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Heritage Homeowner's Preservation Manual
सम्पदा घरधनीको संरक्षण स्मार्नुयल
सम्पदा छैन थुवाया संरक्षण स्मार्नुयल

Kathmandu Valley World Heritage Site, Nepal
काठमाडौं उपत्यका विश्व सम्पदा क्षेत्र, नेपाल
स्विनिग विश्व सम्पदा क्षेत्र, नेपाल:

Advice for Maintenance of Historic Houses in the Kathmandu Valley
काठमाडौं उपत्यकाको ऐतिहासिक घरहरूको मर्मत गर्न सुभाष
स्विनिगले ऐतिहासिक छैन मर्मत यायण सुभाष

Dr. Rohit K. Ranjitkar

INTEGRATED COMMUNITY DEVELOPMENT AND CULTURAL HERITAGE SITE PRESERVATION IN ASIA AND THE PACIFIC
THROUGH LOCAL EFFORT PROGRAMME (LEAP)

UNESCO Bangkok
UNESCO Kathmandu
2006
Foreword

The series of *Heritage Homeowner’s Preservation Manuals for UNESCO World Heritage Sites* has been produced in response to the growing need to ensure the sustainable conservation of historic towns of Outstanding Universal Value.

The Homeowner’s Manuals have been developed within the framework of the "Integrated Community Development and Cultural Heritage Site Preservation in Asia and the Pacific through Local Effort" programme (LEAP), which strengthens local community involvement in heritage conservation. The manuals aim to build local capacity in heritage preservation by training homeowners to maintain their historic properties using appropriate conservation approaches. The manuals present a synthesis of traditional building techniques and modern conservation science. They codify time-tested methods adapted to each type of structure using indigenous building materials and techniques. The manuals have been developed in conjunction with local heritage managers and national conservation experts, who will also be involved in training local stakeholders.

This first volume focuses on the Kathmandu Valley World Heritage Site, which is comprised of seven groups of monuments and buildings, including the Durbar Squares of Hanuman Dhoka (Kathmandu), Patan and Bhaktapur, the Buddhist stupas of Swayambhu and Baudhanath, and the Hindu temples of Pashupati and Changu Narayan. It is hoped that the Homeowner’s Manuals will strengthen the conservation ethic and contribute positively to the long-term sustainability of the Kathmandu Valley.

Richard A. Engelhardt
UNESCO Regional Advisor for Culture in Asia and the Pacific
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This manual offers guidelines for the repair of traditional old buildings to homeowners. This document is subject to revision from time to time, including when new technical solutions are developed. Suggestions from homeowners are most welcome. Because this is the first document of its kind, there may be mistakes or better solutions. The information provided in this document might not work in all conditions. Some issues will have to be solved case by case in situ.

Any repair or restoration works carried out on historic houses should respect, retain and restore the original elements. We request all the homeowners in the World Heritage Site, as well as in historic areas in the Kathmandu Valley, to read this document before any change, renovation or addition is made to historic houses (private or public). Thank You.

SAVE THE VALLEY FROM BECOMING AN URBAN SLUM, AN INVESTMENT FOR FUTURE GENERATIONS

DO WE WANT TO KEEP OUR HERITAGE ONLY IN PHOTOGRAPHS, NOT IN REALITY?

All the illustrations (photographs and drawings) are by the author unless otherwise mentioned in the caption.
INTRODUCTION
INTRODUCTION

WHAT IS THE HOMEOWNER’S MANUAL?

The Homeowner’s Manual is a practical guide to repairing, restoring, renovating and consolidating historic houses for contractors, technicians, and especially for homeowners. The manual is a comprehensive compilation of modern scientific conservation methods and traditional building techniques which should be used in conservation projects.

The Homeowner’s Manual is published by UNESCO. Within the framework of the UNESCO Local Effort in Preservation (LEAP) Programme, the manual will provide local stakeholders and homeowners with basic knowledge, which is critical in making informed decisions about conserving historic houses.

The purpose of the Homeowner’s Manual is to:
1. provide solution to repair their houses in the best and most affordable way;
2. provide references for international standards of best conservation practice;
3. facilitate communication between homeowners and contractors and identify conservation priorities and appropriate methodologies;
4. provide further resources to enable appropriate sourcing of materials and skilled craftsmen as well technicians.

Why repair historic houses?

Historic buildings were constructed over long periods of time in different religious, social and cultural contexts. They were built during the reigns of different rulers and are illustrations of traditional architecture, which shows their value as cultural heritage and examples of how the buildings were constructed during those periods. It is important not to preserve old houses, but also to preserve them using the traditional methods of construction, preserving as much of the authentic historic fabric as possible. Generally people think
that if an old house is demolished and then reconstructed in an old style, using some historical elements, it is still traditional architecture. They never realize that once a house is demolished, it is lost of its historic value. There is a misconception that a new house built with some carvings is traditional architecture.

The numbers of buildings which survived the 1934 earthquake is small, although there are some which date from the 17th century. Many houses were rebuilt after the 1934 earthquake in a traditional manner with traditional techniques and materials. At that time modern methods and materials were not available in the Kathmandu Valley. There was influence from neo-classical architecture, which was an acceptable mix with traditional Nepalese architecture, as opposed to today's modern cement concrete multi-storey blocks.

Many of the old houses in the valley, even those quite humble, are of comparable quality to Nepal's traditional palaces, but sadly many people do not value these buildings and would prefer new houses built with concrete construction.

High quality woodcarving is a principal feature of traditional architecture of Nepal. Traditional architecture of the valley

\[
\text{Fig. 1. Palace and private house.}
\]

\textbf{Left:} Patan Darbar Square. Patan was less damaged than Kathmandu and Bhaktapur Darbar Squares, which required more rebuilding after the 1934 earthquake. \textbf{Right:} Long house, Bhaktapur Darbar Square. A fine example of a 17th century building. There are still many buildings which are as high quality as palaces.
often contains work of high artistic value. Metalwork and other crafts are often seen in traditional buildings. All these crafts are reflected in the long tradition of a culture centered on Kathmandu Valley's compact towns.

One of Nepal's major potential economic resources is tourism, which is already a part of our culture. Many tourists are coming to Nepal to study and enjoy its extraordinary cultural heritage and unique traditional architecture.

The vast majority of new buildings is not structurally sound. Generally homeowners do not consult structural engineers or even follow basic building rules. As Kathmandu is in an earthquake zone, it almost certain that a total collapse of the building would occur were an earthquake to hit, with the resulting loss of life. Few new buildings have adequate seismic strengthening. Without the involvement of an engineer, the size of the columns, beams and the reinforcement used are generally recommended by the contractor or masons based on previous works. Homeowners with no experience in these matters accept this and believe them to be right. Little thought is given as to what will happen during an earth-

Fig. 2. Detail of palaces and private houses.
Left: Hanuman Dhoka Palace, Kathmandu Darbar Square. A royal corner window - a fine example of wood and ivory carving with metal work.
Right: Sathwa Corner Window House, Patan. A rare, carved timber corner window in a local residence. Important historical elements are still intact in palaces as well as private houses.
quake or some other event, which might cause movement in the structure. We can see many buildings of different heights with the same sized columns and beams using the same amount of reinforcing steel. Even without being an engineer this should appear strange, but then the upper floors may be even cantilevered out making structural madness. There are of course bylaws governing structural design but these are never taken seriously. It has become a mere formality, for obtaining a building permit, rather than real structural design work.

