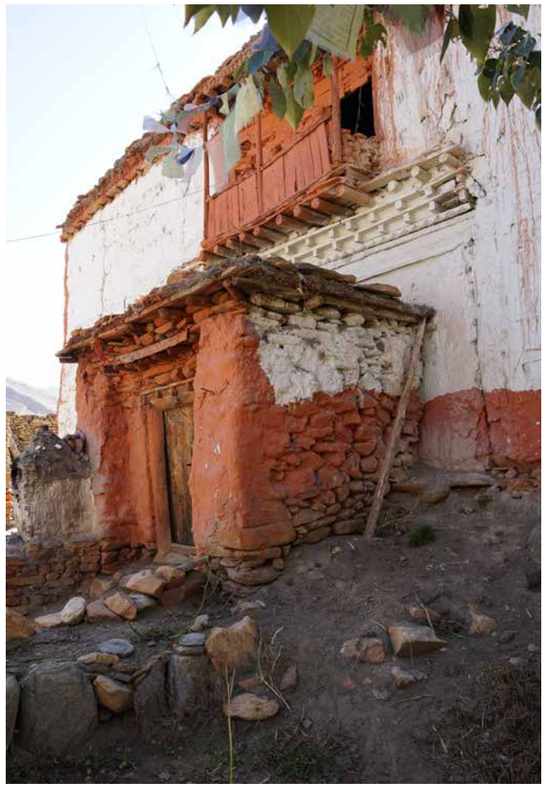
There are three areas where immediate measures need to be undertaken: namely strengthening and partly rebuilding the structural timber support system on all floors, improving the drainage surrounding the temple, and redoing the roof of the monument in its entirety. The latter is necessary as the recent introduction of a plastic sheet underneath the clay layer has not solved the problem of further water infiltration.

Large parts of the structure, particularly the South wing which was added to the original structure at a later date, are in immediate danger of collapse. There are many places in the decorated rooms where wall sections supporting heavy cross beams have either collapsed or are bulging considerably. These sections need to be rebuilt and often the beams are in need of replacement as well. All wooden structural members and their connections will be carefully evaluated and appropriately strengthened or replaced.

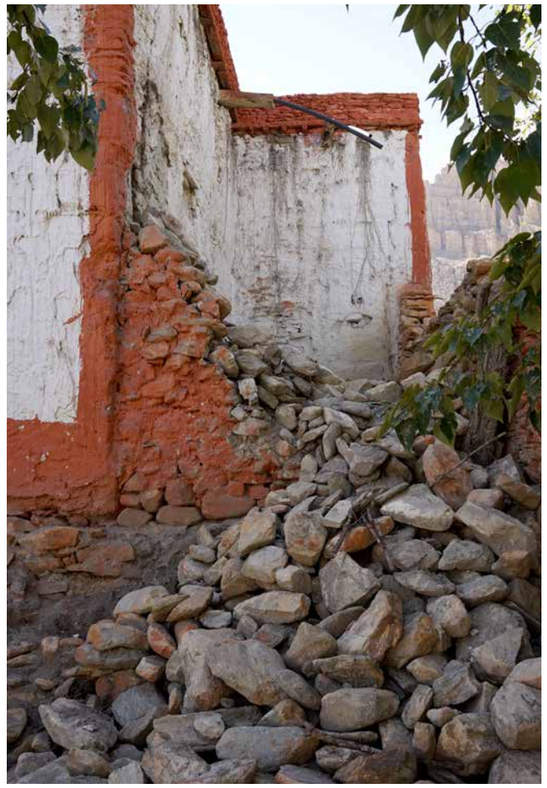
The monument has been the subject of a recent monograph written to support the future preservation of the monument:
Harrison, John, Christian Luczanits, Charles Ramble, and Nyima Drandul, eds. A Blessing for the Land. The Architecture, Art and History of a Buddhist Nunnery in Mustang, Nepal Kathmandu: Vajra Publications, 2018.



PRINCIPAL FACADE
View from the south. The stone masonry porch obliterating the formerly open entrance will be removed.



PRINCIPAL FACADE
View from the east. The balcony will be rebuilt to its original design. The stone wall blocking the opening will be replaced with new windows.



NORTH-EAST CORNER
The partly collapsed stone wall enclosure will be completely removed which will allow better drainage from the roof water spouts.

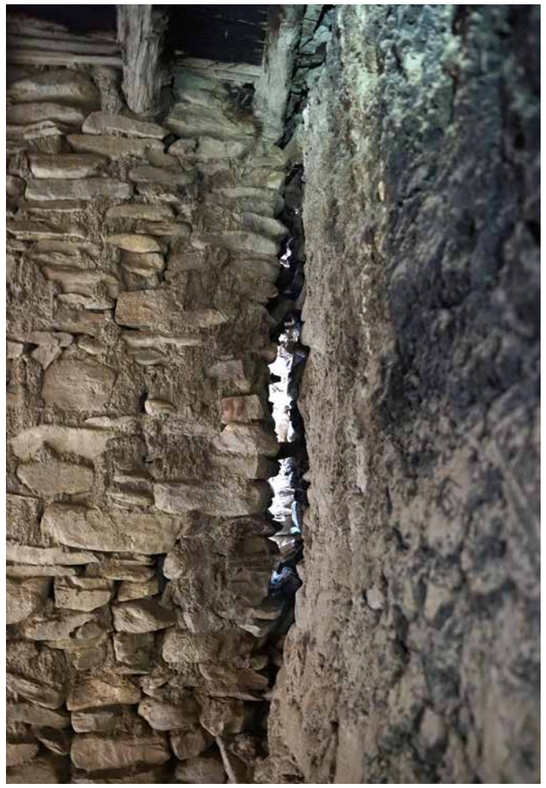
WALL DAMAGE
View from south. This type of damage can be observed at several locations where water from a damaged roof spout has eroded the stone masonry. Often water penetrated to the inside and damaged wall paintings as well.

PRINCIPAL FACADE
View from the south.
Photo by John Harrison, 2005

SANCTUM
View from north. The hybrid construction combines rammed earth and stone walls. The wedge-shaped stone infill is a poorly executed repair of an area that was washed out by water leakage from the roof. The mane stones piled up around the building will need to be removed as they trap snow and water that subsequently leaks into the wall.

SOUTH-EAST CORNER
View from south. The area was once covered by a two-story porch and balcony. Only a single round joist projecting from the wall remains The wall on the right was heavily eroded by roof leaks. The damaged wall and door formerly leading to the balcony was filled in with stones.

BULGING WALL
View from the south-east. The wall, weakened by water infiltration from the roof and failing foundations, is precariously bulging. Compare to the photo on the right taken from the inside of the building.



WALL SEPARATION
View from inside the stable (L05). The wall to the right has been weakened by many years of leaks from the flat roofs. It is bulging to the outside (see photo on the left) and will have to be rebuilt.

OPENING TO TOILET PIT
View from east. This damaged corner section will be repaired and covered with mud plaster and lime wash.

DAMAGED RAMMED EARTH WALL
View from south. Water leaks from a damaged roof drain have severely eroded the mud wall. The void was temporally filled with rubble rock.

ARCHITECTURAL DESCRIPTION

The usual approach to Gonpa Gang is by crossing the Kali Gandaki from Tshug, which lies on the main north-south trail through Mustang. A second circuitous route leads south from Tsele village across the high land west of the river, and then down the Tshumpag Chu valley. Now little used, this way would have been much busier before the settlements along the Tshumpag Chu were abandoned.

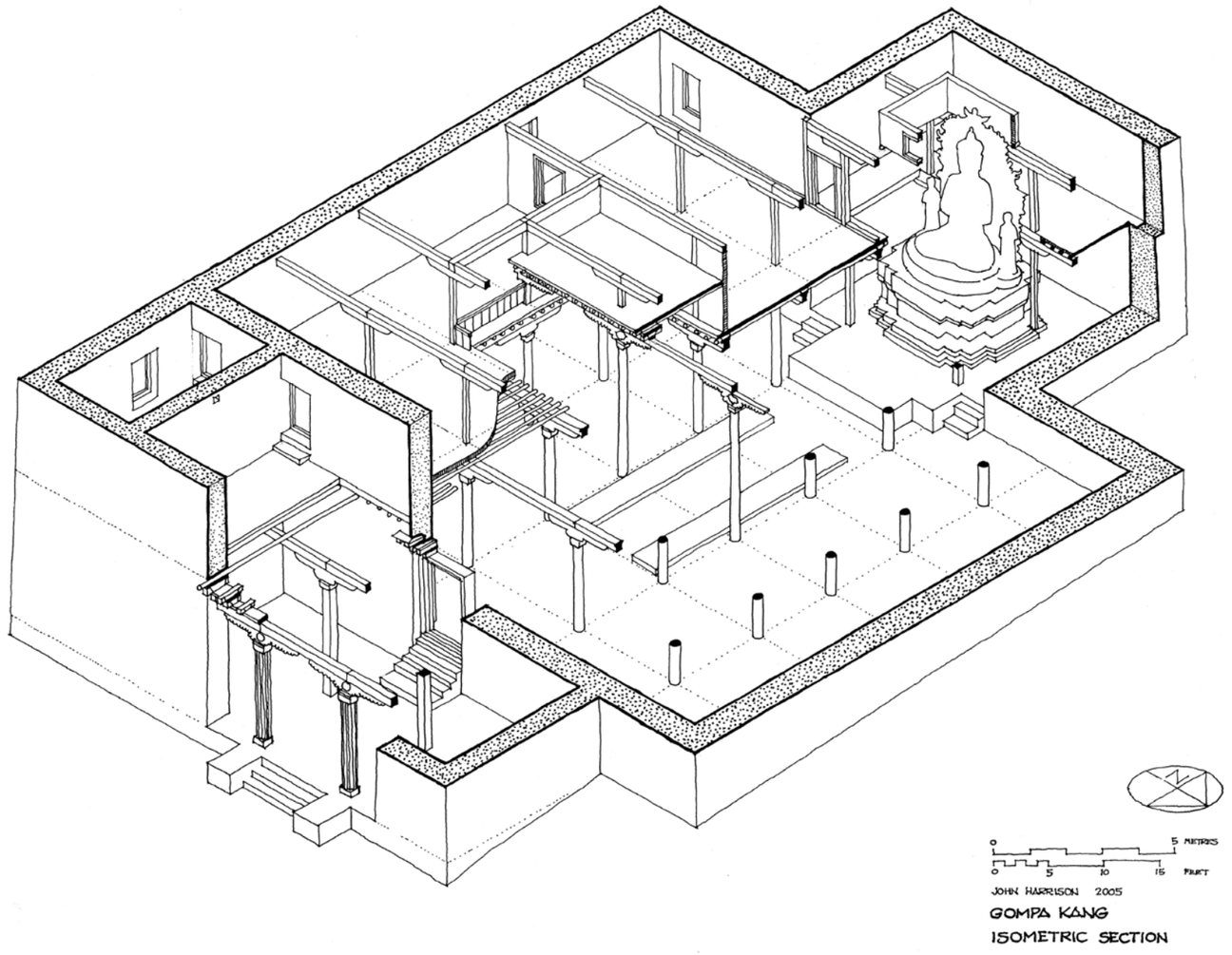
The Kali Gandaki ford from Tshug, which must be an infrequent and hazardous undertaking when the river is in spate, leads to a steep eroded gully in the river cliff bank and thence to a terrace below the higher cliffs and caves. Several hundred metres south the path turns around a first chorten, and then runs below a line of mani walls and chorten. The monastery lies a little below to the left, now surrounded by a recent plantation of trees.

A small doorway in a stone wall leads into the entrance courtyard, with the main east door to the gonpa on the right and on the left a new two-storey building with an access gallery to a meeting room above and the caretaker's room. Across the yard beyond the tall central prayer flag are older ancillary buildings. The view of the east façade from Tshug, across the river, is now partially blocked by the new building.

Stone steps lead up to a large imposing entrance hall in front of the *dhukhang*. A wide opening in the entrance front is spanned by a beam and three-tiered entablature, supported by two fluted columns and carved cloud-motif Tibetan capitals. Originally open, and probably protected by a heavy curtain as at Lo Gekar further north, this entrance screen is now largely in filled by later walls and a small projecting masonry porch, presumably added for reasons of security or better weather protection. The centre section of the entablature projects to support a balcony and a large *rabsal* (rab gsal) window to the upper front room of the gonpa. This opening has a single centre pillar and carved capital supporting a two-tiered projecting canopy, but the window has been closed with later masonry.

The entrance hall, some 9m by 4.5m, and 4m high, has a main beam running north-south supported by two substantial square pillars and simple capitals. Opposite the entrance, and a little off-axis, stone steps lead up to the *dhukhang* door, which has a door frame carved with *chotsek* (chos brtsegs) and a three-tiered bracket head above. Through another door in the southeast corner a stone staircase gives access to the upper floor. There are paintings on all walls of the entrance hall.

The *dhukhang* is entered on the centre of the east wall, with the sanctum and its colossal Maitreya statue at the far side on the centre of the west wall. It is a large square hall, 15m by 15m, with five main beams spanning north-south each supported by four pillars. The hall is therefore five bays wide by six bays deep. The six central bays, three wide by two deep, are open to the floor above, and the two central pillars rise through this space to richly carved capitals and a two-tiered bracketed cornice and ceiling inserted below the main roof of the upper floor. One bay of the roof to the east is open to the sky, flooding light into the central space and down into the *dhukhang*. There are no windows in the walls of the *dhukhang*, so that this is the only source of light reaching the lower floor.



The sanctum at the west, 60cm higher than the floor of the *dhukhang*, is wide enough to permit circumambulation around the base of the main statue. Maitreya Buddha sits cross-legged on a lotus cushion with smaller standing monks at each side, on a massive throne decorated with plaster scrolls, auspicious symbols and horses carrying jewels. The statue rises through two storeys, with a lantern above the roof throwing light through a small window onto the face. The figure is dressed in religious robes, with a bare head and *unihsa*, and raised hands in the *dharmacakra* mudra. Lotus flowers rise to right and left beside the upper arms of the figure, that on the proper left terminating in a small pot and stupa.

Behind is a richly decorated torana screen, with elephants, lions, *saraba* with riders, and then, above a cross beam at shoulder height, makaras with foliage tails scrolling up to a winged garuda at the top. Shelves on the inside of the upper circumambulatory gallery contain rows of miniature Buddha figures.

UPPER FLOOR

The stone staircase south of the entrance hall leads up to a single door in the southeast corner of the upper floor. This large first room is five

bays wide like the *dhukhang* below, and four deep, and in effect forms a generous gallery overlooking the central space of the *dhukhang*. It is very well lit, as an entire ceiling bay is open to the sky, in addition to two windows in the north wall. A log stepladder gives access to the roof above.
A door in the east wall leads to a front chamber above the entrance hall. Although this was presumably the main reception room, *zimkhang* (gzim khang), it is now completely unadorned and neglected, with only one carved capital in the opening to the balcony above the entrance to suggest its former status. This window opening is now blocked by later masonry and window framing.

Returning to the *dhukhang* gallery, doors to the north and south of the central open space lead through the west wall, which is a partition on the line of the fourth main beam. The south room, the larger of the two rooms beyond, is three bays wide and two deep. Doors on the south lead to the later south wing of the gonpa, and at the southwest to a later room, containing a kitchen and toilet, built out to the south of the sanctum. At the north-west is the upper part of the sanctum, with a screen opening onto the face of the statue, and a door to the upper circumambulatory gallery. A door in the north partition wall leads to the north room, two bays by two, with a single north window, and the exit door from the circumambulatory gallery in the southeast corner.

SOUTH WING

There are two principal rooms on the first floor of the southern extension to the gonpa, with some further subdivision of the spaces with thin brick partitions. The southeast room is a more imposing interior, with four square pillars and capitals and a central lantern roof-light. A raised platform at the west side supports two large seated clay statues.

The ground floor below, entered separately through a door at the east, has no windows, and so was presumably used for storage or stables.

The only access to the roof is through the open skylight in the centre. The roof of the south wing is 70cm lower than the main roof. Only the roof lanterns break the large flat surface, but at the west the sanctum walls have been raised to support an upper roof above the main statue's lantern, and a small room added at the southeast corner over the kitchen on the floor below.

BUILDING HISTORY

From the autobiography of Künzang Longyang, the temple's founder, we now know much more about the original construction period from 1684 to 1695. Some further deductions on the sequence of building operations can also be made from an examination of the structure.
The *dhukhang* was the first part of the gonpa to be built, with massive rammed earth walls up to 90cm thick on the ground floor. The attached western sanctum has stone walls, but there are no indications, such as construction joints, to suggest that this was a later extension.

The entrance hall could have been added later, as there are butt joints between its rammed earth walls and those of the *dhukhang* east wall, and the central axis of the entrance pillars is a little south of the *dhukhang* door axis. However, if the entrance hall had been built considerably later, rather than in the initial construction phase, it would mean that the upper floor above the *dhukhang* could only have been reached by external stairs (not, of course, out of the question), and that the *dhukhang* door, not too imposing, had been the main entrance.

A puzzling feature of the east front is its asymmetry: the entrance portico, the hall within, and the window and balcony above, are all designed around the central east-west axis which extends (with a slight slip) right through the *dhukhang* to the main statue in the sanctum. But the east front extends further to the south than the north to accommodate the staircase and a toilet. One might expect this southeast corner to be a later infill, but it is not: the rammed earth of the entrance hall extends southwards to the corner without a construction joint. The present large crack in the front wall is not at the southeast corner of the entrance hall, but further south, and is probably related to differential settlement of the stone toilet walls.

The entire south wing is a later extension. Both floor and roof levels are lower than the main building. The walls are built in stone, and it can be seen in the ground floor rooms, where they are unplastered, that the north-south cross walls lean against the battered and originally external south wall of the *dhukhang*.

On the east front of the south wing can be seen the remains of a timber gallery which would have been reached through a now-blocked door at the top of the stone stairs. This gallery would probably have given access, through a now lost doorway, to the larger of the two upper rooms in the south wing.

The small stone-walled block south of the sanctum is also a later extension, as can be seen by the construction joint in the west wall separating it from the sanctum. It has a stable/store on the ground floor with a separate external entrance, and a kitchen and toilet above. It may have been built before the south wing, as it extends only as far as the corner of the *dhukhang*.

On the roof, the room above is later again, as it has been built over the roof light/smoke hole of the kitchen below, and the adjoining shelter is built over the lantern above the main statue. Both these spaces revert to rammed earth built on the stone walls below. At the main east entrance, the small outer porch, as noted above, is a crudely built later addition which obscures the imposing original portico.
PAINTINGS

All four internal walls of the entrance hall are decorated with wall paintings, although in some places badly damaged by water penetration through the roof. To the right of the entry there is an inscription on the later infill panel, and then two of the four guardians on the original wall in the southeast corner. The south wall has landscape scenes of buildings, perhaps pilgrimage sites, but damaged and obscured by water runs. On the west wall there is a medicine Buddha with more landscape scenes, and then two wrathful deities at each side of the *dhukhang* door. Further to the right is a Padmasambhava and a landscape background. Paintings on the north wall are too badly damaged to decipher. The northeast wall has the first two guardians to complete the set at the other side of the entrance.

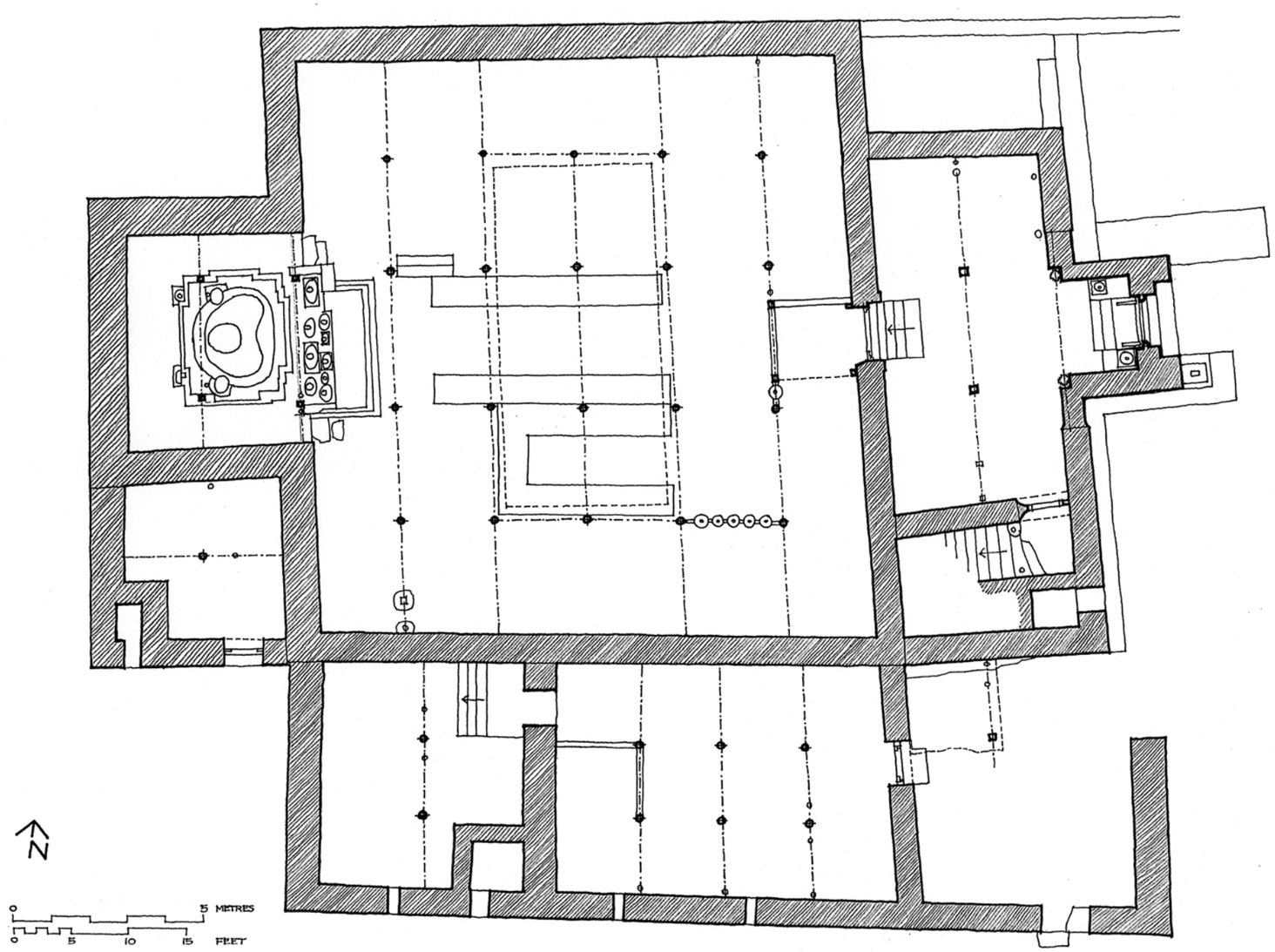
There are paintings on all four walls of the *dhukhang*, but with much water damage on the north and northeast walls. Moving in a clockwise direction from the entrance, the southern section of the east wall has wrathful deities with consorts, and the south wall ten large seated Buddhas with standing attendants and surrounded by a background of small seated Buddhas. On the west wall, to the left of the sanctum there are two Buddhas and a large Padmasambhava surrounded by smaller lamas and deities; to the right is a large lama and two Bodhisattvas, with smaller deities, lamas and lay figures. On the damaged north wall there are a number of large figures, perhaps Bodhisattvas, to right and left, with fierce deities in the centre, surrounded by small deities and dakinis. The figures on the northeast wall may be the four guardians.

The small inner porch screening the entrance door has female figures in a later, more naturalistic Chinese style.

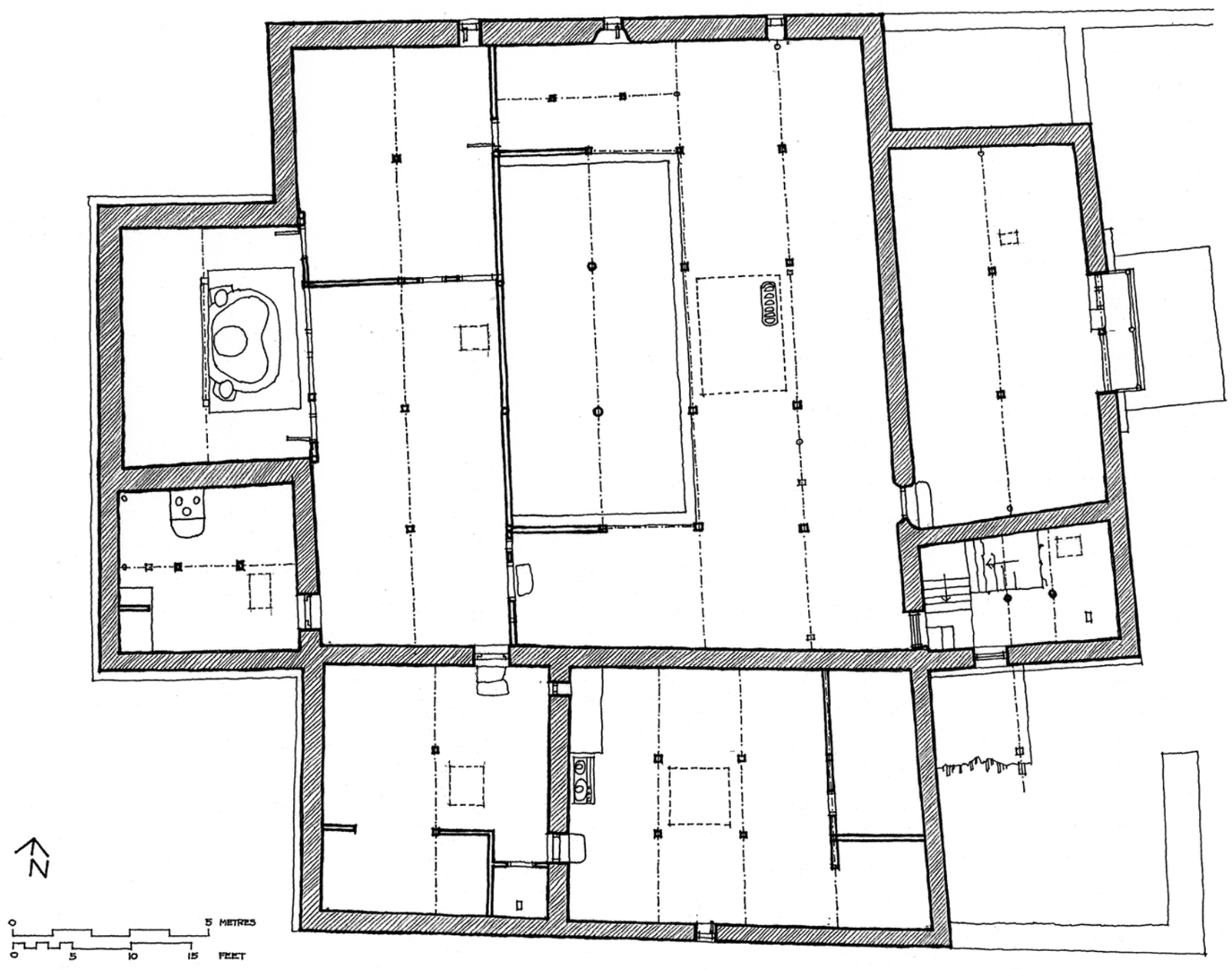
In the central space of the *dhukhang* the lantern walls behind the two taller pillars are decorated, but the paintings are too dirty and damaged to be made out from below.

The three walls of the sanctum around the Maitreya Buddha are fully decorated on both floors. On the ground floor south wall there are three Buddhas with small Buddhas, Bodhisattvas and lamas. On the west wall is a central blue Buddha with a white partner in *yabyum*, and flanking Bodhisattvas. The north wall is damaged, with flaking paint, but has a central Bodhisattva with perhaps Buddha figures at each side, and small lamas.

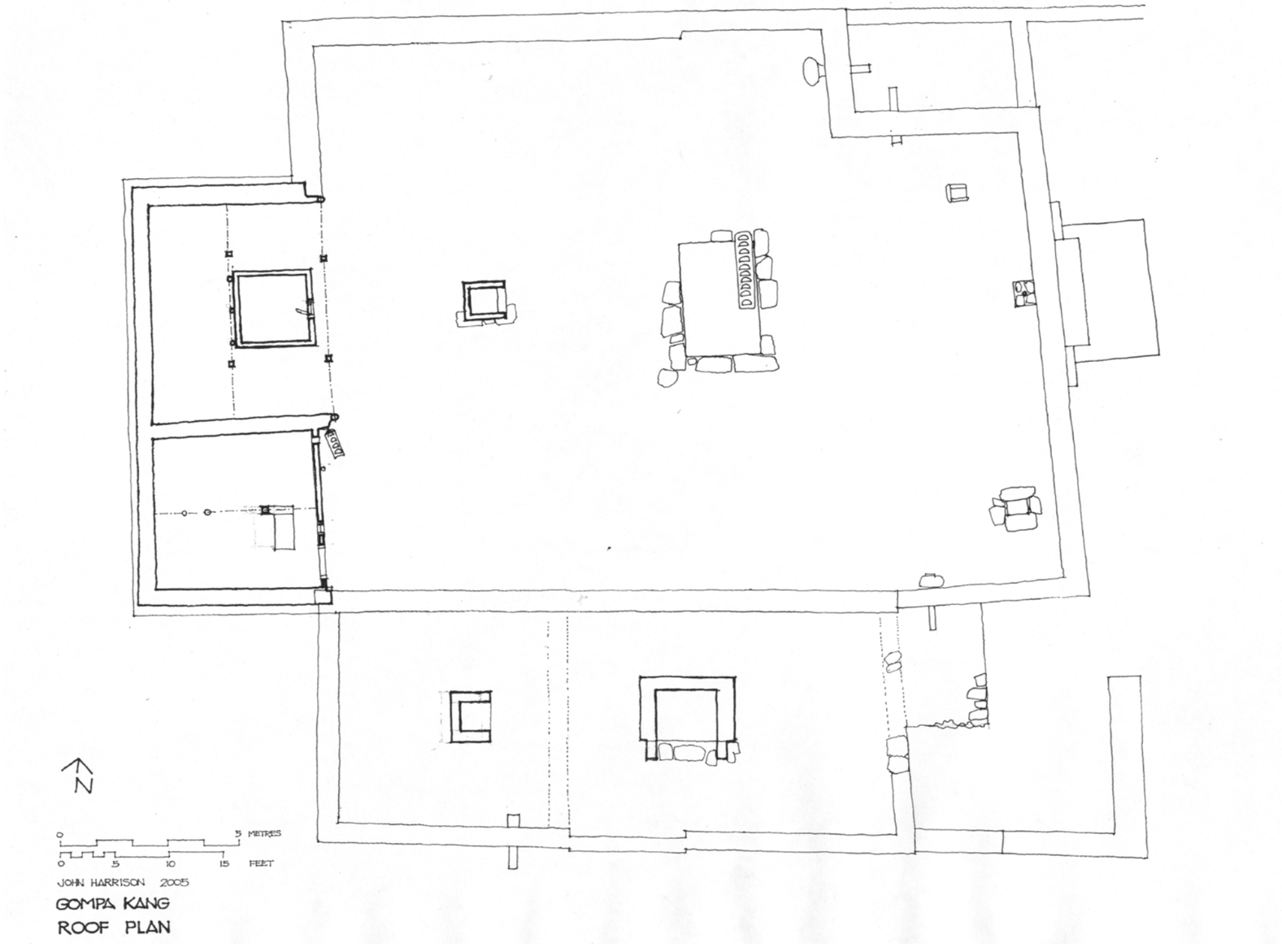
Access was not obtained to the sanctum gallery above, and the west wall could not be seen, but there appeared to be two Bodhisattvas and small figures, lamas, on both north and south walls. The three-sided lantern above the statue has three roundels with Bodhisattvas on each side. There are no wall paintings in any of the other rooms on the upper floor.



GROUND FLOOR PLAN | EXISTING CONDITIONS, 2005
Drawing by John Harrison

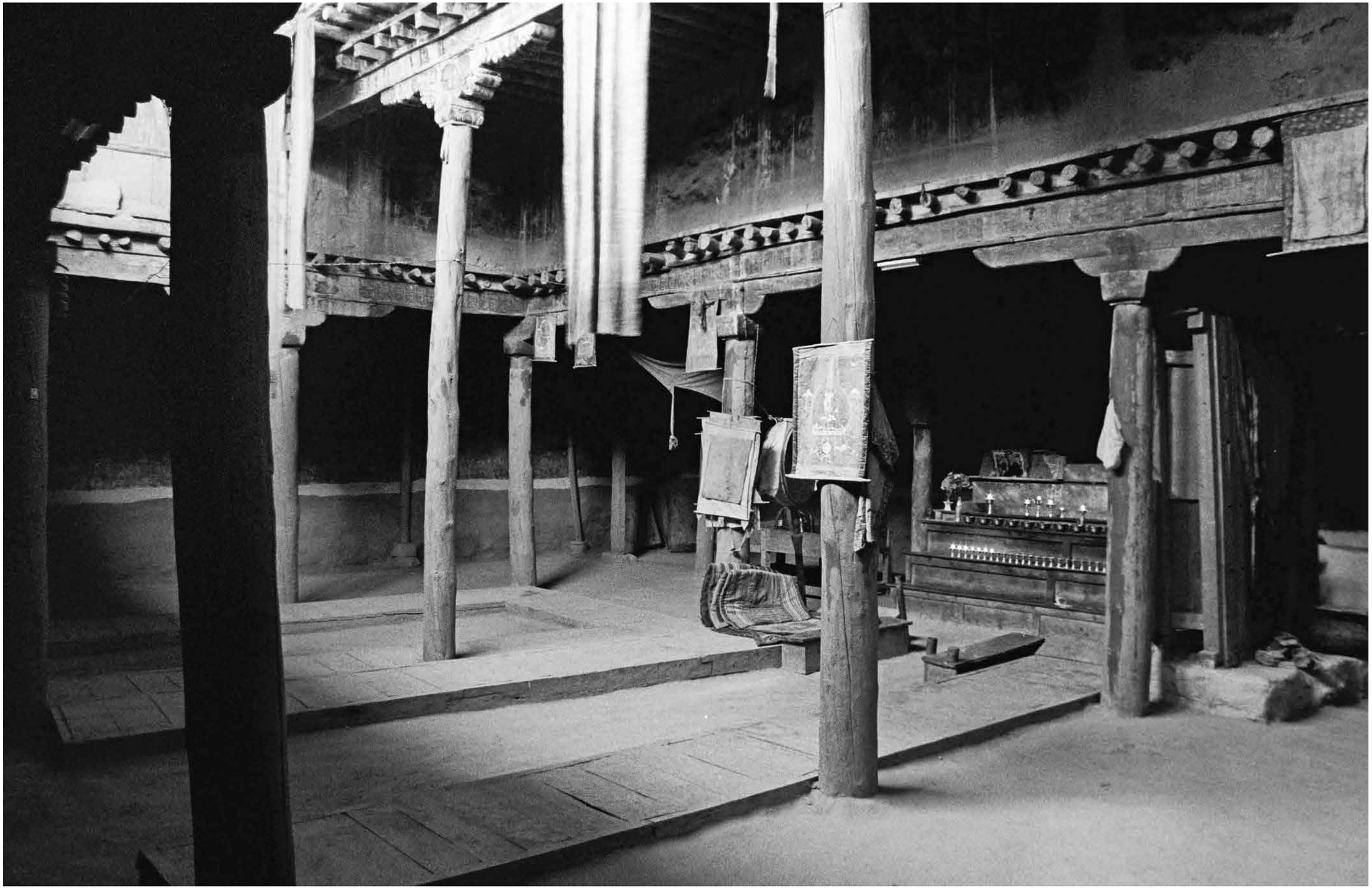


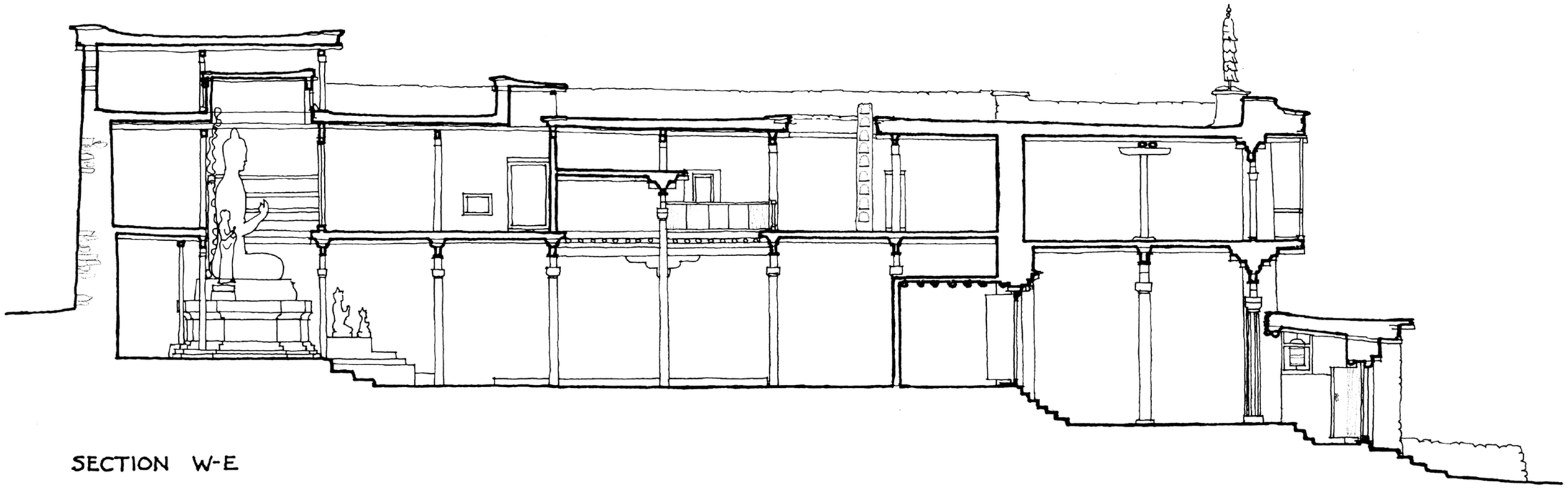
UPPER FLOOR PLAN | EXISTING CONDITIONS, 2005
Drawing by John Harrison



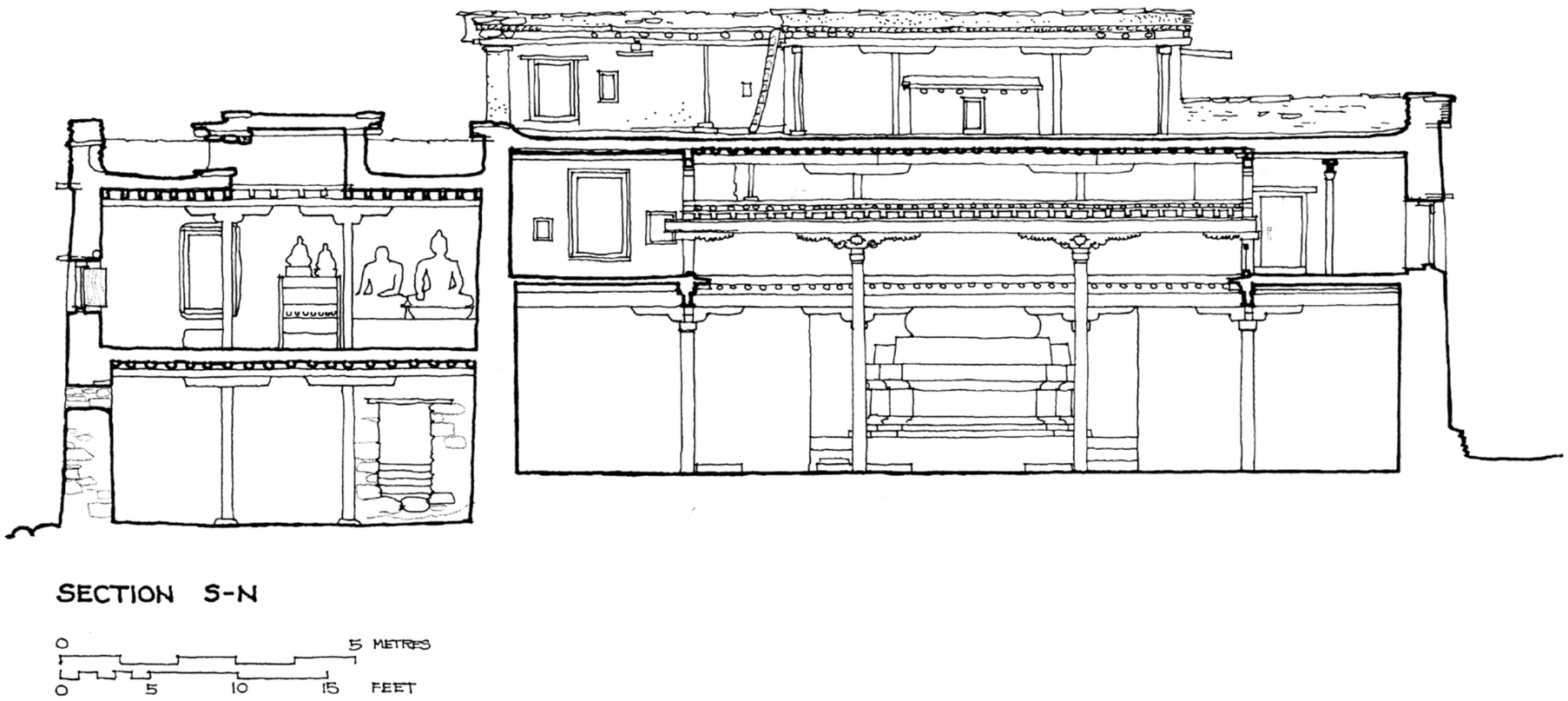
ROOF PLAN | EXISTING CONDITIONS, 2005
Drawing by John Harrison

VIEW OF THE DHUKHANG
Photo by John Harrison, 2005





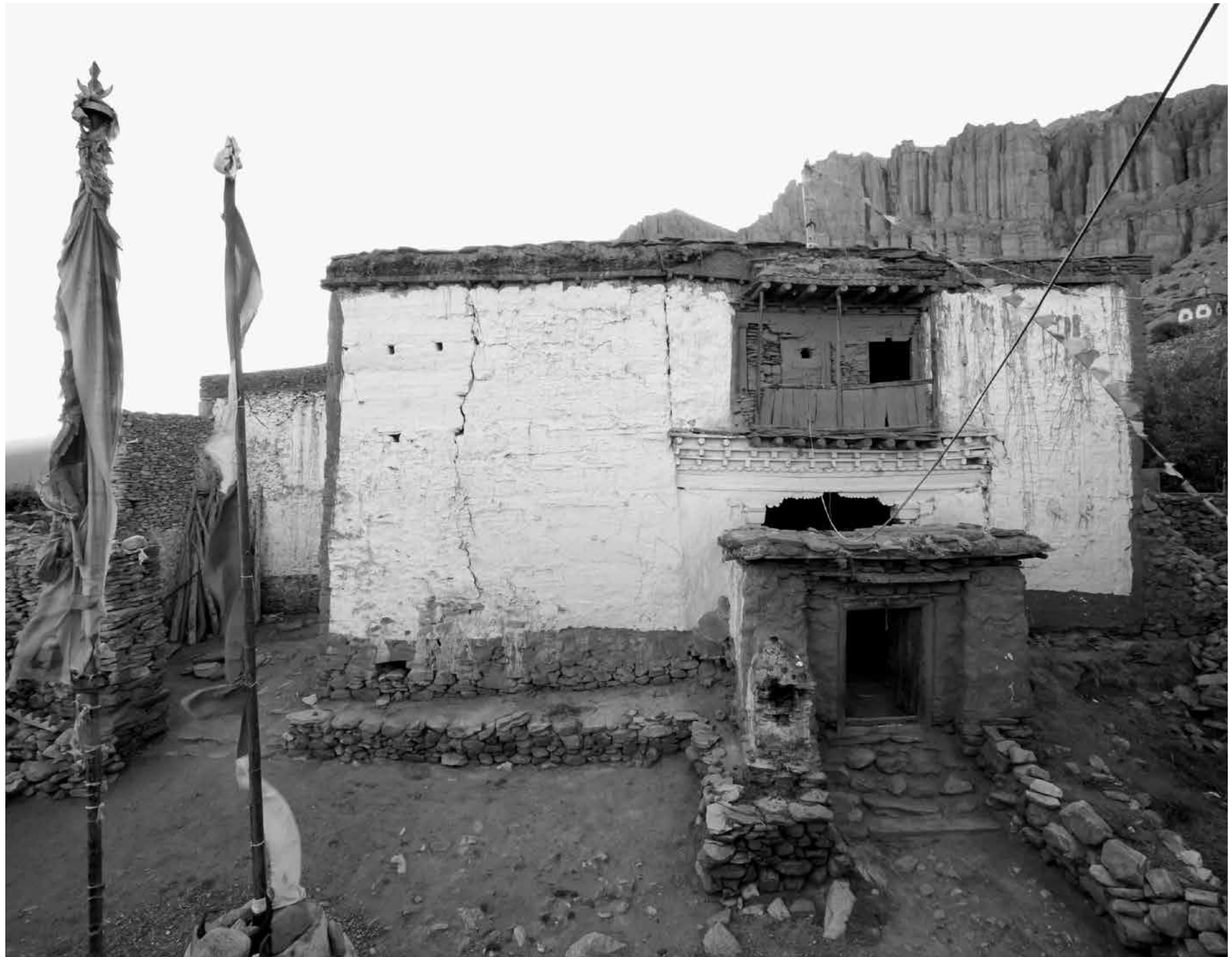
SECTION WEST–EAST | EXISTING CONDITIONS 2005
Drawing by John Harrison



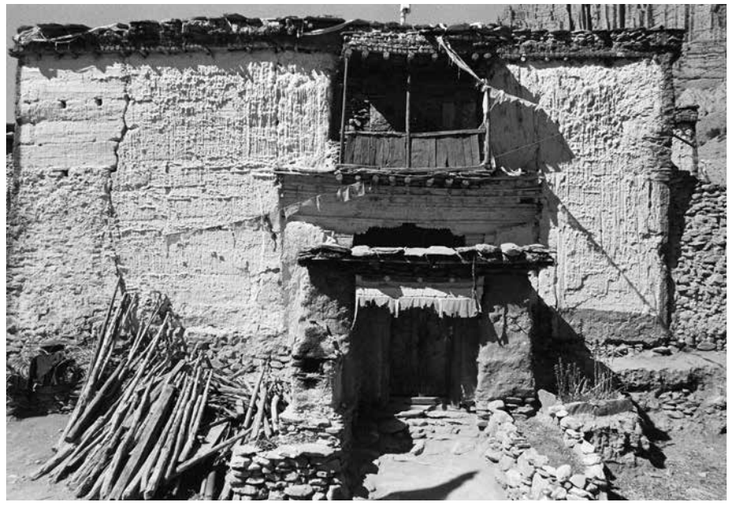
SECTION SOUTH–NORTH | EXISTING CONDITIONS 2005
Drawing by John Harrison

THE PRINCIPAL FACADE

The entry porch is a recent addition that will be removed. The original open entry to the monastery will be restored and the balcony above will be rebuilt.