The present trend of building modern multi-storey houses, illegal constructions and encroachments, after demolishing old houses in the valley, is creating an urban slum - a city where safety, public utilities, access and a pleasant living atmosphere cannot be maintained. The long-term effect will be to decrease property and house values. Illegal, tall buildings, especially in the Darbar Squares, are destroying the beauty of the skyline, which was largely intact until a few years ago. Today ugly new houses block views of temples. Previously people never built their houses higher than temples, even there were no bylaws, but now almost all the houses are taller than temples.

Fig. 3. Juxtaposition of old with new houses.
Elevation of houses on one of the lanes in Patan. There is no relationship and sympathy for old houses when building new cement concrete structure. Photo: Italian student's project work.
CHAPTER 1

CONSERVATION AND CONTEXT
CHAPTER 1

CONSERVATION AND CONTEXT

1.1 Basic Principles of Conservation

The term 'minimal intervention' is often used when referring to renovation and repairs of historic buildings. Minimal intervention means causing minimum disturbance to the original fabric when repairing a building. It involves discrete repairs and localized reconstruction using the original materials and methods as well avoiding unnecessary cost.

The Preservation of Authenticity

The word 'authenticity' has many facets - authenticity of structure, authenticity of method, authenticity of materials etc. When considering a restoration project it is important to assess the value of the materials, which were used in the construction of the building in question. For example, a length of wood, which is old and decayed at one end could either be entirely replaced at great expense or repaired at half the price. The cost of rebuilding will far exceed the cost of repair, and this will save historic elements, even a small piece.

Why repair in situ instead of rebuilding?

Historical buildings are valued because of their age, configuration, historical materials and construction techniques, which are lost upon demolition and inappropriate reconstruction. Most buildings can be repaired in situ, without total dismantling. Archaeological evidence contained in historic buildings is lost, even if the original materials are reused. If dismantling is the only solution, all the existing details should be recorded in photograph and technical drawings.

The importance of associated materials

Rebuilding inevitably destroys associated materials such as plaster works. Not only associated materials are under threat, but also many other details such as built-in cupboards, blind

अध्याय १

संरक्षण र संरचना

1.1 संरक्षणका मुख्य सिद्धान्त

न्युटाम हल्टका भन्ने बाटो ऐतिहासिक धराको स्थापना र संरचना कायमकायम्यूँ र अन्य रोजगार गरिएको हुन। न्युटामका हल्टकाले धराको संरक्षण, धराको संरक्षण, सामाजिक धराको संरक्षण आदि। धराका योजनानिर्माण, विवाद बनाउँछ र निर्माणका संरक्षण, धराका पुनर्निर्माण, सामाजिकका संरक्षण आदि।

बौद्धिक प्रकृति

संरक्षणका संरचना

संरक्षण बन्द अनेक र मुख्य दृष्टिकोण र संरचना संरक्षण, तरीका संरक्षण, सामाजिक संरक्षण आदि। पुनर्निर्माण परिक्रमा योजनापत्र विवाद बनाउँछ र संरक्षणका संरचना संरक्षण आदि।

पुनर्निर्माण धराको संरक्षण

पुनर्निर्माण गरुँबुँ तर्कहरू विषयहरूमा संरचना किन नगर्ने? ऐतिहासिक धराको त्वस्त्र उत्पादन, प्रयोग गराउँछ ऐतिहासिक सामाजिक र संरचना तरीका पहिला धराको मुख्य धराको हुन। जैन धराको पुनर्निर्माण गरुँ dealt in situ र पुनर्निर्माण गरुँ।

विभाग

विभाग का निर्माण अनेक धराको संरक्षण, सामाजिक धराको संरक्षण, संरचना संरक्षण आदि।

महत्त्वपूर्ण संरक्षण

पुनर्निर्माण धराको संरक्षण, पुनर्निर्माण धराको संरक्षण, सामाजिक धराको संरक्षण आदि।

संरचना र संरक्षण

पुनर्निर्माण धराको संरक्षण, पुनर्निर्माण धराको संरक्षण, सामाजिक धराको संरक्षण आदि।

पुनर्निर्माण धराको संरक्षण, पुनर्निर्माण धराको संरक्षण, सामाजिक धराको संरक्षण आदि।

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पुनर्निर्माण धराको संरक्षण, पुनर्निर्माण धराको संरक्षण, सामाजिक धराको संरक्षण आदि।
windows, decorative niches, pilasters, etc. We risk losing some of these which can never be replaced in the same original high-quality way.

Importance of using traditional techniques and materials

The key to good conservation is the correct handling of traditional materials and observance of traditional building techniques, which have been developed over hundreds of years to suit the local environment. Modern conservation techniques also need to be used, particularly for in situ repairs. Buildings may sometimes be distressed to an extent that the traditional construction system no longer functions properly. In these cases modern techniques will need to be used.

1.2 World Heritage Site (WHS)

Granting of WHS status to our cultural property is an indication that our heritage is seen as not just of local importance, but as being a relevant part of the cultural property of the whole world. The interest of many foreign academics and historians in this place

Fig. 4. Repair in situ saves historical fabric.

Left: Aki Baha, Patan. One of the intact courtyards with wall paintings on the exterior surface of the walls beside the windows. Such wall paintings and other ornamental works are routinely lost during reconstruction of buildings. Right: People do not bother to stick pamphlets on the paintings or demolish buildings with any important paintings.
reflects the importance with which our heritage is regarded from outside. The existence of the WHS brings recognition and the prestige to the country as well potential tourist income.

Our ancestors have produced a culture which is unique in the World. These monuments were made when there were no mechanical and technical facilities and were handcrafted to a high quality and in a vast quantity. Today we are not undertaking such work on houses or monuments and appear to be unable to keep them intact. Every day we are losing them and with them the connection to our ancestral past.

Fig. 5. WHS of the Kathmandu Valley. Map of the Master Plan for the conservation of the cultural heritage in the Kathmandu Valley.

क्षेत्र ५. काठमाडौंको विश्वसंरक्षित क्षेत्रको निर्माण। पथशाला: मान्द्र क्षेत्र पत्रकार वि कन्सर्वेशन अड्डा वि कान्सर्वेशन ओडियल स्टेट्स इन्स्टीट्यूट डे मान्द्र क्षेत्र पत्रकार नेपाली।

क्षेत्र ६. काठमाडौंको विश्वसंरक्षित क्षेत्रको निर्माण। पथशाला: मान्द्र क्षेत्र पत्रकार वि कन्सर्वेशन अड्डा वि कान्सर्वेशन ओडियल स्टेट्यूट इन्स्टीट्यूट डे मान्द्र क्षेत्र पत्रकार नेपाली।
There are seven Monument Zones (MZ) in the Kathmandu valley. It is a very prestigious matter to have seven MZs in a small valley, all of which were inscribed in the World Heritage List in 1979. These MZs include two Buddhist monuments (Swayambhu and Baudhanath), two Hindu temples (Pashupati Nath and Changu Narayan) and three palace complexes (Kathmandu, Patan and Bhaktapur).

1.3 Urban Context
Heritage conservation management
Uncontrolled development is not only having an effect on the visible heritage but also results in poor living conditions and inadequate services, such as poor water supply and sewage disposal. The cumulative effect of this is major pollution of the environment. The row of old buildings illustrates the harmony of the traditional architectural city created by 3-4 storey houses, always with sloped roofs. All the plinth levels and floor levels are same. The skyline of the houses is similar. The current trend to build high ceiling heights in the city core is

Fig. 6. Harmony of traditional architecture.
destroying the harmony between adjacent new and old buildings. There is no doubt that property values at such unsightly juxtapositions of new and old building must decrease in the long term. The historic scale and harmony of buildings is disrupted by the raised plinth level. When rebuilding a house, owners always make the plinth height higher than neighbors houses out of competition. In some cases plinth heights are raised to match the increase in road levels, which are raised higher each time the road is re-surfaced. Many of the lanes are too narrow for emergency vehicles to access because steps leading up to the new, higher plinths extend onto the roadway.