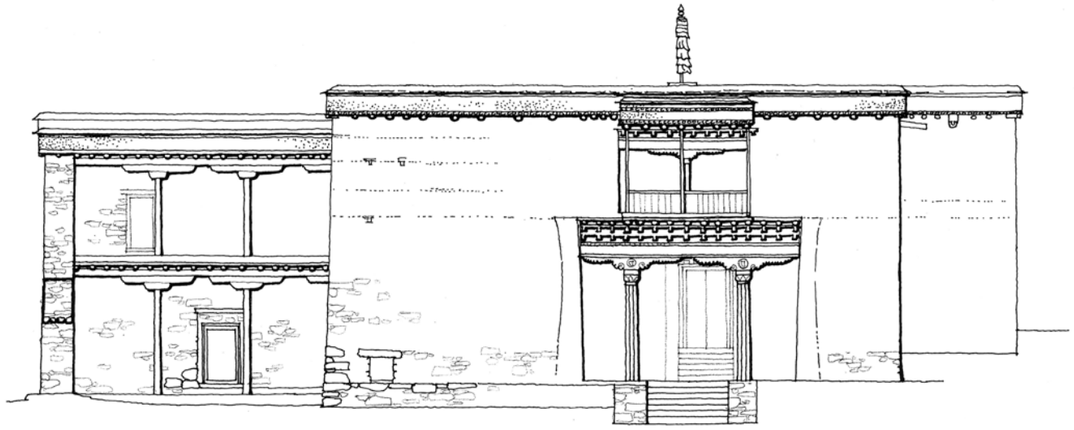
PRINCIPAL FACADE FACING EAST
2022



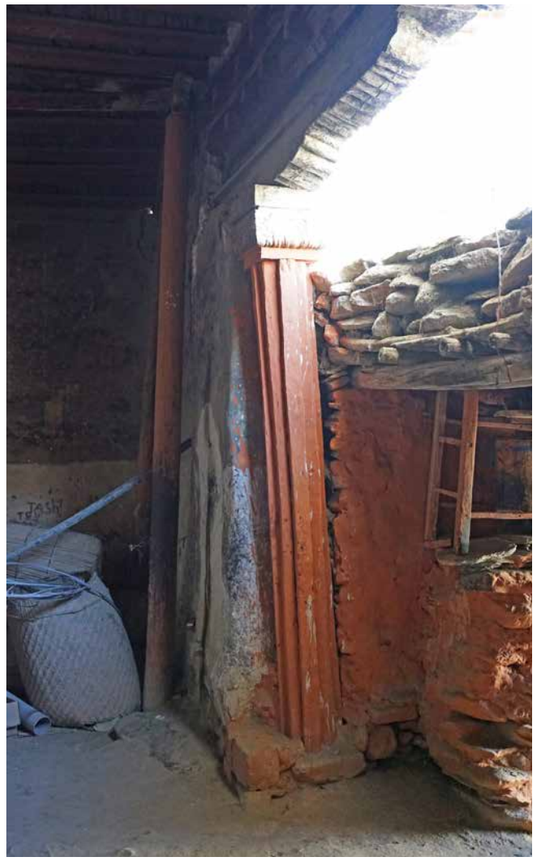
PRINCIPAL FACADE FACING EAST
Photo by John Harrison, 2005
The left corner section, demarcated by a vertical crack, houses the interior staircase. It is likely a later addition. The main entrance used to be open but was at some point closed off with stone walls and a masonry porch. The balcony above has also been closed off with stone walls. By 2022 the balcony collapsed.

DETAIL OF CAPITAL
Photo by John Harrison, 2005

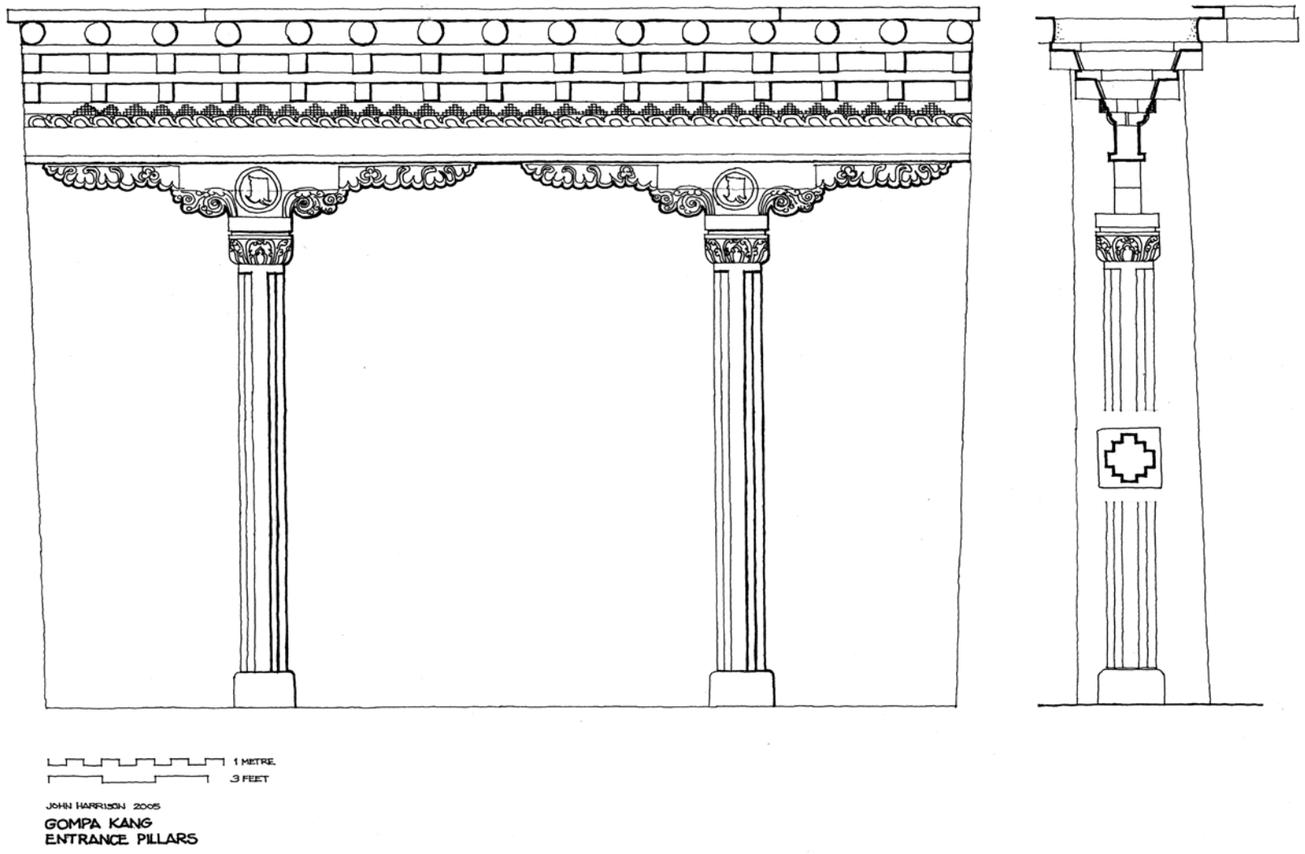
PRINCIPAL FACADE | EXISTING CONDITIONS 2005
Drawing by John Harrison



PRINCIPAL FACADE | PROPOSED RESTORATION
Drawing by John Harrison



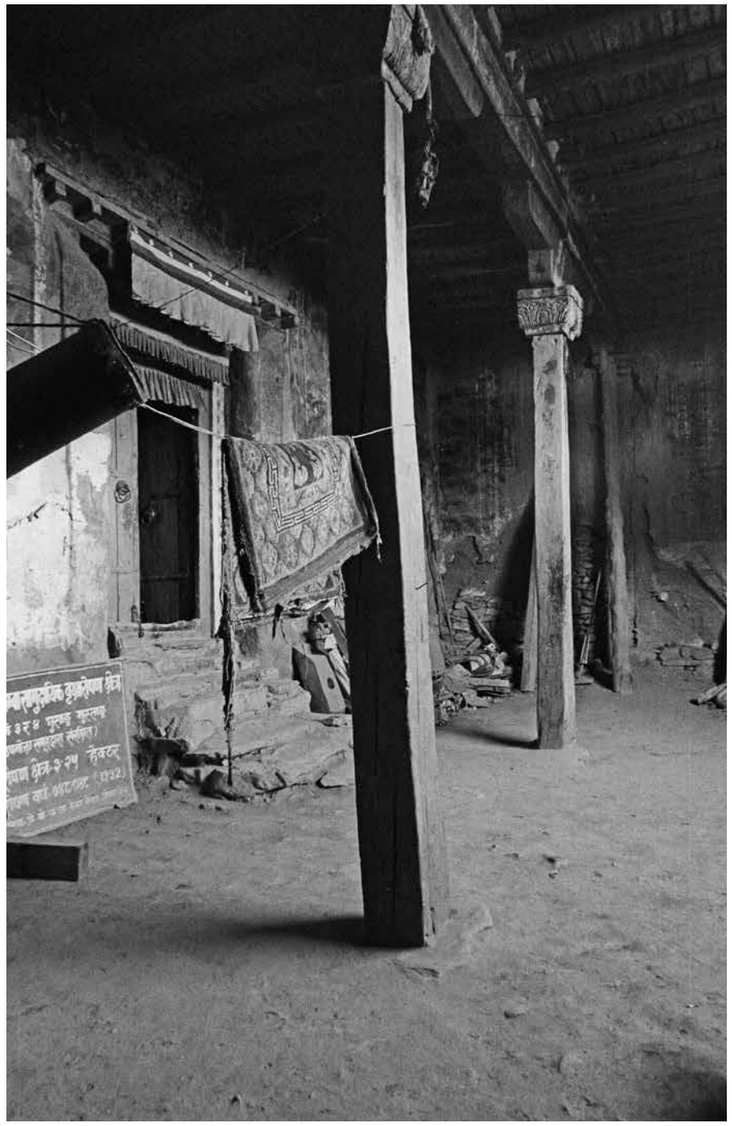
CROSS BEAM AND TEMPORARY SUPPORTS
The badly damaged column is not original to the buildings. It leans to the left whereas the capital has tilted in the opposite direction. The base stone was obviously only temporarily placed there. The entire assemble is in need of complete reconstruction including a new foundation for the pillar to support the weight of the balcony and roof above.



MAIN ENTRANCE PILLARS AND BEAMS
The pillars, with a cruciform cross section, are not made out of a single tree but laminated from five smaller sections. It is unlikely that they are original. Severe damage likely will make a replacement necessary.

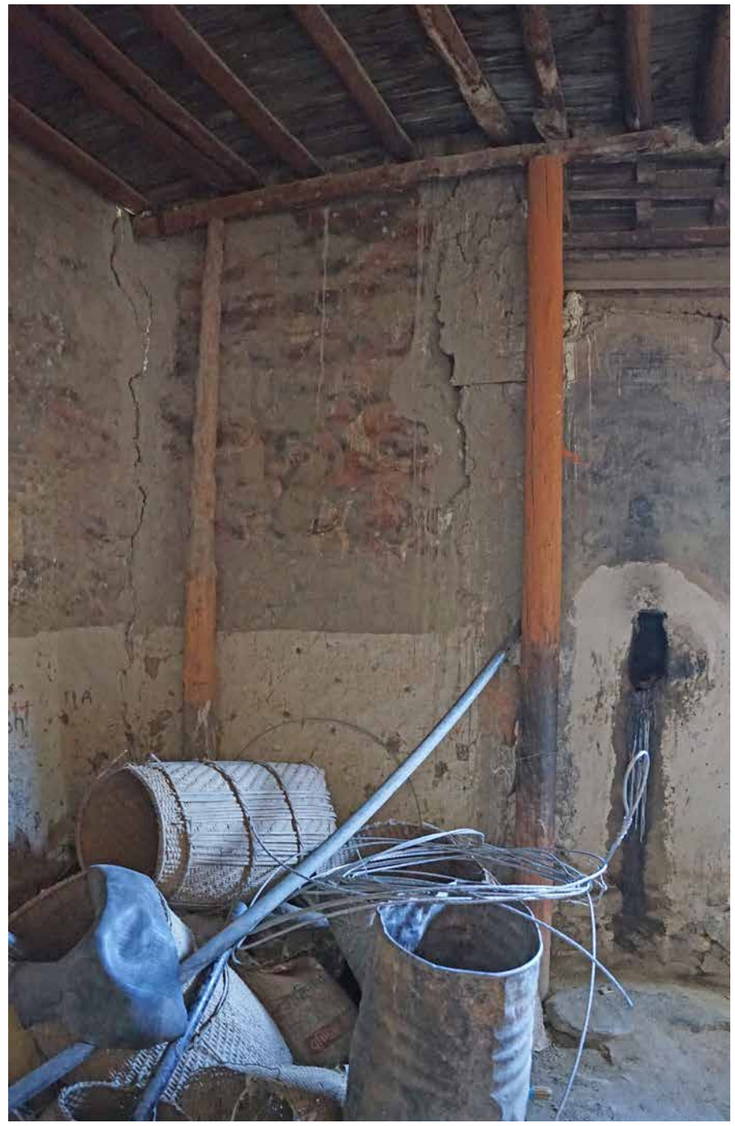
ENTRANCE HALL
GROUND FLOOR – L03

CENTRAL PILLARS AND CROSS BEAMS
The pillars will likely be reused, however, the cross beams are in need of replacement.
Most of the wall paintings are damaged beyond repair.

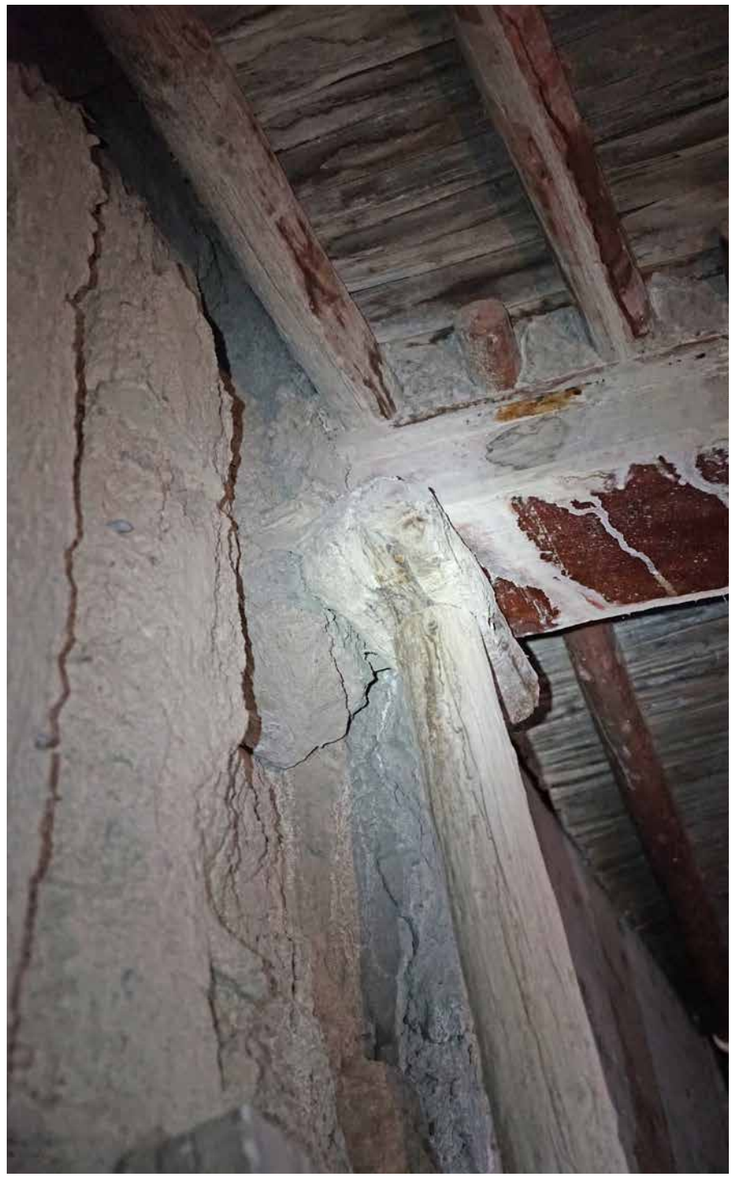


VIEW FROM SOUTH
Photo by John Harrison, 2005
As can be seen in this photo, the severe damage and erosion of the rammed earth walls dates back more than 20 years.

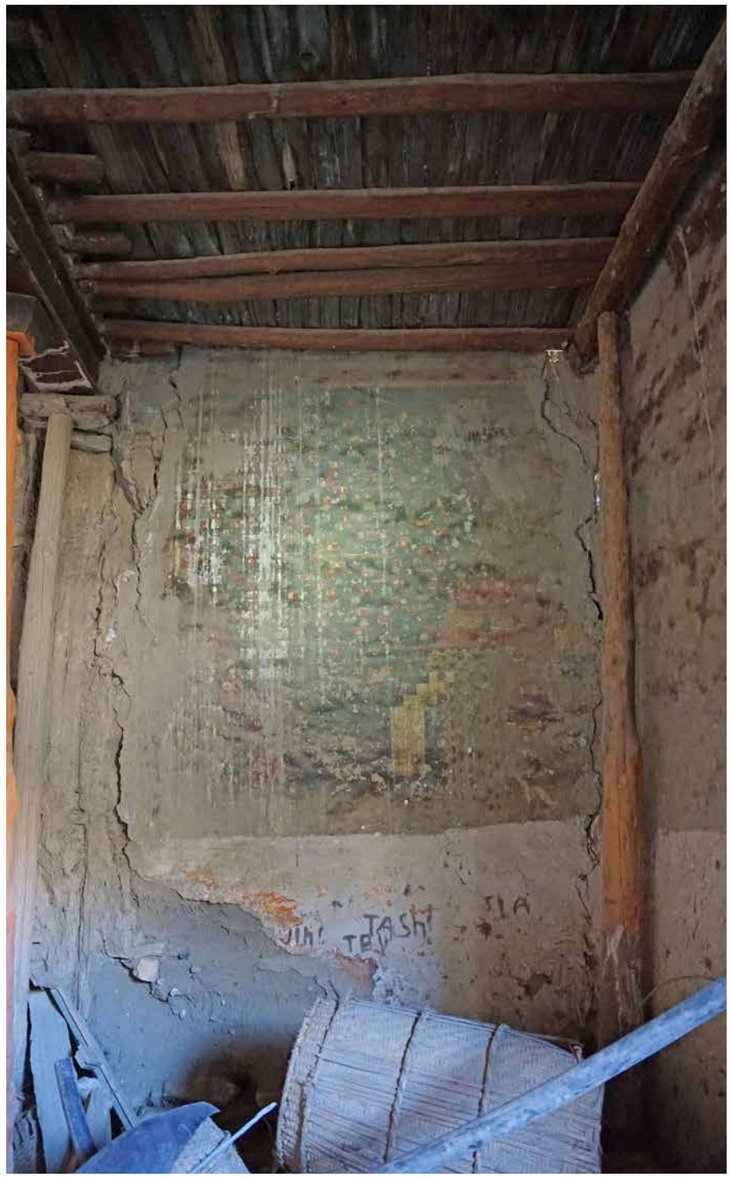
DAMAGE UNDER THE MAIN BEAM
Many years of leaks from a damaged water spout two floors above have severely eroded the wall and completely destroyed the wall paintings. The rammed earth wall was partly filled in with rocks and the main beam supported by makeshift supports.



SEPARATED WALLS
Light can be seen through the vertical crack indicating outward movement of the south wall. The round joists are damaged by wet rot and have been shored up.



DETAIL OF THE NORTH WALL AND BEAM
The wall has been eroded to a point that is can't provide sufficient bearing for the cross beam. The beam is currently held up by a temporary prop.



NORTH-EAST CORNER OF THE PORTAL
Severe water infiltration has damaged the main beam and round joists beyond repair. Similar to the situation in the south of the room, here the beam is also temporarily supported by two props (left) and the rotten joists are held up by a make-shift assembly of a pole and a cross piece (right). A vertical crack in the corner indicates an outward movement of the east wall.

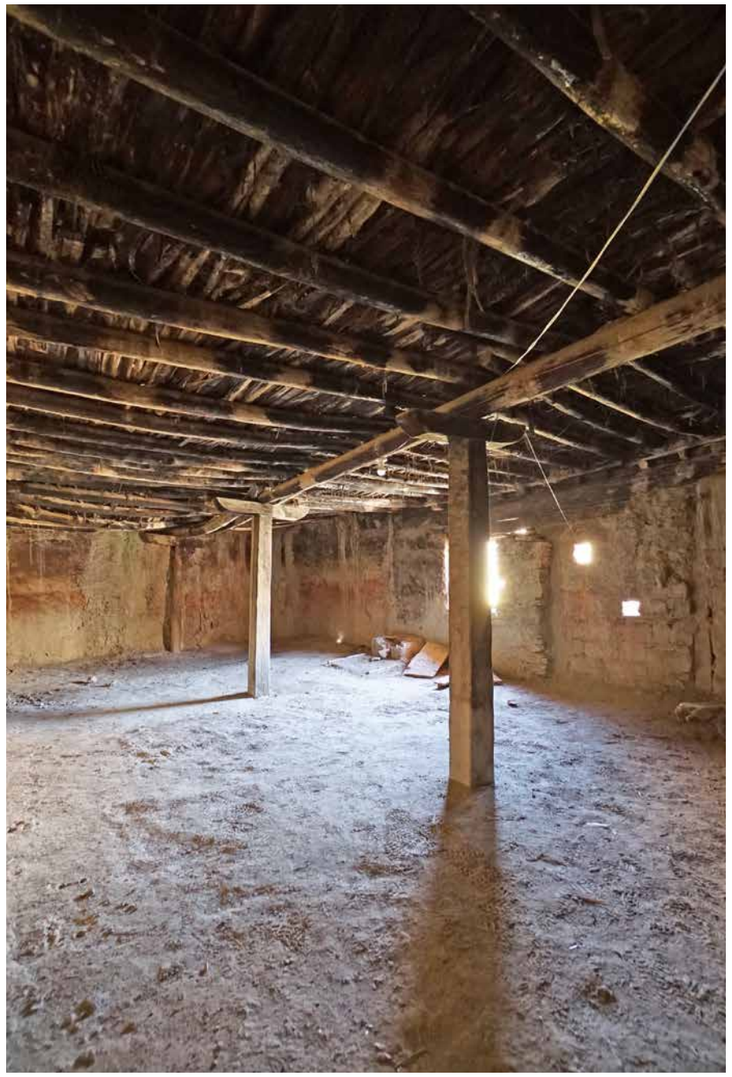
BEAM AND TEMPORARY SUPPORTS
Stains are visible on the ceiling and beam and indicate many years of massive water infiltration from a damaged roof all the way to the ground floor. The large beam's structural integrity is severely compromised. It was propped up by two additional pillars. It is not clear where the carved capital in the center originates from. Mud smears on the wall paintings bear further witness of extended periods of water leakage. Sections of the paintings have flaked off due to increased moisture in the mud and stone walls.

RECEPTION ROOM
UPPER FLOOR – U05

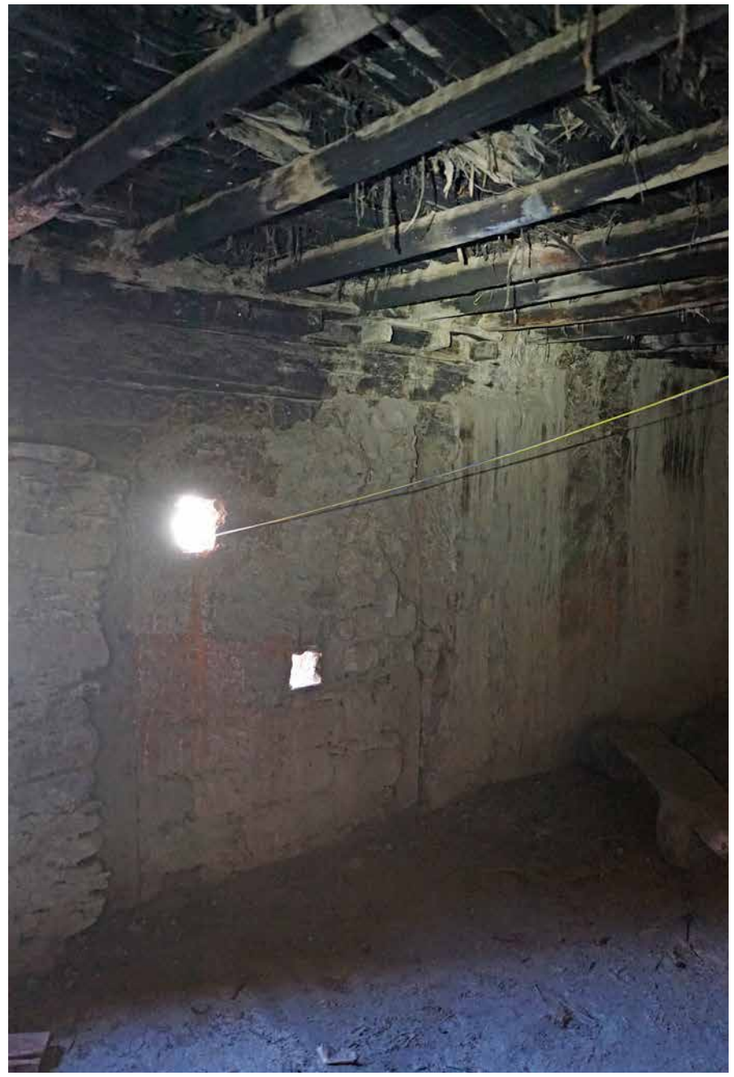
The exact use of this room is not documented. It might once have been used for receptions and for meditation. Over the years it has fallen into disrepair and has been poorly maintained. Excessive water damage makes complete reconstruction with new materials mandatory.

FORMER RECEPTION ROOM
This empty room has not been used for a long time. It is planned to restore it with a new timber structure and a large opening to the balcony protected by 4 doors with glass panes.

DAMAGE TO WALLS AND CEILINGS
Many years of leaks have caused the complete deterioration of walls, wall plaster and ceilings.

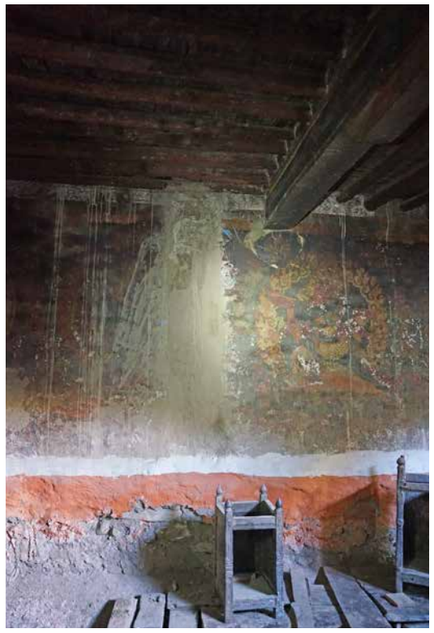
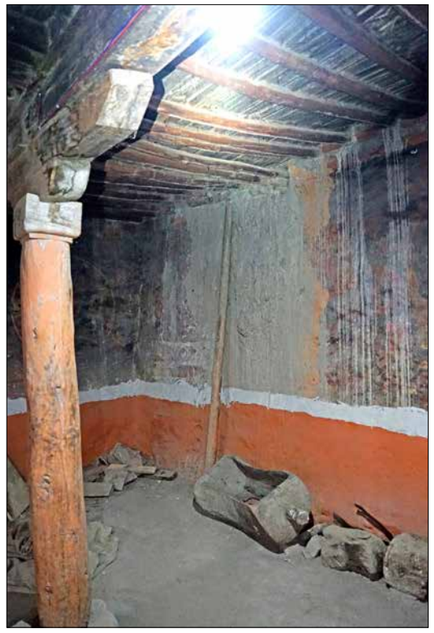
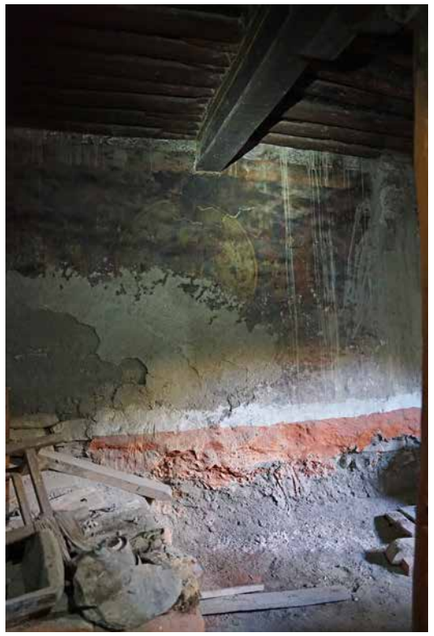


VIEW TOWARDS NORTH-EAST
This room certainly was rebuilt at some time with recycled materials. The capitals are too small, don't match the design used in the dhukhang and are installed perpendicular to the beam. The original cross beam would have certainly been of a rectangular cross-section.



VIEW TOWARDS THE EAST
The opening to the balcony was closed off with mud brick leaving only two small holes in the wall. Most of the two columns and cross beam are encased with mud. The leaking roof has taken its toll on the ceiling structure and walls.

DHUKHANG
GROUND FLOOR – L02

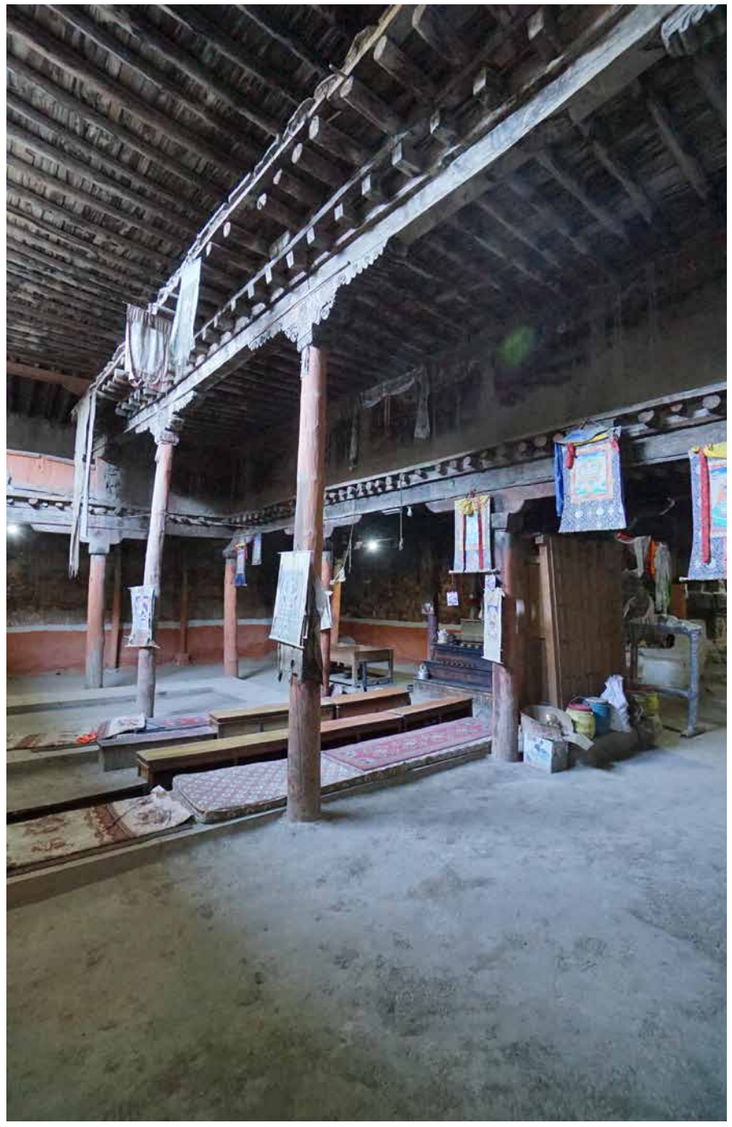





RISING DAMP AND WATER LEAKS
Rising damp and water infiltration from above have eroded large areas of wall plaster and paintings.

MAIN HALL, VIEW TOWARDS THE WEST
Gaps between capitals and beams indicate the settlements of the bearing structure. The columns in front are leaning which likely is a result of earthquake damage. The right cross beam sags which is probably caused by wet rot. Water damage is evident throughout the building.

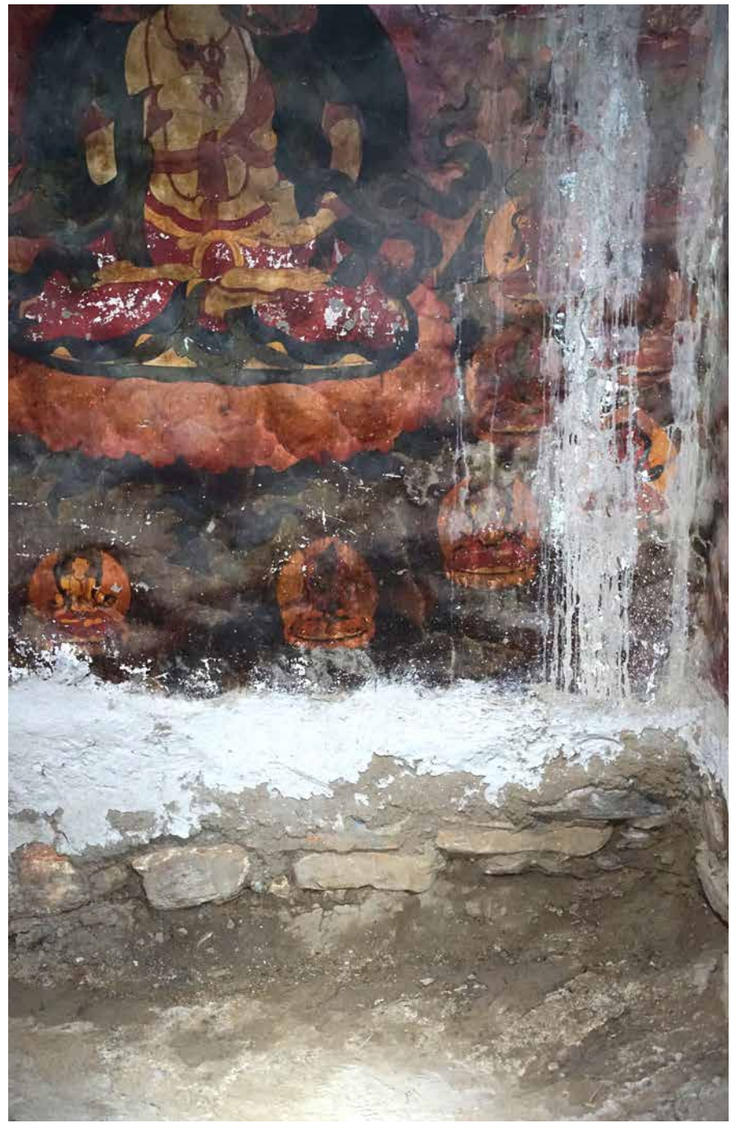
VIEW TO THE EAST
Wall paintings on the east wall were almost completely destroyed by water leaks from above. Peeling mud plaster in the left foreground indicates rising damp. The cross beam in the background is propped up by a post. Note the round pillar that is supported by two stones. In that area the ceiling has sagged by more than 6 inches and will require complete reconstruction.

WALL DAMAGED BY RISING DAMP



VIEW TO THE SOUTH-WEST
The two tall round pillars are leaning. They will be reinstalled on new point foundations.

VIEW TO THE NORTHWEST
The north-west corner of the dhukhang is most affected by rising damp. The new improved drainage system will lessen the impact on the buildings foundations.



DAMAGE TO WALL PAINTINGS

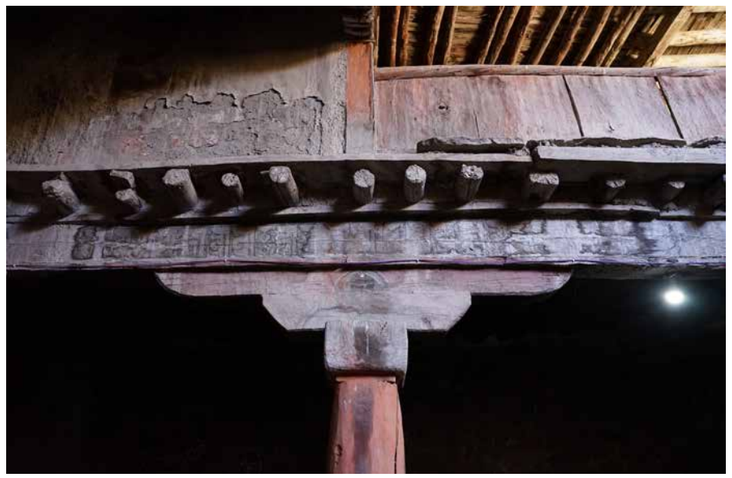
MAIN HALL, VIEW TOWARDS THE SOUTH
The main beam and round poplar joists are held up by temporary supports. Cracks below the beam were poorly patched up with mud mortar.

MAIN HALL, DETAILED VIEWS OF PAINTED CAPITALS AND BEAMS
All areas display signs of water leakage which consequently caused rot and structural damage.

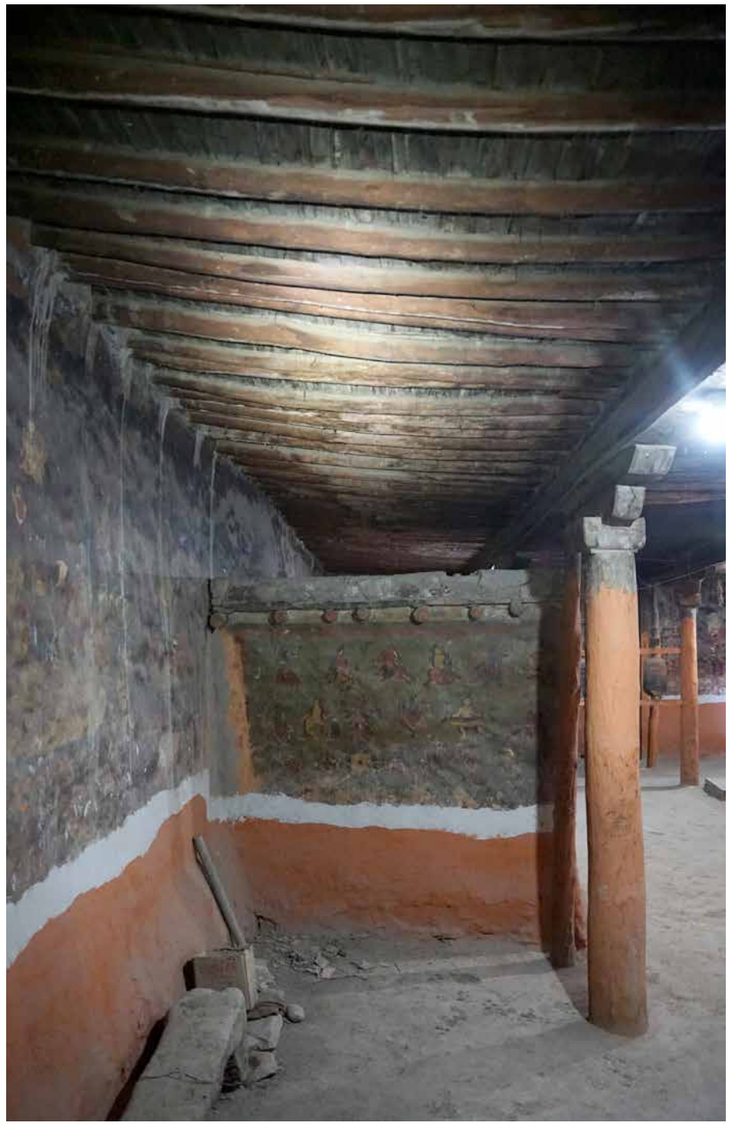


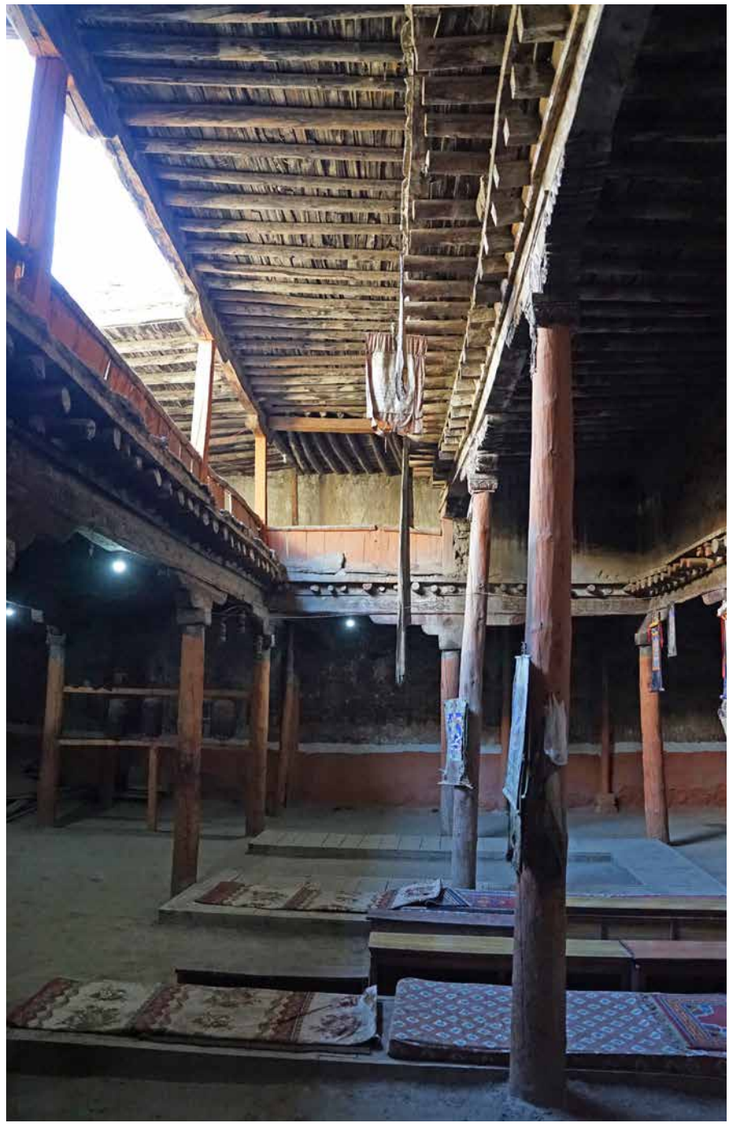




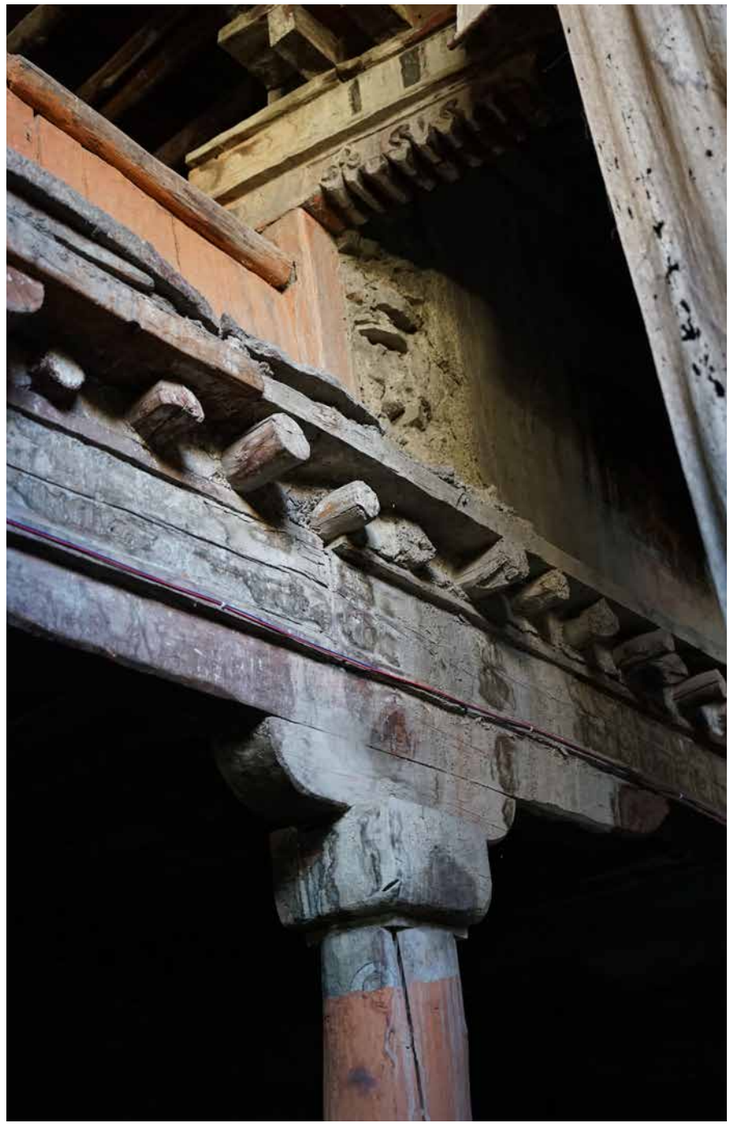




VIEWS OF THE DAMAGED CEILING STRUCTURE
The main beam and round poplar joists are held up by temporary supports. Cracks below the beam were poorly patched up with mud mortar.