Fig. 7. Continuity of building lines.
Left: Tangal Tol, Patan Darbar WHS. The continuity of the old building’s horizontal lines are broken by new building. Right: Naka Bahil, Patan. Old three floors are equal in height to the two new floors.

Maintenance of the old buildings will extend the life of these properties and repair and renovation will assure their continued usefulness in

Conservation and context

13
Some people undertake maintenance but the lack of quality control, often makes it very difficult. More often than not, the repairs are carried out in a poor manner, which brings the decay of other elements of the building. There are too few restored old buildings in the country. Maintenance of buildings and the much-expected transformation of the heritage conservation needs the active involvement of the government and the community. It is not easy to persuade the community to change their ways. People are often content with only superficial changes which do not address the problem of decay.

In some cases, it appears that the major cause of these defects is poor quality control of the work. It is in this context that the role of preservation is important. Buildings are essential to their culture and history. The need for preservation is not just to save the building but to ensure that the history and culture are preserved for future generations.

Fig. 8. Building height. Golden Temple lane, Patan Darbar WHS. New skyscraper built just beside Kathmandu Valley's most important Buddhist monastery Kva Baha. This example shows how the new skyscraper is unsympathetic to its historic character and the Skinner building, which is adjacent to it, is suitably setback in relation to the old buildings. The new skyscraper is not a suitable replacement for the old buildings.
Fig. 9. Repairing old houses to maximize comfort.
Top: Pradhan House, Patan Darbar WHS. It is possible to change old buildings into sophisticated living spaces. An example of interior of an old house, adapted for modern living. Bottom: Kuthu Matha, Bhaktapur. Many of the old houses have been adapted for different purposes, such as this matha which was used as a school building until the last decade. Now it has been converted into a residence with interior and exterior improvements.
houses to serve as examples, so owners or builder/contractors do not appreciate how easy repair is, nor the high standard to which they can be restored.

Proper use of space is required for the management of the historic town core. For example, incompatible businesses, such as those which demand large volumes of transport to enter the historic streets, are potentially damaging and should be relocated elsewhere. Businesses, which produce an excessive amount of noise or objectionable odors are inappropriate in an area earmarked for tourist development and should also be relocated. Illegal high-rise buildings increases density of population, which puts strain on the public utilities of historic town, such as sewerage system, garbage disposal, water supply, communications and electricity.

---

**Fig. 10. Vertical division of the houses.**

*Left:* A historical three bay window drastically cut after vertical splitting of the house. Even though the left side storey heights were not changed, the window was still cut vertically and removed. *Right:* In the new construction the floor height of the right side of the house was changed so it was not possible to keep the window. One common thing to be noted, while house is divided vertically and reconstructed one of the portion never considered, how it was built and everything sliced out including major structural elements.
1.4 Architectural Context

Management of the space

Everybody wants to have modern facilities and renovations to their houses. Families are dynamic and members grow up, so more living space is required. Most people are not able to afford new land or larger houses so will try to accommodate the growing family in the same house somehow: The only solution, homeowners think, is to rebuild in new modern materials with minimal wall thickness, but there are other solutions too.

Traditionally in Nepal property is given to sons by dividing the multi-storey family home vertically and a portion being

Fig. 11. Cantilever and building height.

Left: Walkhin Tol, Patan. Cantilevered upper floors of the new buildings especially in the narrow lanes almost touch opposite buildings, which close lanes as a tunnel. Illegal cantilever in the narrow lanes makes street almost dark. Right: Lack of proper earthquake proof structural reinforcement makes new tall buildings risk not only for the people in those buildings, but also for neighboring buildings and people. Every additional floor increases the risk of collapse in earthquakes, especially given the present poor standards on hazard construction.
allocated to each son. This is a great risk to old houses. If one of the sons wants to reconstruct their house, they will just cut the building vertically with no thought to the structural or artistic implications. For this reason, many important historical elements have been lost. Once the house is divided vertically, the requirement for a stairway partition walls and lobby in each home means wasted space. This makes the living space more smaller. Horizontal division is not in practice.

### 1.5 Uncontrolled Development

The things which make the traditional style of architecture in the Kathmandu Valley (unique balance, proportion and quality) are missing from modern structures being built. It is understandable that people want new things and better standards of living. Also, that people are more accustomed to these days in rebuilding their old houses using 'modern' materials and methods. Many buildings are being ripped down due to the scarcity of accommodation. Again, this is not always the case and the need to explore all possible options must be made because in certain areas the demolition of buildings is not an option. The better utilization of the space is usually the solution. Buildings which are rebuilt often have minimal walls structures, more storeys and illegal cantilevers out over the main streets or public courtyards. The cantilever is also an encroachment into the public spaces, which is potentially dangerous as earthquake safety factors have rarely been considered. In the narrow lanes, streets are very dark owing to tall, multi-storey buildings with illegal cantilevers. The upper storeys are also built dangerously close to electricity poles.

#### 9.4 अनिवार्यता विवाद

काठमाडौं उपत्यकाको बास्तुकला जब बिन अनुपम, सन्तुलित, अनुपातीक्षण र गुणसम्बन्धको बनाई पक्ष तयार दिने निर्देशना र कार्य नाप्न र अल्पकालिक बिन विवेचन सन्तुलित स्थान, ध्वस्त गरी र मात्रहस्ते फाते उठाउँका गर्ने। यसै ध्वस्तकोलाई धाँडा राख्न सन्तुलित, तयार दिने निर्देशना र कार्य नाप्न र अल्पकालिक बिन विवेचन सन्तुलित स्थान ध्वस्त गरी र मात्रहस्ते फाते उठाउँका गर्ने।
CHAPTER 2

UNDERSTANDING YOUR BUILDING
CHAPTER 2

UNDERSTANDING YOUR BUILDING

It is very important that before you go through any intervention for your house, you have to understand the building well. How was it built, what was the concept or system of an old house? Usually it is not easy to compare with other houses (basically façade elements and details have no comparison, but construction techniques have similarities), because each and every house is different. That is why our architectural heritage is extraordinary and rich.

The traditional architecture of the Kathmandu Valley is brickwork built with mud mortar and timber-framed structures. Looking from the outside of any old building, anyone can identify what type of house it is. The façade identifies the type of house, either as private, public or as a palace. Nowadays, the function of buildings cannot be identified simply by looking at them.

2.1 Building Type

For basic classification houses can be categorized as follows:

a. Malla period (1200 - 1769)

This is the most valuable period of the traditional architecture of the Kathmandu Valley, for which Nepal is known all over the world.

Wherever possible symmetry was the main design issue on the façades. Where the ground floor is not used as shop front or a workshop, this section of the façade remains quite simply and symmetrically arranged, and not repeated in the upper storeys, which are arranged independently in symmetry.

Agyāya 2

Āvāna ḍharrha ṛuṃṭu

Agyāya 2

Bṛgu ḍhṛt muṣṭirgupuṇa

Agyāya 2
Fig. 12. Cross section of house.
Section of typical Newari house with their local names. Drawing: N. Gutschow. Newari towns and buildings.