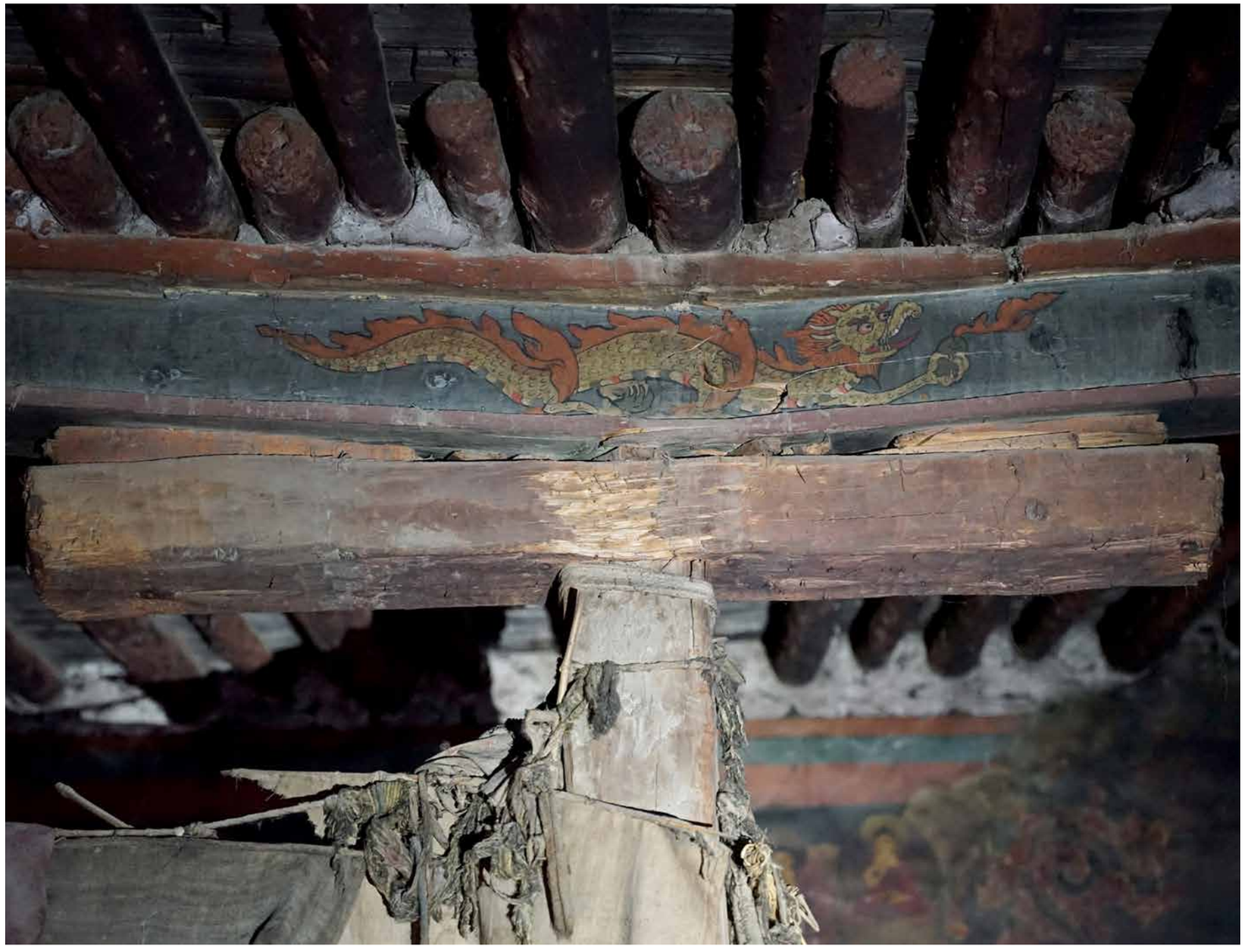




VIEW TO THE SOUTH
Note the leaning pillar in the center.



WATER DAMAGE
Note the leaning pillar in the center.

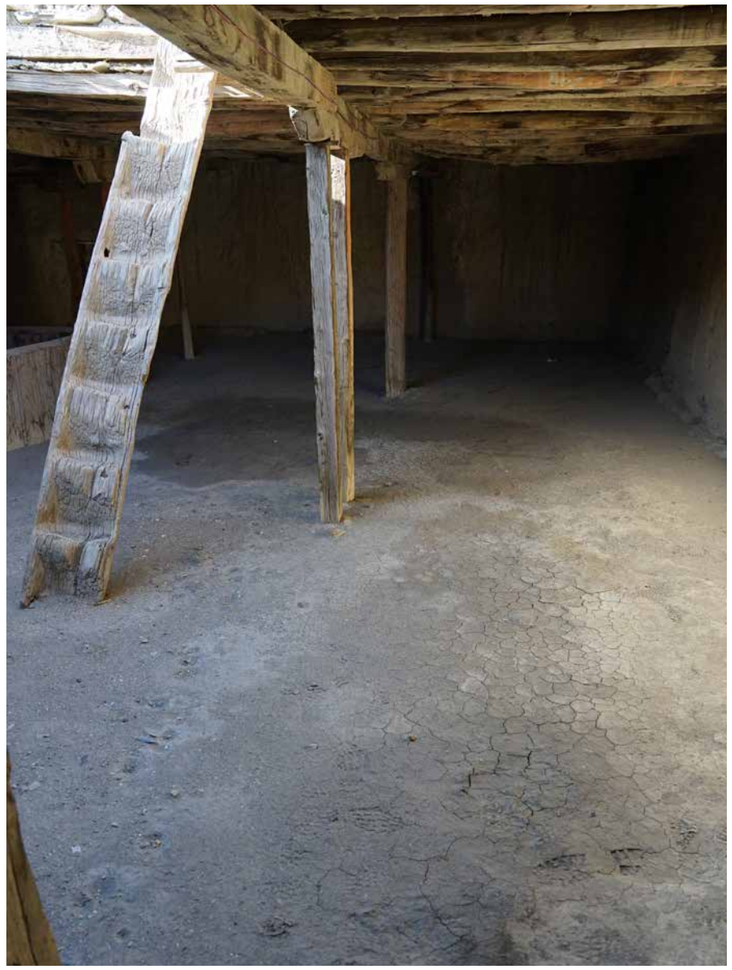


DAMAGE BEYOND REPAIR

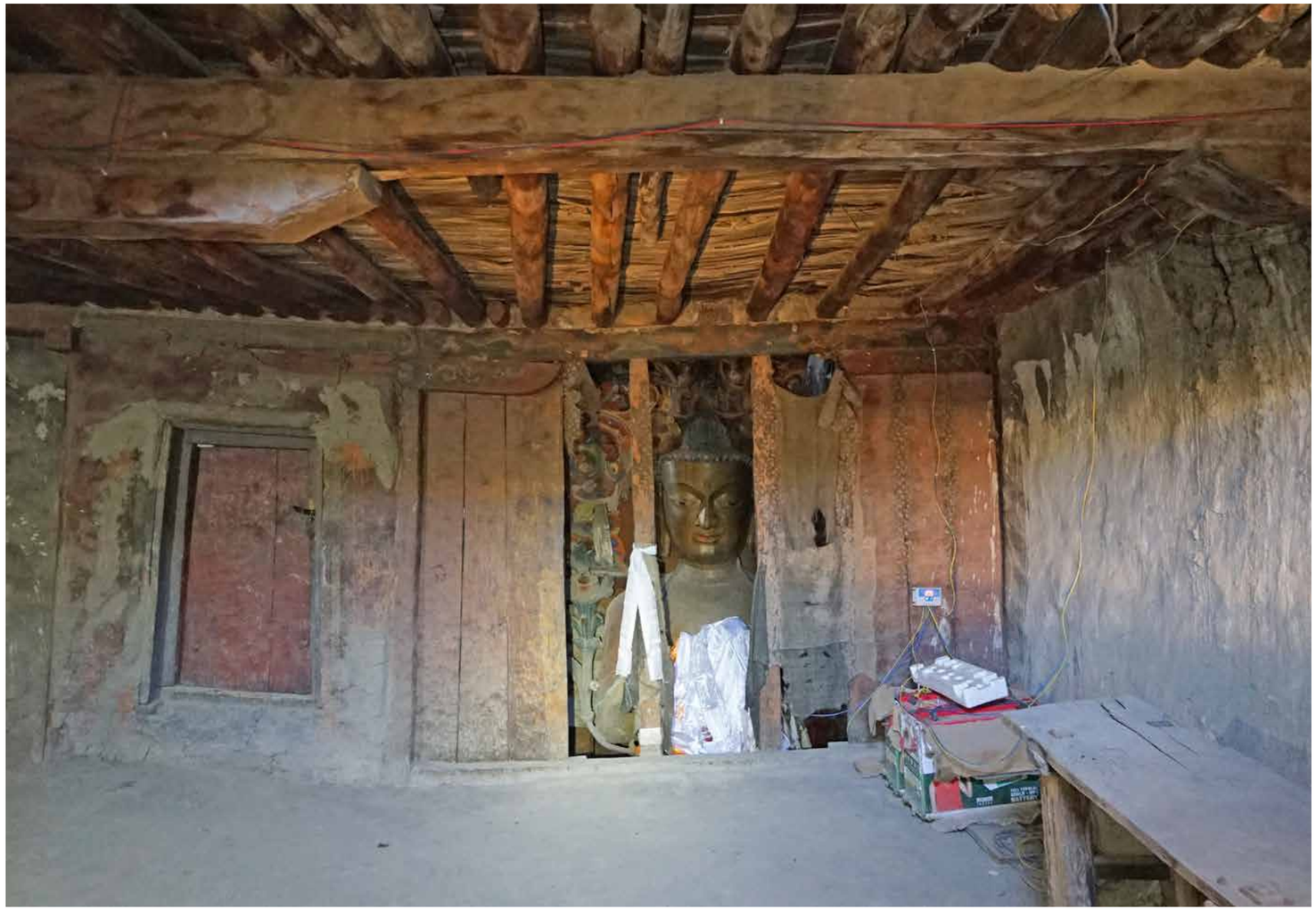
DHUKHANG GALLERY
UPPER FLOOR – U04





ANTECHAMBER
UPPER FLOOR – U02 & U3

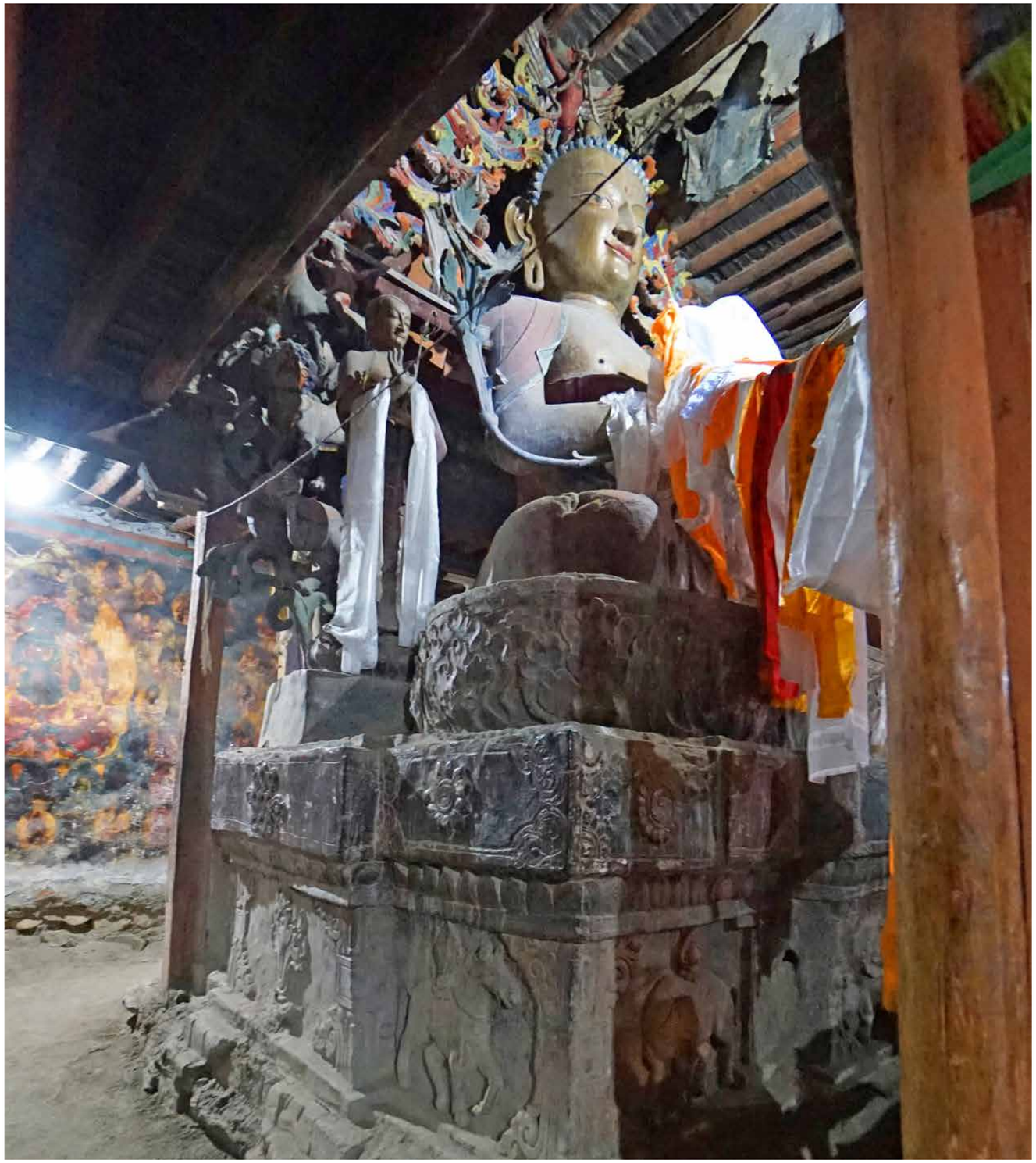


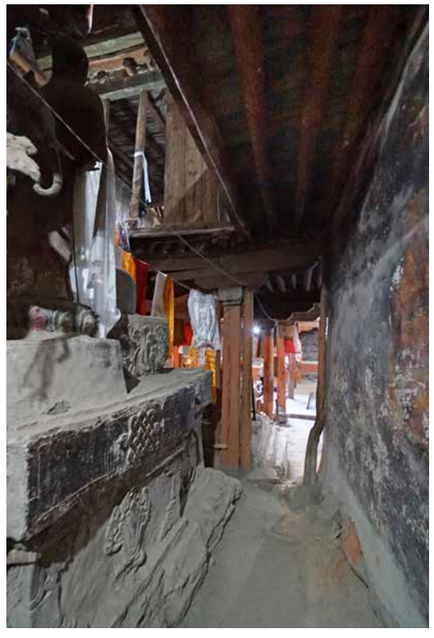
UPPER ROOMS
The northern two bays above the dhukhang are divided into two rooms. One opens to the sanctum and faces Maitreya on eye level. The other room remains unused. Two wooden doors lead to the balcony that allows circuambulation of Maitreya, however, the doors were locked during the field visit to Gonpa Gang.

DAMAGED WALL AND CEILING
The wall exhibits wide streaks of water stains. The round poplar ceiling joists are solid and straight and might be reused for the restoration.

SANCTUM – MAITREYA
GROUND FLOOR – L01

The sanctum's ceiling is supported by four peeled poplar posts with plain hand-hewn brackets and cross beams. The sagging balcony indicates structural problems. The sanctum is the best maintained and protected area of the monastery as no damage to the Maitreya statue, with the exception of the throne, is evident.



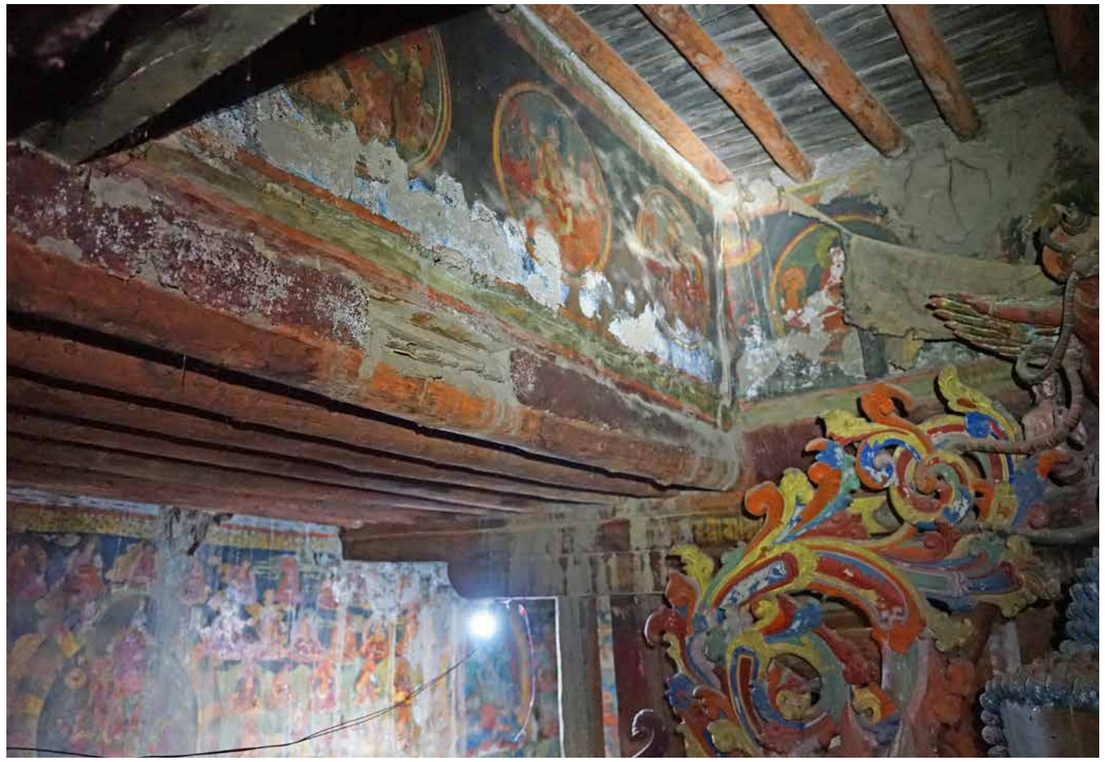


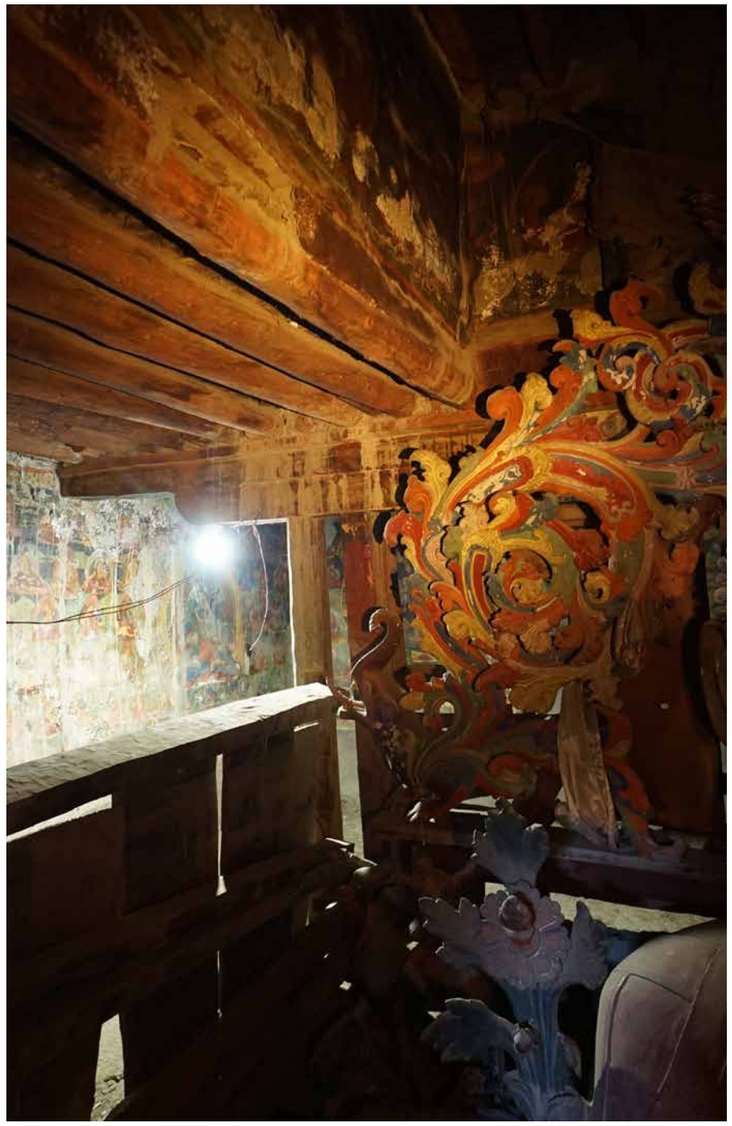
SANCTUM WITH A CLAY STATUE OF MAITREYA
The balcony above the sanctum has been propped up with additional posts and beams, It is evident that the bearing timber structure has been weakened by wet rot. The walls facing north and east are affected by damp which already caused to the wall paintings.

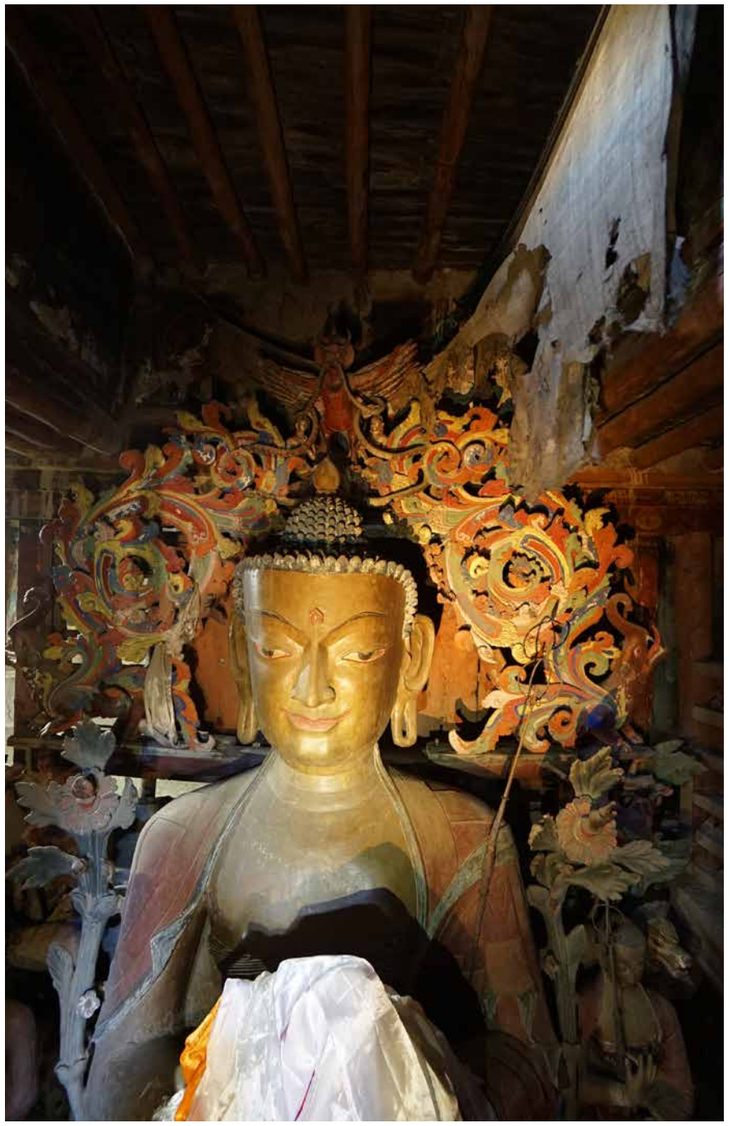
WALL PAINTING DEPICTING BUDDHA
Flaking of the paint layer is an indication of damp walls.

VIEW OF THE BASE OF THE MAITREYA STATUE

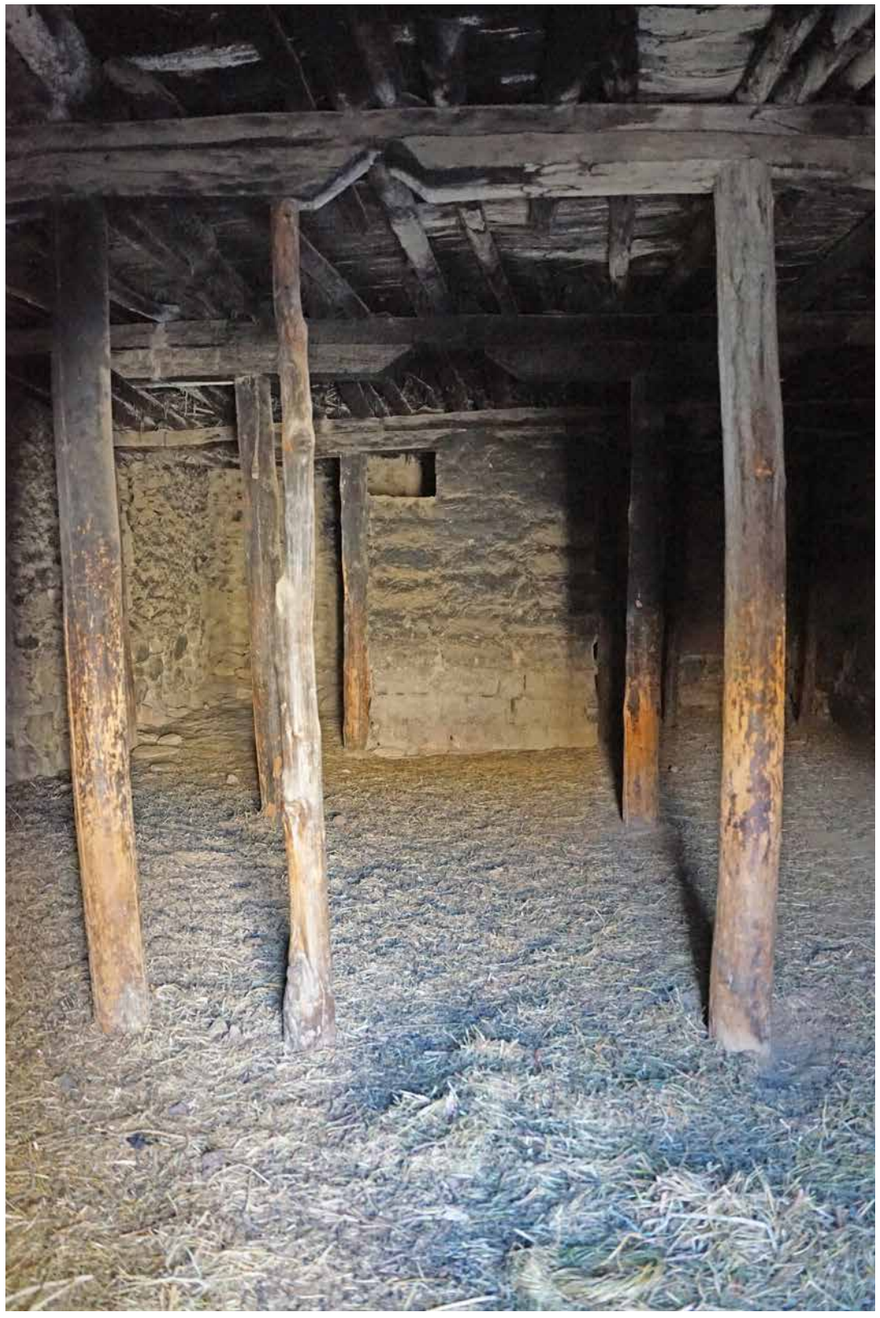
SANCTUM AND BALCONY
UPPER FLOOR – U01







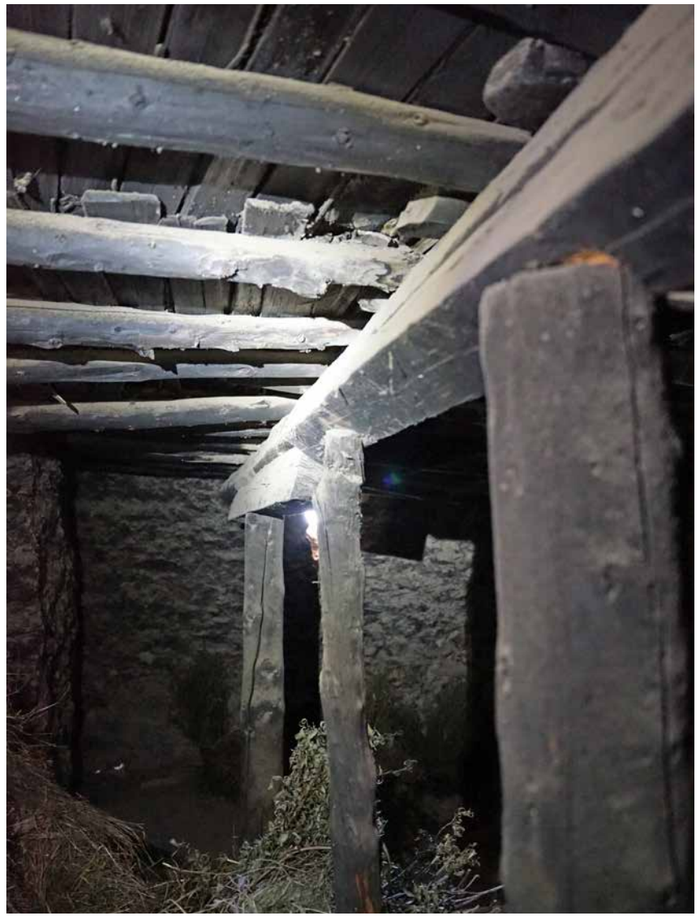
STABLE (GOAT PEN)
GROUND FLOOR – L05



MAKESHIFT REPAIRS
The ceiling is held up by numerous temporary posts to prevent its collapse. Cross beams and capitals are severely compromised by wet rot. None of the timber components can be reused for the restoration.

ALTAR ROOM
GROUND FLOOR – U08

FODDER STORAGE
GROUND FLOOR – L06

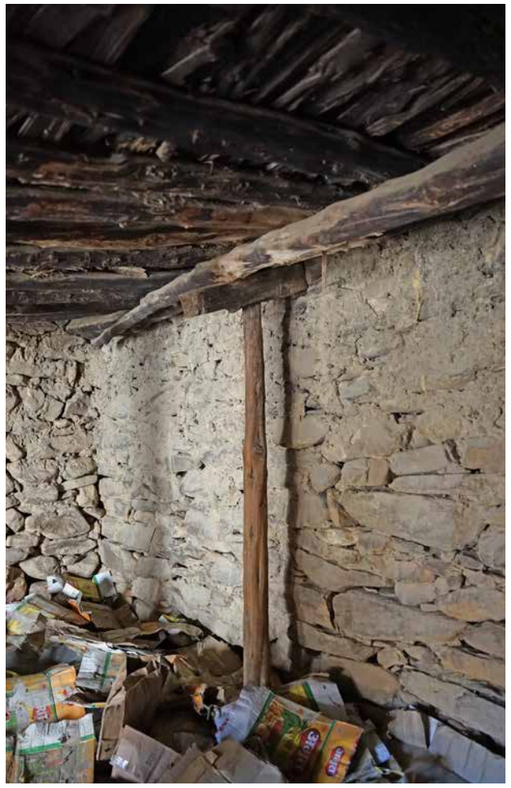


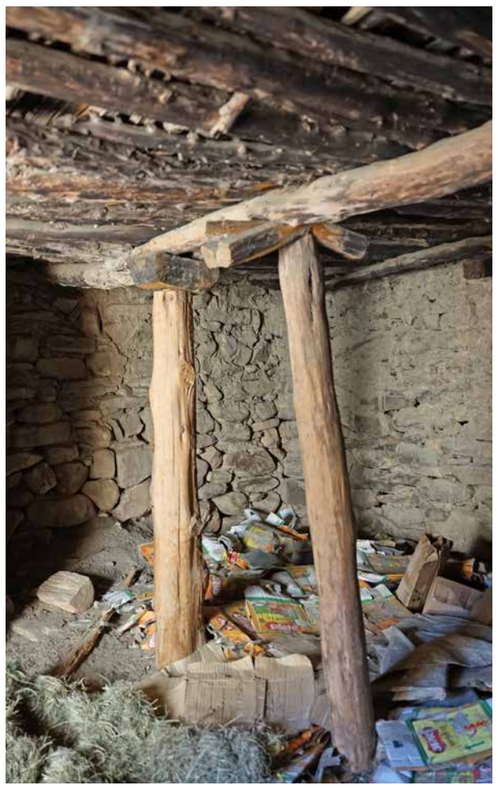
ROOM FOR FODDER STORAGE
The severe tilting of the cross beam might have been caused by the 2015 earthquakes. The capital and loosely attached props might slip at any time and would most certainly cause the collapse of the ceiling and possibly also of the floor above.

ROOM
UPPER FLOOR – U04

STORAGE ROOM
GROUND FLOOR – L07

This small space is a later addition grafted on to the south side of the sanctum. It holds the dry cesspit for a toilet above. The rough stone construction is crude and will require extensive repairs. The round poplar joists are sagging to the extreme and might collapse at any time.





TEMPORARY PROP
The temporary supports are affected by wet rot and might give way at any time.

FORMER KITCHEN AND TOILET
GROUND FLOOR – U10

VIEW TO THE NORTH
This poorly built room is on the verge of collapse. The main beam has failed completely and is held up by two vertical supports.

DAMAGE IDENTIFIED AND PROPOSED INTERVENTIONS

Recorded during a field visit between October 23–25 by Kunzom Thakuri, Sonam Dorji and Thomas Schrom.

BRIEF OVERVIEW OF IDENTIFIED DAMAGES:

The Gonpa Gang complex can be divided into two sections; the original monastery consisting of the sanctum, assembly hall (*dhukhang*), entrance hall, upper rooms and balconies, all dating from the 17th century; and the South Wing, an addition that was built at a later date.

Gonpa Gang has been neglected over a long period of time with only the absolute necessary maintenance carried out. Makeshift repairs have barely prevented collapse and cannot be considered a permanent solution. As a result most of the interior timber framing will require extensive rebuilding. The roof was recently covered with plastic sheets and a layer of mud, however, this repair work neglected the necessary structural repairs necessary below. Therefore, the roof will have to be dismantled and rebuilt in its entirety.

FOUNDATIONS - EXISTING CONDITIONS

A detailed assessment of the foundations' conditions was beyond the scope of this field visit. Possible weak areas were identified in the east-facing walls of the entry hall. Here, vertical cracks are visible to the lateral walls which indicates slight tilting to the east due to weak foundations. The south-east corner of the South wing displays a 3" wide vertical crack which is likely caused by failing foundations. The north-facing foundations of the sanctum are compromised by rising damp due to ineffective rainwater drainage.

WALLS - EXISTING CONDITIONS

Damage can be observed in the walls of the sanctum (L01), the assembly hall (L02), the entry hall (L03), and increasingly more severe on the upper floors and roof parapets. Whereas some of the cracks might be the result of the massive 2015 earthquakes, most other damages can be attributed to leaking roofs and the subsequent softening and deterioration of the stone and mud mortar masonry. Some of the most serious damages are observed on the south-facing walls of the entry hall where mud bricks are crumbling. Heavy structural timber beams embedded in those deteriorated walls have lost the necessary support and are sagging. Water leaks from damaged roof drainage channels have caused massive deterioration to the outside wall faces. The south-east corner of the South wing is the worst affected where a 4 inch wide crack has developed and the two story balcony has collapsed.

The building's parapet walls were haphazardly repaired with cement mortar.

WALLS - PROPOSED INTERVENTIONS

There is little that can be done to strengthen an eroded or delaminated mud brick or rock wall other than rebuilding it. Though labor intensive, intact walls above the damaged sections will first have to be securely braced and supported, then, damaged wall sections will be carefully dismantled and rebuilt. Most of the badly affected walls are located on the upper level of the building and it is proposed to completely rebuild the parapets. The entire roof will require reconstruction and only once the timber and mud structure is dismantled will it be possible to further assess the condition of the walls. Damaged sections will be taken down to a level where they are structurally sound and then rebuilt in traditional fashion.

The reconstructed walls will be rebuilt to a uniform level thus creating a solid base for a flat roof over the entire section of the building. It is estimated that more than 50% of the interior mud wall plaster is in need of replacement.

TIMBER-FRAMED FLOORS/CEILINGS - EXISTING CONDITIONS

All floors are made of mud. Joists are covered with small round pine sticks rather than the traditional brush and branches. Water stains throughout the ceiling indicate a failing roof cover.

The monastery's interior timber frame structure and roof framing is on the verge of collapse. The columns, beams and joists of the upper floor are not original. It could date from a repair effort less than 100 years ago. They work was poorly executed and timber elements are of varying sizes and shapes. Other makeshift repairs such as the addition of vertical supports and doubling up of joists have prevented floors from caving in. Particularly noticeable are many small weak joists on the upper floor that have bowed under the weight of the heavy mud roof. Puddles form on the sagging roof thus accelerating water leakage and causing severe damage to the structural timber frame.

TIMBER-FRAMED FLOORS/CEILING - PROPOSED INTERVENTIONS

All mud floors and mud roof cover, including the damaged layer of brush and planks will be removed. This will allow a careful inspection of joists and supporting beams. Particular attention will have to be paid to assessing the condition of beams where they are embedded in the walls. Wherever possible damaged timber should be replaced with traditional round poplar poles. Since poplar might be in short supply the use of pine beams or round logs could be an alternative.

Traditionally, ceiling beams and joists were placed directly into the mud wall and were only occasionally supported by a stone placed beneath the beam. In order to improve the load-bearing capacity of the wall, new timber wall plates will evenly distribute the weight of the heavy roof onto the mud and stone walls.

All floors are made of mud and it is planned to replace them with pine floor boards except the ground floor rooms of the East wing (stables, fodder storage and store). New stone steps will be built leading up to the entrance hall. It is further planned to install floors made of pine planks throughout the building. Such floors will be embedded in a 4 inch thick layer of mud that will act as a fire retardant.

DOORS, WINDOWS AND CARVED ELEMENTS - PROPOSED INTERVENTIONS

Most doors are of an archaic wood-slab construction and will be repaired as necessary. Under no circumstances should they be replaced with modern frame and panel doors. Two small windows facing north will require extensive repairs. The currently blocked opening to the balcony above the entry hall will receive glazed shutters. All skylights are in need of reconstruction making them water tight for periods of heavy rain and snow.

ROOF COVER - EXISTING CONDITION

The roofs of the building are in deplorable condition. Stains from leaks can be observed throughout the structure and it is quite obvious that the traditional mud roof cover had long reached the end of its life cycle. Recent repairs of the roof included the insertion of a plastic tarpaulin below the mud layer and the partial rebuilding of the parapets with cement mortar. Instead of the traditional timber water drainage spouts small diameter PVC pipes were installed. A major cause for leaks are the

badly designed and poorly installed PVC drainage pipes. On cold winter-days the small pipes, when in the shade, get clogged by ice thus causing water to back up and seep into the parapets.

ROOF COVER - PROPOSED INTERVENTIONS

Following the complete removal of the roof cover, including the mud brick parapets, the structural timber roof framing will be assessed. It is expected that a large part- if not all - of the structural timber framing is in need of rebuilding. An entirely new roof cover will be installed consisting of a diaphragm of marine-grade plywood (for seismic strengthening) and a bituminous-polymer water proofing layer (a precaution in case the traditional mud and clay layer is not sufficiently water-proof.) The drainage system will be completely redesigned and the small PVC pipes replaced by large enough timber channels lined with water-proof material.

Locally, the traditional roof building knowledge has been lost, and furthermore, due to climate change, the amount of rainfall in Mustang has increased. In recent years, Mustang has experienced unusually heavy snowfall and monsoon precipitation which has put unusual pressure on traditional flat mud roofs. Therefore, a new design for the roof may be necessary to meet current environmental conditions.

SEISMIC REINFORCEMENTS AND IMPROVEMENTS TO TRADITIONAL BUILDING TECHNIQUES

A review of the history of earthquakes in Nepal suggests that every 70 to 100 years brings a significant seismic event. We know relatively little about the history of earthquakes in Nepal, but have access to some written documents about the earthquake in 1833, as well as photographic documentation from the earthquake of 1934. There is extensive information available about the devastating earthquakes in 2015. Historic data along with studying damage to existing structures can provide many meaningful insights into the potential damage that future earthquakes may cause upon any of Nepal's historic structures.

Nepal's placement in the highest zone of seismic activity on the planet (zone #5) makes the development of sensitive and effective seismic strengthening programs of the utmost importance. Unfortunately, common conservation efforts are typically limited to repair work or restoration, even when implemented by government agencies and private organizations. Despite the numerous opportunities to improve structural performance by introducing seismic strengthening measures and modern materials that do not harm the traditional aesthetic of structures, this is not the norm; in fact, preservation guidelines in Nepal prevent such techniques outright.

LEARNING FROM THE 1934 AND 2015 EARTHQUAKES:

We know that after the 1934 earthquake, many monuments were not restored to their historical configuration. Instead they were often rebuilt with much reduced detail - a fact which is understandable considering the limited resources at the time.

From existing photographs of major monuments (unfortunately not all historic buildings were documented) we can observe many different types of structural failure. Almost all monuments suffered at least partial damage, however, some structures performed better than others.

Often, upper roofs, top tiers of temples, timber framed galleries, and cantilevered windows were severely damaged or collapsed entirely. As the top brick structure of temples traditionally rests only on timber beams, they lack vertical continuity. During seismic activity, the top towers therefore often tipped off those beams. The heavy loads of traditional mud and tile roofs are other contributing factors in the failure of timber roof structures.

ANALYSIS OF STRUCTURAL FAILURE

Typical reasons for the failure of traditional buildings during seismic activity include:

- Insufficient size and strength of foundations
- Multi layered brick, stone and rammed earth walls with little lateral connection that often leads to delamination under seismic stress.
- Vertical discontinuity of masonry walls at the base of the upper levels of multi-tiered structures
- No horizontal rigidity
- Loose timber joints that cannot withstand lateral movement
- Massive mud roofs that lead to top-heavy structures
- Soft story conditions – particularly open ground floor timber arcades with little or no tying into the structure

IMPROVEMENT OF TRADITIONAL CONSTRUCTION TECHNIQUES

The ICOMOS charter of Venice explicitly states in article 10: "Where traditional techniques prove inadequate, the consolidation of a monument can be achieved by the use of any modern techniques for conservation and construction, the efficacy of which has been shown by scientific data and proved by experience."