Fig. 12. दोमको निवास वातावरण (मैकनरी)
नेवारी घरको मैकनरी एक नमुना र निवासको स्वातंत्र्य नामहरू सहित। नक्षत्र: एन. गूट्स्चो, नेवारी टाउन एवं बिल्डिंग (}

Fig. 12. दोमको निवास वातावरण (मैकनरी)
छणु नमुना नेवा दोमको निवास, नेवारी स्वातंत्र्य नामहरू नक्षत्र: एन. गूट्स्चो, नेवारी टाउन एवं बिल्डिंग (}
Fig. 13. Elevation of house.
Elevation of typical urban house, an example of Newari traditional architecture with their local names. Drawing: N. Gutschow. Newari towns and buildings.
A central wall normally divides the ground floor into two narrow rooms, of which the front room is usually a shop front or workshop.

The first floor is used mainly for bedrooms. Also as in ground floor two rooms are created by a central wall. To keep the privacy from the outside, this floor usually has only fixed lattice windows.

The most important communication to the street other than the ground floor door on the front façade is decorative bay window on the second floor. It has window bench and its latticed window shutter is openable. This floor is the main living and family room. A row of twin columns takes the place of the central wall to create a larger space in the house.

Third (attic) floor is used as kitchen, dining and shrine area. It makes sense to have kitchen on the top floor when people use firewood for cooking, so smoke doesn’t go through the whole building. Same as on the second floor a row of columns is found in the center to hold the ridge of the building.

Fig. 14. Shah Period Houses.
On the first floor, lattice windows are still kept but in vertical proportion and the second floor windows besides sanjhyah also became vertically proportioned.

**Fig 14. Shah Period Houses**

![Shah Period Houses](image-url)
b. Shah period (1769 - 1846)
In the beginning of this period most of the houses were still built in Malla Period style, but enlarging in proportion. Only sanjhyah, now less ornate, was retained in its original location on the façade. By the middle of this period there was the influence of Mughal architecture, which may have introduced stucco plaster in the valley for the first time.

c. Rana period (1846 - 1951)
Most of the outside influence arrived in the valley in this period. Before the turn of the century the trend towards lighter, larger and simple windows was introduced. These

Fig. 15. Rana Period Houses.
Left and Middle: A typical example with vertical window and stucco plastered façade. Top: Three units of the same windows used together to create sanjhyah appearance on the second floor.
window are vertical in proportion, sized about 3'x5'. Sanjhya was also replaced by the same type window, but in some cases three of them were put together to give the same appearance as sanjhya. The façade took on a vertical appearance, but still an uneven number of windows per storey was retained whenever the length of the house permitted it.

Houses from this period are not considered as a monument, but they are still better than modern cement concrete houses and stands better with our traditional house as an ensemble.

The use of natural renewable products is always better for human beings than many modern materials, not only for environmental conservation reasons. Houses built from natural materials using traditional methods are normally more suited to seasonal climatic changes.

The natural materials, such as brick and mud mortar used in thick walls, are much warmer in winter and cooler in summer. In another words the thick wall works as insulation. Many of the constructions built today have thin walls. While they do

Fig. 16. Transformation of facade: Façade showing typical changes on façade from Malla to Rana period. Drawing: W. Korn. The Traditional Architectural of the Kathmandu Valley.

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give more living space, the thin walls are not good for tem-
perature regulation and therefore, it is bad for the quality of
life of the inhabitants. A thin cement mortar wall does ... on such a struc-
ture adds to it being hot in summer and cold in winter. Inold traditional houses a thick mud layer and
jhingati
roof act
as insulation.

2.2 The Role of Documentation

Documentation is the same as taking a snapshot of a build-
ing. It allows, for example, investigation into the authenticity
of structures as well as being a historical record at the time
of documentation. Documentation is a resource for higher
academic research, which can be used as a resource by owners
and academia alike. Documentation is essential so that the
planner of a renovation project knows as much as possible
about the building and can make decisions in an informed
way. Careful and accurate documentation can extend our
knowledge of a traditional building, allowing us to have an
accurate picture of what was there. Without documentation
it is very difficult to preserve authenticity. A building, which
has been restored without being properly recorded and
understood will almost certainly have reduced historic value
through ill-planned alterations to its historic fabric.

Documentation of the existing buildings

Surveys should be undertaken to record the condition of
buildings and are invaluable in helping to assess which parts
are at risk. It is recommended to have a measured drawing
and photos, which will allow to make future planning. Of
course it will cost to make measured drawings. But it does
not cost much to take a lot of pictures before and after the
work, which is a simple, cheap and useful thing to do.
All the photographs should be taken with a standard lens, not wide angle and should include measuring lines and tapes, which will give future assistance in producing scaled drawings and photogrammetric rectified images. All the external and internal fittings such as doors and windows, however damaged and fragmentary, should be noted and labeled on the drawings and referred to in the photographs. These should be used to ensure repaired elements match the original.

The building condition
While documenting the building this will come together. All that is needed is a few more lines in the drawing or a few more photographs to show damaged areas.

Documenting the conservation work itself
This is something similar to keeping your medical reports, which will give you information in the future about what was done/changed before.

Fig. 17. New houses.
Today’s houses are built to maximize the use of the land they own. The shape of the houses are not really comfortable and living spaces are limited.
Understanding your building

**Documentation from historical resources**

It is very unlikely to find historical documentation of private houses, because there was no system to keep records. But if possible, it is still desirable to look for the following information:

- **a)** Age of building
- **b)** Original design of buildings, including any sketch or drawings
- **c)** Historic photos of the building
- **d)** Oral and written account of the building
- **e)** History of additions or alteration to the building

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![Fig. 18. Documentation before reconstruction.](image)


*Right:* Sometimes even proper documentation does not achieve the goal of maintaining originality. After rebuilding the whole house, the original configuration of the temple was lost. The rooftop temple is now much smaller than original configuration, which makes the pinnacle too large in proportion to the lower structure. Following reconstruction, the lower section of the temple is not visible from the street.
Fig. 19. Sample measured drawing before and proposed restoration.
Kujhyah House; Plans, sections and elevations
Fig. 20. Example of historic photo documentation.

निर्देश २०. ऐतिहासिक फोटो मानोबंधकरण

माही गाँव देखिया आचरण फोटो एम. स्लुसर १९६८ माही गाँव छाने र संध्या १९८८ मा भएको। तर गाँवमा नए फिल्म संध्याका विषय नै प्रयोग गरिएको। तर गाँवमा क्विकलिप्ट विषयक प्रभाव फुँक्यो।

निर्देश २०. ऐतिहासिक फोटो मानोबंधकरण

जो देखि देखिया आचरण फोटो एम. स्लुसर १९६८ जो तबै पी र संध्या १९८८ भएको। तबै देखि नए फिल्म संध्याका विषय नै विषयक प्रभाव फुँक्यो।
CHAPTER 3

SETTING CONSERVATION OBJECTIVES
CHAPTER 3

SETTING CONSERVATION OBJECTIVES

Before starting any work, the homeowner should think about what will be the future use of the house? This will give the direction for what to change or what to repair in the old house. Generally houses can be adapted most easily if the new use is not very different from the existing. This will ensure minimum intervention and therefore minimize the loss of original fabric as well being more economical.

3.1 Setting Conservation Objectives and Priorities

The following worksheet might be helpful to the homeowner to make decisions for the future use of the house.