In many instances in Nepal it is no longer feasible nor possible to use traditional methods and local materials for reinforcement. The use of modern or non-traditional materials however should be considered carefully and should be used in a manner that preserves the original spirit of the monuments.

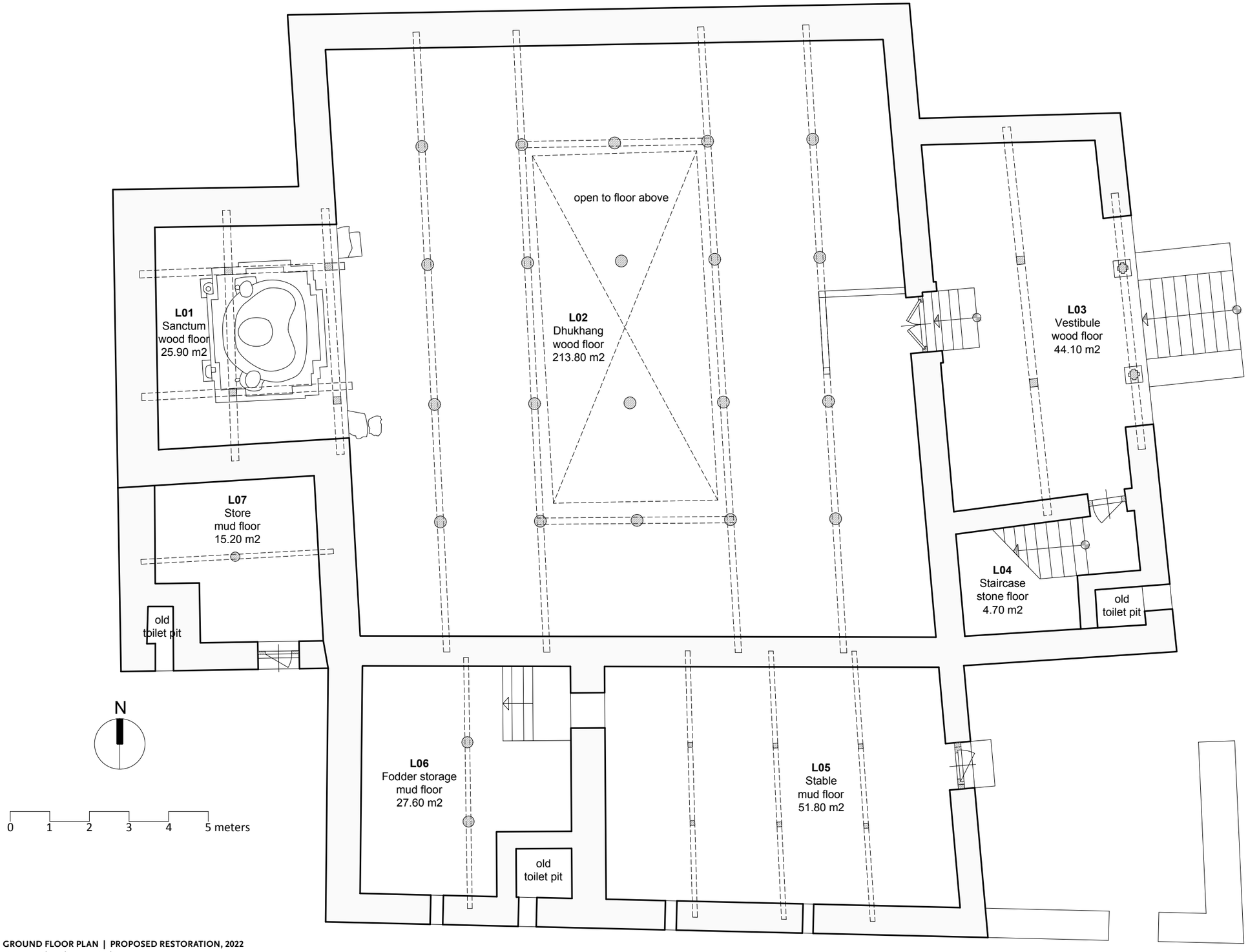
GENERAL OBSERVATIONS

The introduction of horizontal rigid plates that provide additional support to wall plates or ring beams is a consolidating measure that helps structures react as a larger whole in the event of an earthquake. This is something easy to add to old buildings as the thick mud floors allow the installation of concealed layers of marine-grade plywood or layers of planking laid at 45 degrees. Metal bracing is also a possibility.

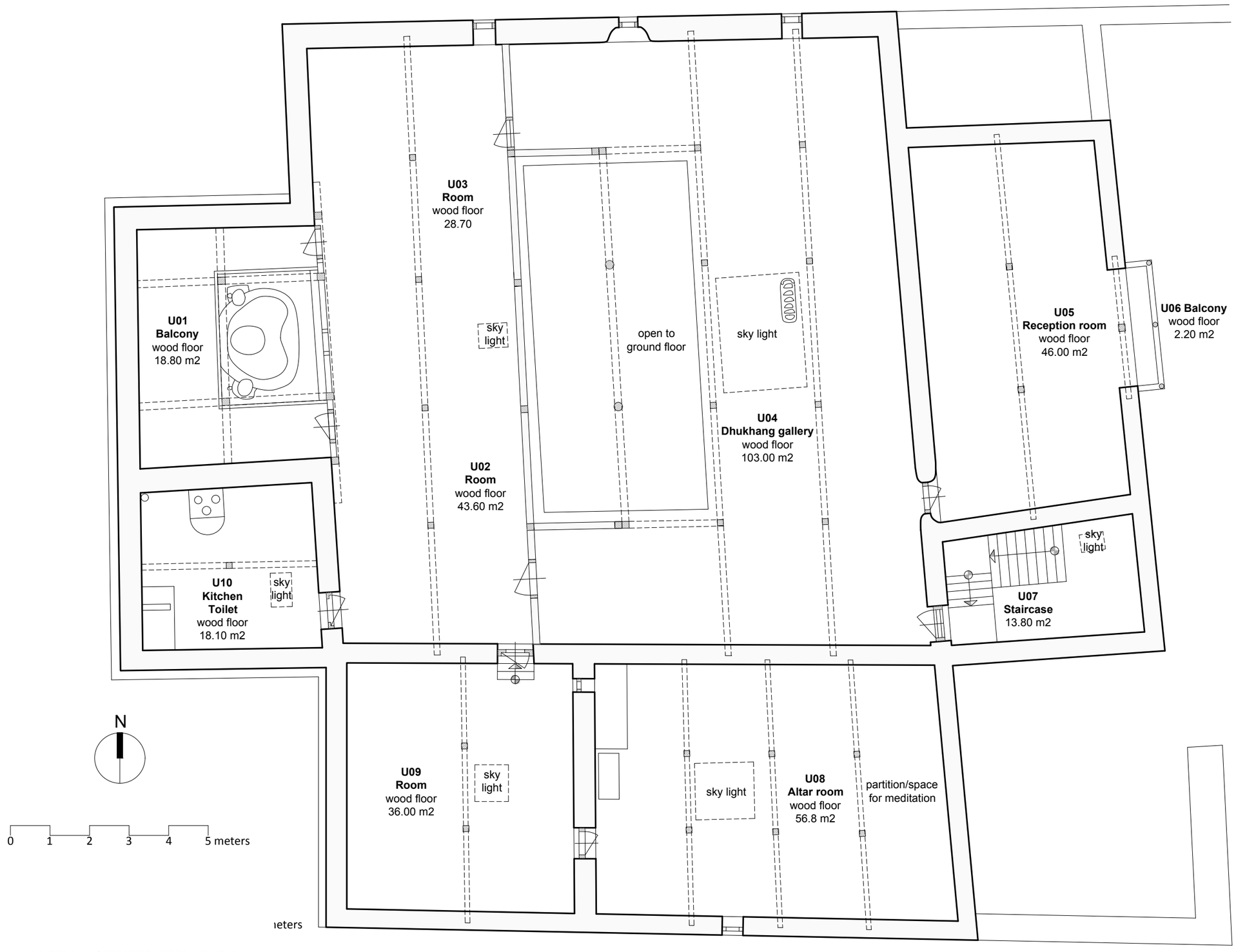
The technique of drilling continuous vertical rods into loose masonry is widely practiced around the globe. In Nepal, this is not feasible as the technology is not available and the loose masonry further complicates the issue. One alternative is to install vertical rods alongside the walls and tied into the ground floor foundation pads. The rods can either remain exposed, or be concealed within the wall plaster.

CONCLUSION:

There is no single solution to stabilize historic buildings against seismic activity. The choice of methods for structural improvements should be based on artistic importance, future use, and on the seismic analysis of the monuments present condition. In each case a specific solution has to be found which can achieve a balance between the authentic spirit of the monument and safeguarding the structure against future shocks.

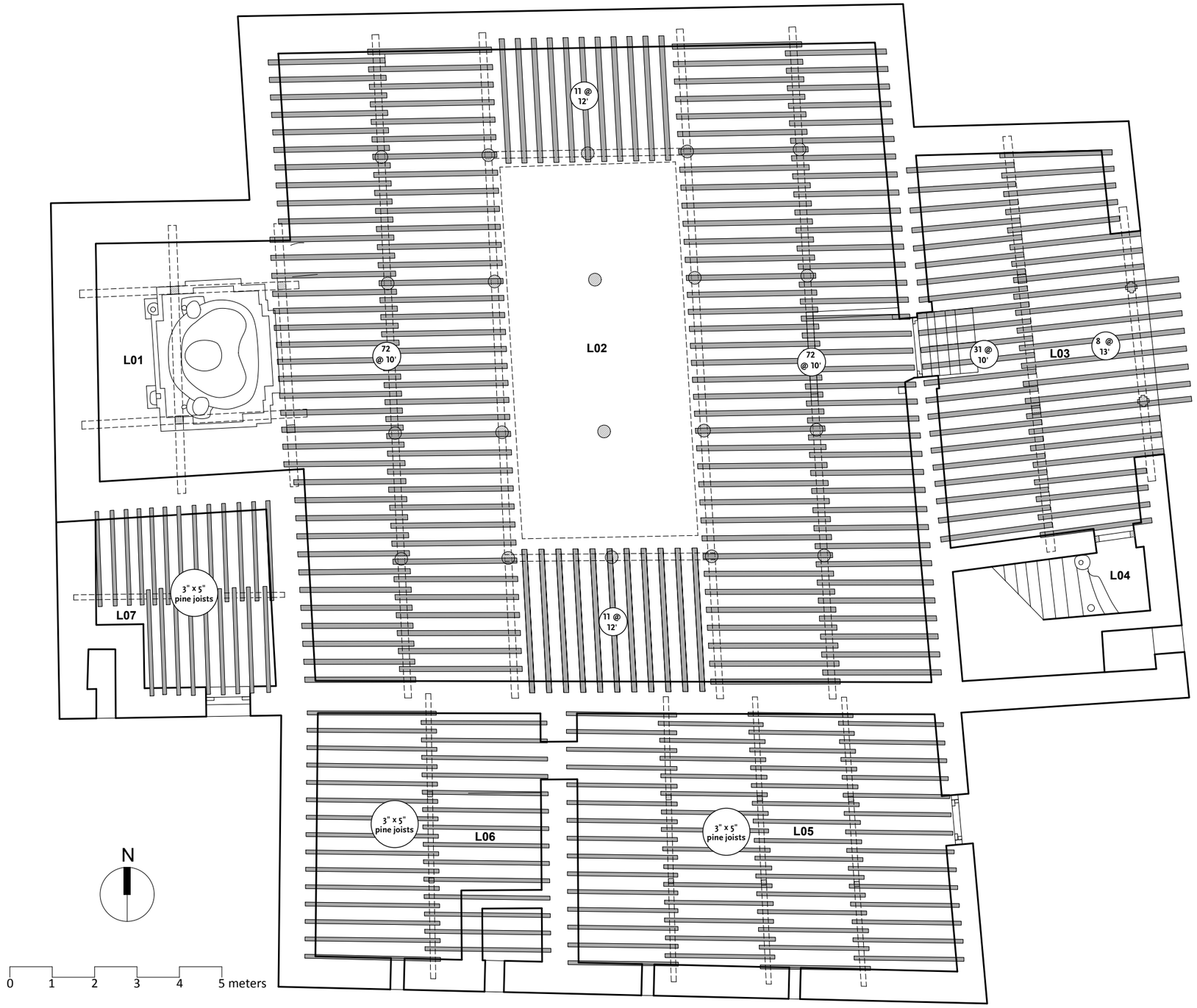


GROUND FLOOR PLAN | PROPOSED RESTORATION, 2022
Drawing by Thomas Schrom



UPPER FLOOR PLAN | PROPOSED RESTORATION, 2022
Drawing by Thomas Schrom

Lo2 prayer hall:	144	**pcs @ 10' round poplar**
	22	**pcs @ 12' round poplar**
Lo3 portal:	31	**pcs @ 10' round poplar**
	14	**pcs @ 13' round poplar**

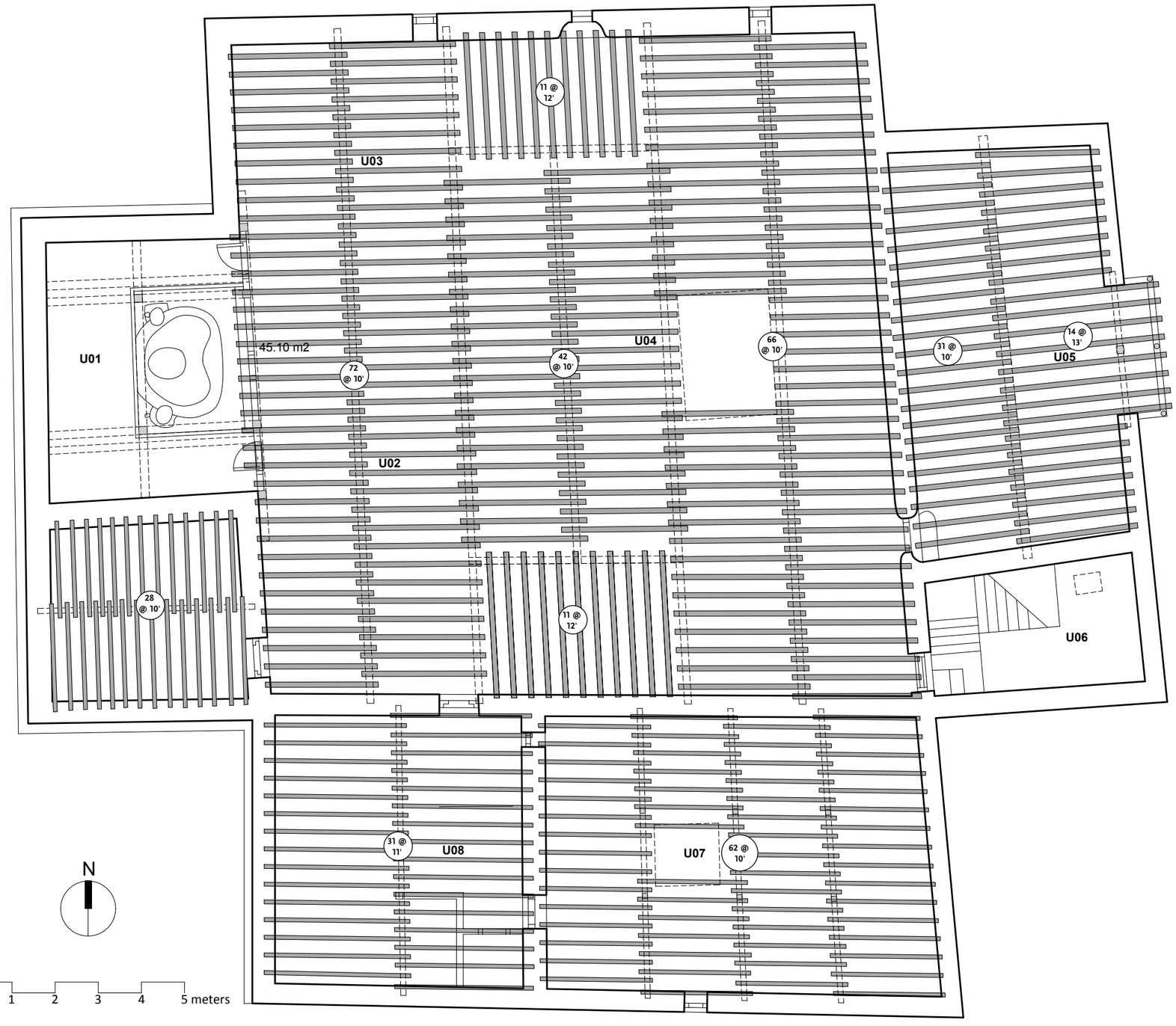


LOWER FLOOR | SCHEMATIC LAYOUT OF JOISTS
Drawing by Thomas Schrom, 2022

U04 GALLERY:	42	PCS @ 10' ROUND POPLAR
	66	PCS @ 10' ROUND POPLAR
	22	PCS @ 12' ROUND POPLAR
U05 PRAYER ROOM:	31	PCS @ 10' ROUND POPLAR
	14	PCS @ 13' ROUND POPLAR
U07 SHRINE ROOMS	62	PCS @ 10' ROUND POPLAR
U08 ROOM	31	PCS @ 11' ROUND POPLAR

ROUND POPLAR JOIST TOTAL:

448	PCS @ 10'	ROUND POPLAR
31	PCS @ 11'	ROUND POPLAR
28	PCS @ 13'	ROUND POPLAR



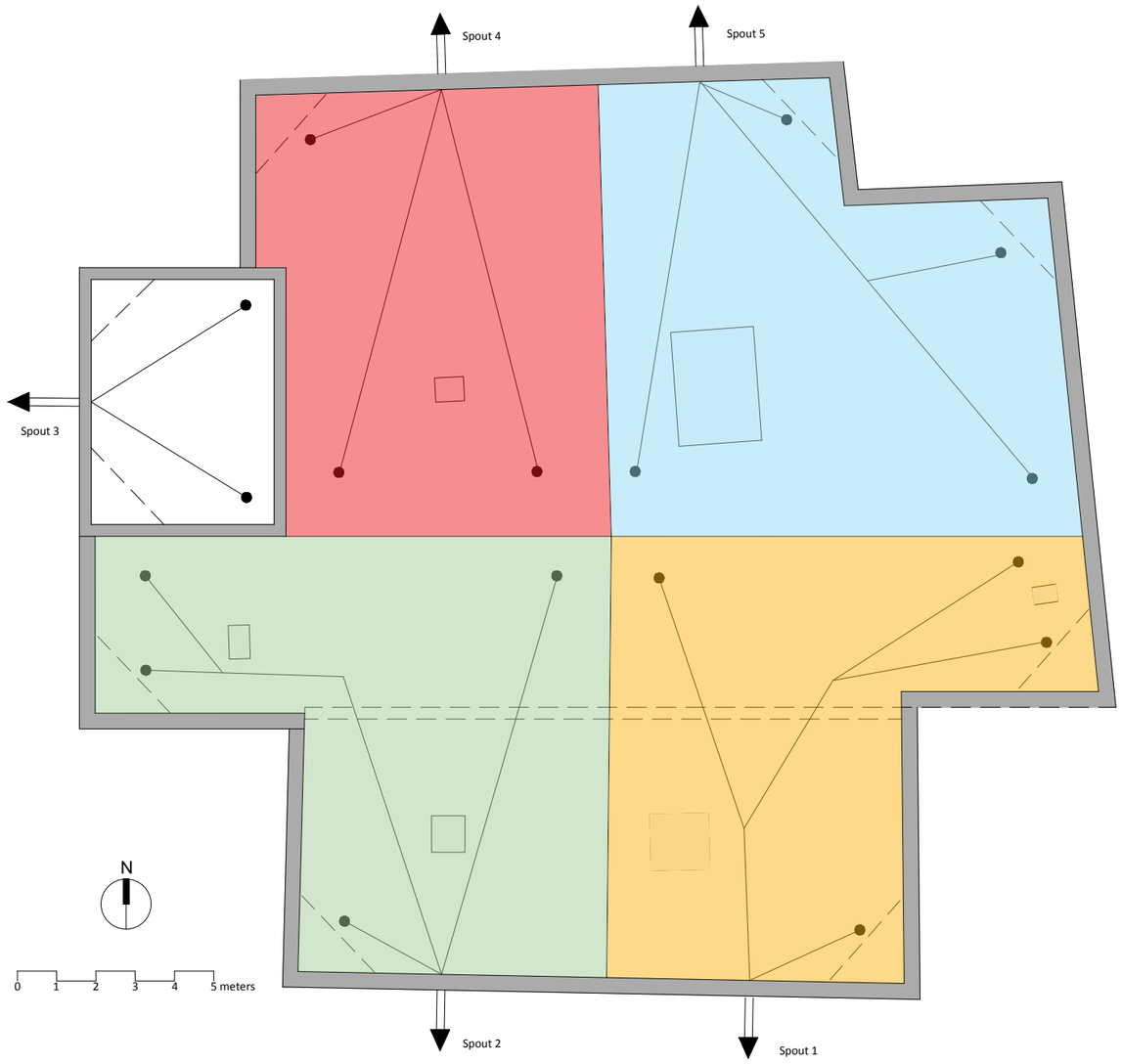
UPPER FLOOR | SCHEMATIC LAYOUT OF JOISTS
Drawing by Thomas Schrom, 2022

THE ROOF

SCHEMATIC ROOF DRAINAGE PLAN
Not to scale

The new roof design will include a more direct and functional drainage system. The elevated roof above the sanctum will drain to the west (spout no. 3).
The remaining roof is divided into four quarters of approximately the same size and will drain towards two spouts on the south and two spouts on the north.
To provide extra protection against leaks the insertion of a bituminous polymer waterproofing layer is proposed. Most importantly, high quality earth (clay) for the mud roof needs to be sourced and the proper installation and compaction of the mud layers ensured. The current roof suffers from the poor quality of the earthen layer that is cracked in many places and allows water to penetrate easily.

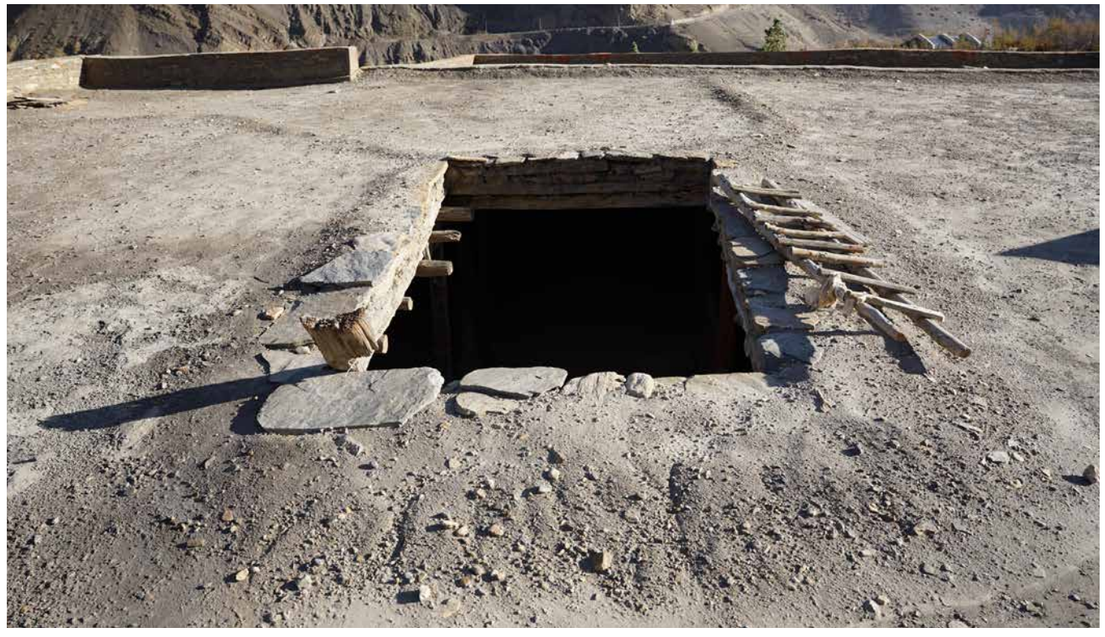
VIEW FROM THE WEST
In 2015 the roof was repaired my means of a plastic sheet and the construction of new parapets using stone and cement mortar.



HISTORIC WATER SPOUT
This wooden spout has lost its purpose a long time ago. Recently, such wooden spouts were replaced by PVC pipes that are too small in diameter and cannot drain water adequately.

DRAIN PIPES ON THE NORTH–EAST CORNER
New PVC pipes were installed in the historic wooden water channels. Such pipes often freeze in the winter and as a result melting water finds its way through the parapets into the walls below. Heavily eroded wall have been crudely patched with rocks.

THE OLD KITCHEN
The roof has sagged dramatically causing water to accumulate around the opening rather than finding its way through the drain spout (hidden by the rock leaning against the parapet on the left).



ROOF OPENING ABOVE THE DHUKHANG
This opening provides the only light source into the temple since there are no windows in the heavy walls. It will require a cover to keep snow and rain from entering the dhukhang.

RESTORATION COST ESTIMATE

BUDGET OVERVIEW

Establishing an estimate of how much of the original substance of Gonpa Gang can be conserved and how much of it will need to be rebuilt or replaced poses clearly the most difficult challenge. The survey and analysis of restoration needs identifies the most vulnerable areas, such as the severely compromised bearing timber structure and the poorly repaired flat roof.

The restoration assessment identifies the internal timber structure and roof as so badly deteriorated that a reconstruction can be justified, whereas the remaining parts should be restored in-situ.

The following estimate is based on many sources and information obtained during the study. Unit rates were acquired from published government rates, personal communications with private and government contractors, builders and architects, and our own experience from past projects.

The estimate covers the physical restoration costs, national project management, basic site expenditures, and running costs over a two year period. The estimate does not include further architectural and structural planning, international experts, and international coordination. Overheads, contingencies, and applicable taxes should be calculated separately.

This estimate corresponds with the high standard design and construction specified for such an important building and integrates traditional architectural concepts with modern technological requirements.

Cost Estimate December, 2022

s.n.	*description of works*	*quantity*	*unit*	*rate*	*Amount NRs*	*Amount US$*	*sub total*
	Site preparation, demolition works, equipment						
1	workmen quarters (furnishings, beds, cooking equipment, etc.)	1.00	l/s	200,000	200,000	€1,686	
2	construction of work shed and carpenters' workshop	1.00	l/s	200,000	200,000	€1,686	
3	machinery (table saw, jointer, generator, etc.), tools, safety equipment	1.00	l/s	400,000	400,000	€3,373	
4	scaffolding: 20 sections + braces and walk boards	20.00	l/s	15,000	300,000	€2,530	
5	steel supports, bracing materials and hydraulic jacks	1.00	l/s	150,000	150,000	€1,265	
6	tarpaulins for rain and dust protection	1.00	l/s	220,000	220,000	€1,855	
7	demolition, cleaning and stacking of reusable materials	100.00	man/days	1,200	120,000	€1,012	**€13,406**
	Entry hall (L03)						
8	remove mud floor	44.10	m2	80	3,528	€30	
9	consolidation and repair of walls	5.00	m2	12,000	60,000	€506	
10	repair/rebuild 4 point foundations of pillars incl. base stones	4.00	l/s	10,000	40,000	€337	
11	replace 2 pillars (front) and capitals	2.00	l/s	40,000	80,000	€675	
12	repair 2 pillars and capitals (center)	2.00	l/s	15,000	30,000	€253	
13	new pine floor including purlins	44.10	m2	12,000	529,200	€4,462	
14	new cross beams	0.90	m3	225,000	202,500	€1,707	
15	new wall plates	0.13	m3	225,000	29,250	€247	
16	new round poplar joists	39.00	pcs	2,500	97,500	€822	
17	new ceiling pine planking or willow branches	44.10	m2	3,000	132,300	€1,116	
18	dust proof barrier between planking and mud layer	44.10	m2	300	13,230	€112	
19	protection and cleaning of wall paintings	1.00	l/s	25,000	25,000	€211	
20	rebuild stone steps to main door	1.00	l/s	15,000	15,000	€126	
21	mud wall plaster	5.00	m2	1,200	6,000	€51	**€10,624**
	Reception room (U05)						
22	remove mud floor	46.00	m2	80	3,680	€31	
23	consolidation and repair of walls	10.00	m2	12,000	120,000	€1,012	
24	repair 2 pillars and capitals (center)	2.00	l/s	15,000	30,000	€253	
25	new pine floor including purlins	46.00	m2	12,000	552,000	€4,654	
26	new cross beams	0.54	m3	225,000	121,500	€1,024	
27	new wall plates	0.17	m3	225,000	38,250	€323	
28	new round poplar joists	45.00	pcs	2,500	112,500	€949	
29	new ceiling pine planking or willow branches	46.00	m2	3,000	138,000	€1,164	
30	dust proof barrier between planking and mud layer	46.00	m2	300	13,800	€116	
31	mud wall plaster	56.00	m2	1,200	67,200	€567	**€10,061**
	Balcony (U6)						
32	new pine floor including purlins	2.20	m2	12,000	26,400	€223	
33	front posts and railing	1.00	l/s	50,000	50,000	€422	
34	double doors with glass panels	2.00	l/s	24,000	48,000	€405	**€1,049**

	Dhukhang (L02)						
35	removal of mud and stone floors	25.90	m2	80	2,072	€17	
36	prop up intermediate floor	1.00	l/s	25,000	25,000	€211	
37	build partition wall (screen) to protect sanctum	1.00	l/s	20,000	20,000	€169	
38	consolidation and repair of walls	12.00	m2	12,000	144,000	€1,214	
39	repair/rebuild 20 point foundations of pillars incl. base stones	20.00	l/s	10,000	200,000	€1,686	
40	new pine floor including purlins	213.80	m2	12,000	2,565,600	€21,632	
41	repair of wooden columns and brackets	20.00	l/s	15,000	300,000	€2,530	
42	wall plates	0.40	m3	225,000	90,000	€759	
43	12 new cross beams (50%)	2.16	m3	225,000	486,000	€4,098	
44	repair 50% of cross beams and capitals	1.00	l/s	180,000	180,000	€1,518	
45	new round poplar joists	166.00	pcs	2,500	415,000	€3,499	
46	new ceiling pine planking or willow branches	178.00	m2	2,500	445,000	€3,752	
47	dust proof barrier between planking and mud layer	178.00	m2	300	53,400	€450	
48	repair mud plaster	20.00	m2	1,200	24,000	€202	
49	protection and cleaning of wall paintings	1.00	l/s	80,000	80,000	€675	**€42,412**
	Dhukhang gallery (U04)						
50	removal of mud and stone floors	103.00	m2	80	8,240	€69	
51	consolidation and repair of walls	12.00	m2	12,000	144,000	€1,214	
52	new pine floors including purlins	103.00	m2	12,000	1,236,000	€10,422	
53	repair of wooden columns and brackets	14.00	l/s	15,000	210,000	€1,771	
54	wall plates	0.33	m3	225,000	74,250	€626	
55	8 new cross beams (50%)	0.86	m3	225,000	193,500	€1,632	
56	repair 50% of cross beams and capitals	1.00	l/s	140,000	140,000	€1,180	
57	new round poplar joists	202.00	pcs	2,500	505,000	€4,258	
58	new ceiling pine planking or willow branches	140.00	m2	2,500	350,000	€2,951	
59	dust proof barrier between planking and mud layer	140.00	m2	300	42,000	€354	
60	repair mud plaster	40.00	m2	1,200	48,000	€405	**€24,882**
	Rooms (U02 & 03)						
61	removal of mud floors	72.30	m2	80	5,784	€49	
62	consolidation and repair of walls	8.00	m2	12,000	96,000	€809	
63	new pine floors including purlins	72.30	m2	12,000	867,600	€7,315	
64	repair of wooden columns and brackets	1.00	l/s	15,000	15,000	€126	
65	wall plates	0.11	m3	225,000	24,750	€209	
66	5 new cross beams	0.45	m3	225,000	101,250	€854	
67	repair of capitals	1.00	l/s	20,000	20,000	€169	
68	new round poplar joists	72.00	pcs	2,500	180,000	€1,518	
69	new ceiling pine planking or willow branches	72.30	m2	2,500	180,750	€1,524	
70	dust proof barrier between planking and mud layer	72.30	m2	300	21,690	€183	
71	repair mud plaster	60.00	m2	1,200	72,000	€607	**€13,363**

	Sanctum (L01)						
72	removal of mud floors	25.90	m2	80	2,072	€17	
73	prop up intermediate floor	1.00	l/s	12,000	12,000	€101	
74	protect Maitreya statue	1.00	l/s	20,000	20,000	€169	
75	consolidation and repair of walls	4.00	m2	12,000	48,000	€405	
76	repair/rebuild 4 point foundations of pillars incl. base stones	4.00	l/s	10,000	40,000	€337	
77	new pine floor including purlins	25.90	m2	12,000	310,800	€2,621	
78	repair of wooden columns and brackets	4.00	l/s	8,000	32,000	€270	
79	wall plates	0.15	m3	225,000	33,750	€285	
80	repair cross beams and capitals	1.00	l/s	25,000	25,000	€211	
81	reinstall used poplar joists	1.00	l/s	20,000	20,000	€169	
82	new ceiling pine planking or willow branches	18.80	m2	2,500	47,000	€396	
83	dust proof barrier between planking and mud layer	18.80	m2	300	5,640	€48	
84	repair mud plaster	4.00	m2	1,200	4,800	€40	
85	protection and cleaning of wall paintings	1.00	l/s	15,000	15,000	€126	**€5,194**
	Sanctum balcony (U01)						
86	removal of gallery floors	18.00	m2	80	1,440	€12	
87	consolidation and repair of walls	4.00	m2	12,000	48,000	€405	
88	new pine floor including purlins	18.00	m2	12,000	216,000	€1,821	
89	repair of wooden columns and brackets	4.00	l/s	8,000	32,000	€270	
90	wall plates	0.15	m3	225,000	33,750	€285	
91	repair cross beams and capitals	1.00	l/s	25,000	25,000	€211	
92	reinstall used poplar joists	1.00	l/s	20,000	20,000	€169	
93	new ceiling pine planking or willow branches	18.00	m2	2,500	45,000	€379	
94	dust proof barrier between planking and mud layer	18.00	m2	300	5,400	€46	
95	repair mud plaster	4.00	m2	1,200	4,800	€40	
96	protection and cleaning of wall paintings	1.00	l/s	15,000	15,000	€126	**€3,764**
	Stables (L05)						
97	consolidation and repair of walls	10.00	m2	12,000	120,000	€1,012	
98	repair/rebuild 6 point foundations of pillars incl. base stones	6.00	l/s	10,000	60,000	€506	
99	replace 6 pillars	0.36	m3	225,000	81,000	€683	
100	refinish mud floors	44.10	m2	500	22,050	€186	
101	new cross beams	0.68	m3	225,000	153,000	€1,290	
102	new wall plates	0.17	m3	225,000	38,250	€323	
103	new pine joists (3x5")	1.74	m2	225,000	391,500	€3,301	
104	new ceiling pine planking or willow branches	44.10	m2	3,000	132,300	€1,116	
105	dust proof barrier between planking and mud layer	44.10	m2	300	13,230	€112	
106	mud wall plaster	5.00	m2	1,200	6,000	€51	**€8,578**
	Fodder storage (L06)						
107	consolidation and repair of walls	5.00	m2	12,000	60,000	€506	

109	replace 2 pillars	0.12	m3	225,000	27,000	€228	
110	refinish mud floors	27.60	m2	500	13,800	€116	
111	new cross beams	0.23	m3	225,000	51,750	€436	
112	new wall plates	0.14	m3	225,000	31,500	€266	
113	new pine joists (3x5")	0.87	m2	225,000	195,750	€1,651	
114	new ceiling pine planking or willow branches	27.60	m2	3,000	82,800	€698	
115	dust proof barrier between planking and mud layer	27.60	m2	300	8,280	€70	
116	mud wall plaster	5.00	m2	1,200	6,000	€51	**€4,190**
	Store (L07)						
117	consolidation and repair of walls	5.00	m2	12,000	60,000	€506	
118	repair/rebuild 1 point foundations of pillar incl. base stone	1.00	l/s	10,000	10,000	€84	
119	replace 1 pillar	0.06	m3	225,000	13,500	€114	
120	refinish mud floors	15.20	m2	500	7,600	€64	
121	new cross beams	0.12	m3	225,000	27,000	€228	
122	new wall plates	0.10	m3	225,000	22,500	€190	
123	new pine joists (3x5")	0.87	m2	225,000	195,750	€1,651	
124	new ceiling pine planking or willow branches	15.20	m2	3,000	45,600	€384	
125	dust proof barrier between planking and mud layer	15.20	m2	300	4,560	€38	
126	mud wall plaster	5.00	m2	1,200	6,000	€51	**€3,310**
	Altar room (U08)						
127	removal of mud floors	56.80	m2	80	4,544	€38	
128	consolidation and repair of walls	8.00	m2	12,000	96,000	€809	
129	replace 6 pillars	0.61	m3	225,000	137,250	€1,157	
130	new pine floor including purlins	56.80	m2	12,000	681,600	€5,747	
131	new cross beams	0.68	m3	225,000	153,000	€1,290	
132	new wall plates	0.16	m3	225,000	36,000	€304	
133	new round poplar joists	31.00	pcs	2,500	77,500	€653	
134	new ceiling pine planking or willow branches	56.80	m2	3,000	170,400	€1,437	
135	dust proof barrier between planking and mud layer	56.80	m2	300	17,040	€144	
136	mud wall plaster	5.00	m2	1,200	6,000	€51	**€11,630**
	Room (U09)						
137	removal of mud floors	36.00	m2	80	2,880	€24	
138	consolidation and repair of walls	5.00	m2	12,000	60,000	€506	
139	replace 2 pillars	0.14	m3	225,000	31,500	€266	
140	new pine floor including purlins	36.00	m2	12,000	432,000	€3,642	
141	new cross beams	0.20	m3	225,000	45,000	€379	
142	new wall plates	0.14	m3	225,000	31,500	€266	
143	new round poplar joists	31.00	pcs	2,500	77,500	€653	
144	new ceiling pine planking or willow branches	36.00	m2	3,000	108,000	€911	
145	dust proof barrier between planking and mud layer	36.00	m2	300	10,800	€91	
146	mud wall plaster	5.00	m2	1,200	6,000	€51	**€6,789**
	Former kitchen/toilet (U10)						
147	removal of mud floors	18.10	m2	80	1,448	€12	
148	consolidation and repair of walls	5.00	m2	12,000	60,000	€506	
149	replace 2 pillars	0.14	m3	225,000	31,500	€266	
150	new pine floor including purlins	18.10	m2	12,000	217,200	€1,831	
151	new cross beams	0.20	m3	225,000	45,000	€379	
152	new wall plates	0.14	m3	225,000	31,500	€266	
153	install used round poplar joists	26.00	pcs	400	10,400	€88	
154	new ceiling pine planking or willow branches	18.10	m2	3,000	54,300	€458	
155	dust proof barrier between planking and mud layer	18.10	m2	300	5,430	€46	
156	mud wall plaster	24.00	m2	1,200	28,800	€243	**€4,094**
	Roof						
157	removal of mud roof	462.00	m2	80	36,960	€312	
158	remove parapet	134.00	m	160	21,440	€181	
159	rebuild parapet	134.00	m	5,000	670,000	€5,649	
160	1 large skylight over dhukhang gallery	1.00	l/s	50,000	50,000	€422	
161	5 water drainage spouts	5.00	l/s	20,000	100,000	€843	
162	sub roof built-up (providing slope)	462.00	m2	400	184,800	€1,558	
163	marine grade plywood sheeting over the entire roof (3/4")	462.00	m2	2,200	1,016,400	€8,570	
164	water proof barrier for entire roof	462.00	m2	1,100	508,200	€4,285	
165	mud cover	462.00	m2	1200	554,400	€4,675	**€26,494**
	General work						
166	patching of exterior wall plaster and paint	1.00	l/s	300,000	300,000	€2,530	
167	stone paving of front stairs and courtyard	120.00	m2	2,800	336,000	€2,833	
168	drainage around building	1.00	l/s	200,000	200,000	€1,686	
169	electric connection and main panel	1.00	l/s	150,000	150,000	€1,265	
170	subpanels, wiring, power points	1.00	l/s	250,000	250,000	€2,108	
171	basic light fixtures	60.00	pc	3,500	210,000	€1,771	
172	final site clearance and cleaning	1.00	l/s	120,000	120,000	€1,012	
173	utilities (telephone, electricity, generator, water) and office expenses	24.00	month	10,000	240,000	€2,024	
174	printing of historic structures report, drawings, documentation	1.00	l/s	100,000	100,000	€843	**€16,071**

total restoration costs:	**€205,971**	**€205,910**

GONPA GANG, MUSTANG **QUANTITY ESTIMATE** **DECEMBER 2022**

building foot print **505.00 m2**

		FLOOR AREA		WOOD FLOOR		WALL PLATES (5x20cm)			PINE JOISTS (8X13CM)				COLUMNS (15x15cm)			BEAMS					CEILING PLANKING	
		area		m2		l	v per m	m3	pc	l	v per m	m3	pc	vol		pcs	l	h	w	vol		m2	
L - LOWER FOOR (MONASTERY)																						
L01	Sanctum	25.90	m2	25.90		15.00	0.01	0.15					4	0.06	0.24						18.00	
L02	Dhukhang	214.00	m2	214.00		40.00	0.01	0.40					round extensions			12	3.60	0.25	0.2	2.16	103.00	
L03	Entry hall	44.10	m2	44.10		13.00	0.01	0.13					2	0.1	0.2	5	3.60	0.25	0.2	0.90	44.10	
L04	Staircase	4.70	m2																			
	floor area:	**288.70**	**m2**	**284.00**	**m2**	wall plates:		**0.68**	**m2**						**0.44**	**m3**				**3.06**	**m3**	**165.1**	**m2**
L - LOWER FOOR (SOUTH WING)																						
L05	Stable	51.80	m2			17.00	0.01	0.17	58	3	0.01	1.74	6	0.06	0.36	9	3.00	0.18	0.14	0.68	51.80	
L06	Fodder storage	27.60	m2			14.00	0.01	0.14	29	3	0.01	0.87	2	0.06	0.12	3	3.00	0.18	0.14	0.23	27.60	
L07	Store	15.20	m2			10.00	0.01	0.10	22	3	0.01	0.66	1	0.06	0.06	2	2.40	0.18	0.14	0.12	15.20	
	floor area:	**94.60**	**m2**	**0.00**	**m2**	wall plates:		**0.41**	**m3**			**3.27**	m3		**0.54**	**m3**				**1.03**	**m3**	**94.60**	**m2**
U - UPPER FOOR (MONASTERY)																						
U01	Sanctum balcony	18.00	m2	18.00		15.00	0.01	0.15													25.90	
U02/03	Room	72.30	m2	72.30		26.40	0.01	0.26								5	3.60	0.18	0.14	0.45		
U04	Dhukhang gallery	103.00	m2	103.00		33.20	0.01	0.33								8	3.60	0.2	0.15	0.86	214.00	
U05	Reception room	46.00	m2	46.00		16.50	0.01	0.17								3	3.60	0.2	0.15	0.32	46.00	
U06	Balcony	2.20	m2	2.20																	2.20	
U07	Staircase	13.80	m2																		13.80	
	floor area:	**255.30**	**m2**	**241.50**	**m2**	wall plates:		**0.91**	**m3**											1.64	**m3**	**301.90**	**m2**
U - UPPER FOOR (SOUTH WING)																						
U08	Altar room	56.80	m2	56.80		16.20	0.01	0.16					9	0.068	0.612	9	2.50	0.18	0.15	0.61	56.80	
U09	Room	36.00	m2	36.00		13.50	0.01	0.14					2	0.068	0.136	3	2.50	0.18	0.15	0.20	36.00	
U10	former kitchen/toilet	18.10	m2	18.10		10.00	0.01	0.10					1	0.068	0.068	2	2.50	0.18	0.15	0.14	18.10	
	floor area	**110.90**	**m2**	**110.90**	**m2**	wall plates:		**0.40**	**m3**						**0.816**	**m3**				**0.95**	**m3**	**110.90**	**m2**
		749.50	**m2**	**636.40**	**m2**			**2.40**	**m3**			**3.27**	**m3**		**1.796**	**m3**				**6.67**	**m3**	**672.50**	**m2**

ROOF

roof	upper floor	428.00	m2
	over sanctum	34.00	m2
	total roof area	**462.00**	**m2**
parapet	upper floor	111.00	m
	over sanctum	23.00	m
	adobe parapet length:	**134.00**	**m**