1. What is the existing use of your house?
2. What future use do you have in your mind? (This is also depends upon the location of the house.)
3. Do you want to think about what can be done minimally to get more advantage and at cheaper cost?
4. What are necessary changes for the same or new use?
5. How much to keep and how much to repair or reconstruct? Does the proposed change in your house affect any architectural, historical or cultural significance?
6. Is your house structurally capable to take new changes or additions?
7. Is the future use compatible with the surrounding context of the buildings?
8. Explore the ideas with consultant/architect.
9. What is your budget for repair/renovation? How much proposed work can be done with your budget?
10. Check with the Municipality and Department of Archaeology if solutions and changes are allowed under bylaws.
3.2 Advice on Alternative Use
The very best way to preserve buildings as buildings, as opposed to museum objects, is to keep them in use. This will involve modernization and renovation with or without adaptive alterations. The original use is generally the best for conservation of the fabric, meaning fewer changes. An understanding of the original layout and use of the building is an important first step in the process. Adaptive re-use of the old building may involve the introduction of new construction techniques, but it is important that the structural integrity and historical character of the building remain.

a. Proposals for tourist accommodations
Conserving a house does not need to be done purely on the grounds of heritage preservation. According to the Venice Charter, conservation is a 'means of safeguarding cultural heritage, with the view to suitably adapting it to the society’s needs by a series of technical, legislative, financial, fiscal, educational and other'. The entire effort can be self-sustaining if the houses are restored and put to productive use. This is where the idea of 'adaptive re-use' or building recycling comes in. Aside from turning the houses into income-generating assets, re-using the building 'could ensure its maintenance, and therefore, preserve it'.

K. पर्यटकस्थल चलन दिनको निषिद्ध प्रयोगहरू
समुदायको जिल्लाहरूको हिस्यकोत्तर धारा घरलाई सर्वांश गर्न आवश्यक हो। भैरवनाथ गाः आनामा सर्वांश भएको नै निषिद्ध प्रयोगहरू, वैज्ञानिक, वित्तीय, अर्थीय, रीतिक र अन्य उपायवट समाजको आवश्यकता अनुसार यसलाई अनुकूल बनाउने उद्देश्यसँग गराउने सार्थकतामा सर्वांशको साधन हो। यो सम्भव काम स्वयं: दिनाको पर्यटकस्थल ध्वनि त्वर हटा सक्ने जब धराहरूलाई नियुक्त गरेर उपायवट मार्गदर्शित प्रयोगमा व्यक्त। यो नै अनुकूल पूर्वधराको भरोसा प्रयोग गर्न सहज हुन्छ। धराहरूलाई आदाय दिने रोशनीको स्थापना तथा सर्वांशको पनि पक्का गरिएको छ।

K. पर्यटकस्थलमा ध्वनि प्रमाण
समुदायको जर्मनाहरूको हिस्यकोत्तर धारा यस ध्वनि प्रमाण हुन्छ। भैरवनाथ गाः आनामा सर्वांश धारा नै निषिद्ध प्रयोग, वैज्ञानिक, वित्तीय, अर्थीय, रीतिक र अन्य उपायवट समाजको आवश्यकता अनुसार यसलाई अनुकूल बनाउने उद्देश्यसँग गराउने सार्थकतामा सर्वांशको साधन हो। यो सम्भव काम स्वयं: दिनाको पर्यटकस्थल ध्वनि त्वर हटा सक्ने जब धराहरूलाई नियुक्त गरेर उपायवट मार्गदर्शित प्रयोगमा व्यक्त। यो नै अनुकूल पूर्वधराको भरोसा प्रयोग गर्न सहज हुन्छ। धराहरूलाई आदाय दिने रोशनीको स्थापना तथा सर्वांशको पनि पक्का गरिएको छ।
Buildings identified as being of outstanding importance should be preserved in their original state, but alternative uses could be found for many other buildings.

**Hotels/Bed-and-breakfast lodges** - Although there are many modern tourist inns and guest houses in the valley, traditional dwellings could be adapted for tourists who like to stay in historic houses. While some buildings and owners may not be up to operating a large hotel, they could convert the ground floor or extra space as a bed-and-breakfast or apartments. This would generate additional income.

Restaurants/Fast-food centers. The food business is a good venture as people usually spend a larger proportion of their income on basic needs. Some of the old ancestral houses, if renovated, could serve in part as good gourmet restaurants, where people can experience fine and leisurely dining, or fast-food centers for those who are always on the go. Obviously this is not possible in all cases and does depend upon the location.

**Fig. 22. Adaptive re-use of old houses.**

Left: Shrestha House, Kulima, Patan. Right: Rajbhandari House, Kwalaku, Patan. Patan Tourism Development Organization, supported by UNESCO, proposed to convert these two houses into new use. This is a good start to inform people how they could earn money from old houses without investing a large amount of money for new construction.

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As Kathmandu continues to become the center of business and government administration, migration, either transitory or permanent, will swell the population and increase the demand for housing. Homeowners who are not inclined to operate serviced businesses could still make productive use of their buildings. These could be renovated to serve the housing needs of small families or individuals.

**Boarding houses**

Left: Jagamo Matha, Dattatrya, Bhaktapur. An old, ruined matha was restored for re-use as a restaurant on the first floor and shop fronts on the ground floor. Adaptive re-use of old houses could easily generate money for maintenance as well as return a good profit to the owners. Middle: Bhailadevo Sattal, Taumadi, Bhaktapur. The restoration of this sattal by the Bhaktapur Development Project, with some changes in the historical building for use as a small restaurant, became one of the attractions for local people and foreigners alike in Bhaktapur. Right: A house built after the 1934 earthquake in Kathmandu Darbar WHS has been turned into a restaurant, which has become one of the busiest restaurants in the center of the city.

Fig. 23. Adaptive re-use as a cafe.

Left: Jagamo Matha, Dattatrya, Bhaktapur. An old, ruined matha was restored for re-use as a restaurant on the first floor and shop fronts on the ground floor. Adaptive re-use of old houses could easily generate money for maintenance as well as return a good profit to the owners. Middle: Bhailadevo Sattal, Taumadi, Bhaktapur. The restoration of this sattal by the Bhaktapur Development Project, with some changes in the historical building for use as a small restaurant, became one of the attractions for local people and foreigners alike in Bhaktapur. Right: A house built after the 1934 earthquake in Kathmandu Darbar WHS has been turned into a restaurant, which has become one of the busiest restaurants in the center of the city.

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Exhibit venues/Crafts center shops - Kathmandu is rich in traditional crafts. Many crafts such as the woodcarving, metal craft, weaving, pottery and the paper industry still thrive today. Although there are a lot of people who are involved in these crafts, there seems to be a lack of a proper marketing scheme to promote the products. Display centers and stores for such goods would be well-sited in ancestral houses.

The important thing about adaptive re-use is that it provides a means of maintenance for existing structures. The possible uses of houses need not be limited to those that relate to the past like art and craft antique shops. Houses can continue to thrive as a haven where the old co-exists with the new. Kathmandu can retain its authenticity as a heritage town while adapting to changes brought about by development. This way, it becomes a living and functional historic town.

Fig. 24. Adaptive re-use for craft center shops.
Taja Matha, Dattatriya, Bhaktapur. An old matha was adapted for re-use as a handicraft bazaar on the exterior and as a workshop for traditional woodcarving in the inner courtyard.

Fig. 24 बाजार प्रयोग नयाँ बाजार प्रयोग
तहा मठ, दत्तात्रय, भक्तपुर। एउटा पुरानो मठको बाहिरीको निर्माण बनाउने र नयाँ निर्माणको बाहिरीको व्यतिरिक्त लागि बाजार कार्यस्थल बनाउने।

Fig. 24 बाजार प्रयोग नयाँ बाजार प्रयोग
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b. Advice on extensions: maximizing use of space through extensions and modernization

a. Everybody wants to have modern facilities such as bathrooms, new kitchens and so on. These can often be accommodated in extensions to the existing building rather than demolishing and rebuilding the historic house. Imaginative use of space can improve better living conditions.

Fig. 25. Adaptive re-use for shopping complex.
Top: Some parts (mainly walled and stable) of the Baber Mahal, a 20th century palace was restored and extended for re-use. Bottom: Baber Mahal Revisited, Kathmandu. Today it is famous for its shopping complex and eateries. It was the first major, high-end, private, adaptive re-use project in the country.

ख. विस्तारार्थ सलाह : विस्तार र आधुनिकरण
क. प्रत्येक व्यक्ति वापस, नया भवन जस्ता आधुनिक सुविधाहरू चाहेका । हाल रहेको घरलाई विस्तार भएर पानि मिलाउन सकिन्छ, पुरानो ऐतिहासिक घरलाई विस्तार गरेका पुनर्निर्माण नै गर्न पर्नै आवश्यकता देखिएको । वास्तवमा कल्याणीय प्रयोग जीवनशैलीमा सुगन्ध त्यानुसार सकिन्छ ।

ख. विस्तारार्थ सलाह : धार्मिक अनुष्ठान उपयोग
विस्तार र आधुनिकरण
क. प्रत्येक मनुष्य वापस, नया भवन नै धार्मिक सुविधाहरू यथैक । आ दूर छैन्त विस्तार जस्ता भएका त्यसै पुनर्निर्माण ऐतिहासिक छैन्त नै पुनर्निर्माण धार्मिक आवश्यक खाने रहेको । धार्मिक कल्याणीय प्रयोग जीवनशैलीमा सुगन्ध हरेका ।
h. Houses can be enlarged by the sympathetic addition of floors, rather than by demolition and rebuilding. This will save the lower structure and save hard-earned money. Repairs are then reversible and the option for restoration of the historic core of the building in the future will be maintained. The value of old buildings in Kathmandu may soon take on the same status as a valuable financial asset as old buildings do in more economically developed countries.

Fig. 26. Additional floors
Left: House in Taumadi, Bhaktapur. Adding a floor without damaging the original lower structure and maintaining the jhingati roof overhang is the best solution to get more living space. Right: House in Svatha, Patan. Another satisfactory solution, preserving the lower floors of the old house rather than rebuilding with modern materials.
c. Homeowners have always complained that there are not enough openings for light and air circulation in old houses. This leads to ground damp problems and poor living conditions. These problems are inherent to old houses, but there are many simple and cheap solutions. Extra light can be admitted by making fixed lattices openable by installing suitable hinges and glazed shutters (see Adaptation of openings in Chapter 5). Dormer windows can be added to the rear slopes of roofs.

Fig. 27. Dormer window.
Cupin Ghat Sattal, Bhaktapur. A dormer window was introduced on the courtyard façade of the building to get more light and air circulation.

d. Vertical division is one of the causes of losing living space because it involves the loss of large amounts of floor area to accommodate new staircases, lobby and partition walls. It is advisable to divide horizontally not to lose space for individual lobbies.

के, घर धनीहरूले सङ्गै गणातो गर्दछ कि पुरानो घरहरूको प्रकाश र हवा साधनहरूले निम्नत प्रयोग खुलापना हुन्छ। उसले गर्दछ मुँह आफ्नो समस्या र खराब जीवन अवस्थाको भ्रमण हुन्छ। यी पुरानो घरहरूको अभिनव समस्याहरू हुन्छ तर यसलाई घरको सामान्य र समस्याहरू समाधानहरू हुन्छ। घरको रहेको अभिनव खुलासहरूमा उपयुक्त कक्षा हालेर खोल्नुहोस् गरेँ र ऐना खानाको राखी बियह प्रकाश आउन विनेनु पर्दछ। (लेखावास: अध्याय ६ मा भूलय र ढोकाको अनुकूलन) पतझडिएको मिलानी छानामा बुझालको भवान (डोर्मर) भन्ने सकिन्छ।

घ. ढोको विभाजन थाहस थानो क्रममा भर्न जातो एउटा कारण हो किनन्छ यसले नयाँ भर्याद, बाटो, विभाजन गरेनुभएको दैध देखरेखको आबाधकता हुन्छ। व्यक्तिगत बाटोको निम्नत थान नग्नवाडी भागभाग हर्ष ढोको नगरी तहात विश्वसनीय भाँग लगाउन बियह उपयुक्त हुनेछ।

घ. ढोको विभाजन हे थाहे थाप भने यो जुग्य बजारा छाल वाणी ढा यसा ढोको नयाँ स्थान, नब, विभाजन प्लास तयार यस्ता बाणी मानी। व्यक्तिगत नयाँ नामान्त नयाँ गम मयमय व्यापार झुल्ने ढाँडो मगायौ तहात विश्वसनीय भाँग लगे याँहरू अङ्ग उपयुक्त ज्ञान।
Fig. 28. Vertical division.

Left: Houses divided in several parts after vertical division. Middle: A narrow house with minimal width remains after vertical divisions of this house, with not enough space for even a minimum size room in one floor. Right: A small fragment remains after vertical division. What will happen to these houses in the next vertical separation?

Setting conservation objectives
Fig. 29. Vertical division.
Before reconstruction of the left part of this house, it appeared externally as one house, even though it was already vertically divided in several parts.

Before reconstruction of the left part of this house, it appeared externally as one house, even though it was already vertically divided in several parts.

Fig. 29. वर्तिका विभाजन
धरारे वारां भार पुनर्निर्माण गरने अनानो यो कार्यकारीक एक घर जसले एक्षिण्यो जबकि एकदा वर्तिका विभाजन गरी अनेक भागमा कौन विभिन्न किसिमको विस्तार।

Fig. 29. वर्तिका विभाजन
क्षेत्र वागाँ भाग पुनरुत्तरित गरेका नेपाल विने वार्षिक खराब हो भए जस्तै उनको विभाजन पारा वन भएको छुन्नु।
CHAPTER 4

UNDERTAKING CONSERVATION
CHAPTER 4

UDERTAKING CONSERVATION

4.1 Legislative Framework

Guidelines, Regulations and Restrictions

Q. Do homeowners need a permit to build? Do they know the difference between repair, renovation, remodeling and reconstruction? Professional technical advice?

A. The first thing is to assess what your aim is and see what the options are. This is usually best undertaken between the family members and interested parties. It is important that the regulations and guidelines are understood and that the proposal is realistic. The second thing is to see if there is a need to undertake expensive and perhaps unnecessary rebuilding work and whether repair, renovation or extension can solve the problem more cheaply. Only after exploring the options and checking the details against the bylaws, should you decide what building action to take. Does it involve the services of an architect or can the matter be dealt with by a contractor with the right mix of skills? List all your needs and requirements and include sketch plans of the house with the relevant details. This will help whoever you approach to understand what you need more clearly. The next step is to check with the Municipality for information they require to lodge the building application. It is important that the architect or contractor has the necessary understanding of the building restrictions in order to assure you good service with the minimum of problems.

Q. What are the height restrictions?

A. 35 ft high inside the Monument Zones and 45 feet high outside. It must be made clear that the height is the apex of the building, not just for overall building height, but also the maximum floor to floor height which is 8’0” in all historical core areas.

**Pr. 4.1**

**गर्दी**

4.1 **कानूनी व्यवस्था**

मार्ग निर्देशन, नियमक रह और प्रतिबंधक

प्र. के पर यहाँ योग्यता गति वाली तंत्रित लिखा आवश्यकता क्यों?

Q. के तिरंगेदार बाड़ी, मेडिटेंट, रिमोडलिंग और पुनर्निर्माण के बीचकी अंतरर बारे में चाहिए?

A. निम्नलिखित है आपके बायरो स्थिति के लिए नीति बनाने के लिए योग्यता गति वाली तंत्रित लिखा आवश्यकता क्यों?

उ. पहिले कुछ हो अपने उन्नत के हो भी नियम गति र रे के विकास छूट भी नहीं रहे। 

Q. विविधता का ज्ञान करते है?

A. कर्मयोगी जगत में उभरने के ही भी नियम गति र रे के विकास छूट भी नहीं रहे।

**Pr. 4.2**

**याना चुंनु**

4.2 **कानूनी व्यवस्था**

मार्ग निर्देशन, नियमक रह और प्रतिबंधक

प्र. छँखने स्वयं नियम देश यथा जनाकर करे माना दु हस्त लवण, विद्यालय, रिमोडलिंग और पुनर्निर्माण के विषयों या अन्य बारे में चाहिए?

Q. नाम भाषा उन्नत है ख ख धारा वित्तीय जाना म त व व प्रवर्तक हु धारा आंका?

A. तथा आप अत्याधुनिक बारे बाली र स्व द्वीप सम्म व्हें याने उन्म जी। नियम र मार्ग निर्देशन विशेषता महत्त्वपूर्ण जू ज प्रक्त वास्तविक जीवा?

Q. भाषा यह बाली संभाल अत्याधुनिक वाना व विनायक विनमन बवृत ह जांच यां स्वच्छ जांच जीवा जय याने गैर के बेका प्रतिबंधक जय आमया?

A. दुई वार्ता विद्वाना सेवा वाली वा ज्ञा बेका व विधाय वातान्त्रिक सम्म मन याना पीता। दु फूके आवश्यकता तत्काल स्वच्छ ताजा ता व अवाक्य विन्दु पाया देखा पता। बेका आंका सता कोही कुछ बांट पता आपने बनाई स्वच्छ ताजा स्वच्छ ताजा किया जाना। बेका याना समाधी गया। दु पता बहुत लगे कोही नियमक तत्काल स्वच्छ ताजा ता व विधाय विन्दु भुवने हो। तो विधाय उत्तम है वाटरवाटर देखा देखा अवाक्य तत्काल स्वच्छ ताजा स्वच्छ ताजा ता व विधाय विन्दु पाया देखा पता।
Q. Will I be permitted to put disk antenna and water tank above the roof line?
A. No. In the Monument Zones, water tanks and antennas cannot be above the 35 foot line. These are treated as part of the building.

Fig. 30. Fixing overall building height.
Top: The top of the ridge line, not the top of the living space must not exceed 35'.
Bottom: New houses must have a sloped roof to match old houses. Dormers could be added for more light and air circulation.

Fig. 31. Apex of the building.
Top: Taumadhi Square, Bhaktapur. Disc antennae and water tanks are a big eyesore. They are about one floor higher than the roof of the building.
Middle: Patan Darbar WHS. A water tank as well as a sign on the house to the right is above the ridge line.
Bottom: There are ways to keep disc antenna and water tanks below the height limit.

Q. Does this include flat roofed buildings?
A. No flat roofs. All buildings should have sloping roofs covered in an acceptable material, preferably jhingati roof tiles or terracotta colored zinc sheet.

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Middle: Patan Darbar WHS. A water tank as well as a sign on the house to the right is above the ridge line.
Bottom: There are ways to keep disc antenna and water tanks below the height limit.
Q. If I build in the Monument Zone (MZ) can I put in bigger windows and different details than original?
A. Windows in the MZ are supposed to be 3 feet wide by 5 feet high and can be double or triple bays. If an old house is being renovated, the owner must re-use as much of the original material as possible including windows. New details should match the quality of the originals. The general arrangements of the facades must follow the flow of the adjoining properties.

Q. For security I would like to have rolling steel shutters on my property.
A. No rolling shutters are allowed in the MZ. There are traditional solutions to the problem. One example is to use folding timber shutters lined with steel for added security.

Q. Pratiwaniyak kshetram 3'x5' daan shahab aap karo? kado kado kshetram shahab aap karo?
A. Pratiwani kshetram 3'x5' daan shahab aap karo. Aap kado kado kshetram shahab aap karo?

Fig. 32. Appropriate windows for WHS.
Left: A typical 3'x5' window. Right: Vertical windows are an appropriate mix with the old houses with traditional carved windows.

Fig. 33. Juxtaposition of modern and old structure.
A small but inappropriate addition is more than enough to destroy the beauty of old houses.

Undertaking conservation
Q. What type of finish can I put on the external walls of my property?
A. Exterior walls should be pointed with mud mortar or lime surkhi mortar. If homeowners want to plaster the wall surfaces, the finish should be lime plaster and lime wash.

Q. I want to get the maximum space from my property and I have seen other buildings with three foot cantilevers. Can I do the same?
A. No cantilevers are allowed for living spaces. Cantilevers are allowed above the second floor to protect the walls from the rainwater and sun, but no room should be built on top of the cantilever. The only exception is in buildings where there are projecting upper windows. These should be detailed, designed and constructed in the traditional manner.

Fig. 34. Cantilever.
Left: The slope of the cantilever must be constructed of timber. If concrete, then it must be covered with roof tiles. Right: It must be made clear that no plain concrete cantilever (B), no balcony (C) and no living space (D) should be built.

Fig. 35. Pada
A. Pada
B. Pada, Graded ground
C. Pada, Graded ground
D. Pada, Graded ground

Fig. 36. Pada
A. Pada
B. Pada, Graded ground
C. Pada, Graded ground
D. Pada, Graded ground
Q. I would like to raise the ceiling heights to give more head room. Can I do this?
A. The floor to floor height needs to match the old building lines in the adjoining properties and in any case should be no more than 8 feet. The only exceptions will be where it has been demonstrated that the original height exceeded this.

**Fig. 35. Cantilever.**
Left: Cantilever blocks the view as well as air circulation to the house next door, if rooms are built on top of the cantilever. Right: Cantilever construction brings electrical lines closer to your house, which creates a risk for your family.

**Fig. 36. Floor height.**
The floor height of new houses is usually raised higher than existing structure. The 2nd floor of the old building is level with the 1st floor of new houses.
Q. Is it acceptable to add a floor on top of an old house?
A. This is preferable to rebuilding. It will save the historical layers on the bottom levels, the ancestor's history and... is permanent. Sometimes the house might need reinforcement to support the additional weight but this is not so difficult.

Prachin Shahrastha jastle kaumdi utpadhaya purana r satya gharha sanga banaideka dhatu. Hamile purana sanga milene gare nayana gharhakoj dijaite gane samkirtana gane kaari guntuvta.

As in the ancient cities, old and new buildings are built side by side in the Kathmandu Valley. We must look for compromise in the design of new buildings to harmonize with the

Fig. 37. Additional floors.
Top: During the mid-20th century there was a trend of adding floors. Bottom left: Adding more floors on the top of old buildings, if allowed under the bylaws, is always better than demolishing old houses to rebuild. Once an old house is demolished it can never be returned to its original state. Bottom right: This is a good compromise of adding a floor to the old house, at the rear of the house. It appears as if it is a different house at the back while the front half remains intact. The new floor could have been designed to match the old style. This is a good example of adding a floor, especially as this doesn't block the air and light in the narrow lanes.
Undertaking conservation

Fig. 38. Additional floors.

Left: Ason, Kathmandu. Two new floors were added. Even though the details were not copied from the old lower floors, the architecture between the old and new conforms.

Right: This is the best solution for adding floors on top of the old structure. The upper three storeys have been added (3rd - 5th floor), and were copied from the original lower storeys. Unfortunately this building was demolished and rebuilt in cement concrete.
old. The most critical features needed to maintain traditional style are the height of buildings, cantilever design and the size and style of the openings.

4.2 The Correct Professional and Technical Advice

Professionals without specialized knowledge can instigate damaging alterations to traditional buildings. In addition to the government and official agencies, there is now a growing body of professional architects and engineers with specialized conservation expertise. In many cases the homeowner either can't afford or doesn't want to engage a professional consultant. They prefer to save money and just take advice from building contractors. This is often false economy as the results are of poor advice from a contractor are often more expensive than the fee of a professional.

4.3 उचित पेशावागत तथा प्राथिमिक सल्लाह

विशिष्ट शाखा विनाको पेशेवरहरूले परम्परागत धरारम्भको हानि नौकराली हुने गरी फेरबदल गर्न उद्देश भएको छ। सरकारी व औपचारिक संस्थाहरूको साथसाथ आजकल विशिष्ट संस्करण नियुक्तामा भएका पेशेवर आर्किटेक्चर हरू (बास्टुविद) र इंजीनियरहरूले बेबूझ छूनु। उर्दू अवसथामा घरघरीको कि न पेशेवर परम्परागतको धरारम्भको हानि नौकराली हुने गरी फेरबदल गर्न उद्देश भएको छ। लक्षित पैदा जोडिएको हिसाबले ठेकेदारहरू बाट सल्लाह लिने गर्नु। यो एक गलत हिसाब हुन्नको कारण थेर्केदारको धरारम्भको हानि नौकराली एक पेशेवर को सूचना असर बढो हुन्नको छ।
CHAPTER 5

TIMBER STRUCTURE
CHAPTER 5

Timber Structure

Timber is one of the principal construction materials in traditional architecture. It is used for decorative elements as well as structural members. Generally for the structural members and carved elements, hard wood like sal wood is used. For other non-structural elements normally soft wood, like pine, is used. Today many people do not want to use pine, because they think it is not durable. But in the old buildings we can see today that pine has been used very widely. When pine is used and kept from water ingress, it can stay sound for many years, reduces weight in the building and is cheaper than sal wood.

अध्याय ५

काठको संरचना

काठ परम्परागत वास्तुकला का मुख्य निर्माण सामग्री हुन । यसलाई सजावटका साथे संरचना र अर्कायको लिमित प्रयोग गरिन्छ । साधारणतः संरचनाको र कृतिका तल्लोको लागि अराख काठ प्रयोग गरिन्छ । अर रंग र सजावटका साथैले अरा मान्यता भएको प्रयोग गरिन्छ । बहादुर हो र विषयक सल्ला प्रयोग गर्न विषयक गरिन्छ, फिन्करे सबैले सल्लालाई ध्यान धन्याच्छन् । तर पुराना परहेमा सल्लालाई अन्यायकृत रूपमा प्रयोग गर्न राख्ने अर्ने पनि हामी पाउँछौँ । सल्लालाई प्रयोग गर्न यदि पारिको झुकाव वात बजाउन सक्छौँ भने यो कुर्यास मध्यम दिन्त्रो रहन सक्छ । यसले घरको पनि तील घटाई दिन्छ । र साथै यो अराखनुभएका मध्यम सल्ला छ ।

अध्याय ५

सिंहा संरचना

Fig. 39. Sectional axon showing potential problem areas.

विच १९. सजावटका समया क्षेत्र देखाउँगो संस्करण आकृति ।
विच २०. सम्भवप्राय समया क्षेत्र बन्नु हो लग्न संस्करण आकृति ।
5.1 Symptom and Causes of Decay

Every thing is subject to decay in a certain period as decay is a natural process. But most decay in buildings is caused by neglect or lack of maintenance. There is no doubt that mud and timber structure can easily suffer from water penetration.

Timber structures are capable of lasting a considerable length of time if correctly maintained. The key to preserving timber buildings is to keep the timbers dry. Leaking roofs allow rainwater to penetrate onto structural members which can lead to fungal or insect attack. Insect attack is often secondary, with insects eating timber which has already been softened by fungi. The other source of danger to timber buildings is from moisture rising by capillary action from the ground.

5.1 Section and Decay

Shaggy growths on the surface, which are referred to as pink mould, should be removed immediately. This growth can be unpleasant and can cause structural damage to timbers.

Water penetration is not easy to detect due to the thick mud bed. But when the water travels up to the timber, water marks become easily visible on the timber elements.

Fig. 40. Decay of timber elements.

Left: Damage of joists from rain water poured for several years. Water is the main enemy for timber.

Right: Damaged by ground water rising easily. This process damages the ends of joists where not enough air circulation and causes the collapse of the whole floor.
If there is a small water leakage in the roof, it will become bigger and bigger every monsoon (individual elements of the buildings are described in ‘Parts of the building at risk’). This reduces the building into a ruinous state. Once the water enters the structure, the timber is not the only thing at risk. Many internal walls are built with sun-dried mud bricks with the mud mortar bedding which are subject to water damage.

Damp and fungal attack
This is an easy-to-detect symptom of rising damp from capillary action on the timber elements.

Fig. 42. Damage from water penetration.
Left: Baidhya House, Nardevi, Kathmandu. Sometimes maintenance of the building is a problem due to property disputes. Right: Taumadhi, Bhaktapur. Water penetration from the roof can bring buildings to ruin, if not taken care of in time.

Fig. 43. Deterioration of timber elements from damp.
Left: Water penetration on roof struts from the roof made green scum on the surface of carved elements. Right: All the timber parts were damp from the ground damp which traveled up the wall and decayed part of the joist inserted into the wall, which caused collapse of the whole floor.

Heritage Homeowner’s Preservation Manual
There was no system of damp proofing in the old days. Generally there were stone foundations up to the ground level and then brick work in mud mortar. Mud mortar can easily transfer ground damp to the wall but normally this will evaporate into the atmosphere from the mortar joints.

In unventilated rooms, the air becomes humid and allows the airborne moisture to travel up to other parts of the building such as the first floor timbers. The dissimilar materials and the moisture formed where the timber penetrates the walls provide the ideal environment for the airborne spores of fungi to grow. We can see this in many of the joist ends (inserted part in the wall) which are decayed from the ground damp. The dissimilar materials and the moisture formed where the timber penetrates the walls provide the ideal environment for the airborne spores of fungi to grow. The moisture formed where the timber penetrates the walls provides the ideal environment for the airborne spores of fungi to grow. The moisture formed where the timber penetrates the walls provides the ideal environment for the airborne spores of fungi to grow. The moisture formed where the timber penetrates the walls provides the ideal environment for the airborne spores of fungi to grow. The moisture formed where the timber penetrates the walls provides the ideal environment for the airborne spores of fungi to grow. The moisture formed where the timber penetrates the walls provides the ideal environment for the airborne spores of fungi to grow. The moisture formed where the timber penetrates the walls provides the ideal environment for the airborne spores of fungi to grow.

**Attack by insects**

We can see many tiny holes in the old timber, especially pine joists. If the insects are active in these timber elements, these holes drops wood dust every morning.

![Image of damaged timber](image)

**Fig. 44. Deterioration of timber elements from insects.**

**Left:** From outside it looks like only small holes, but in reality we always found the whole timber structure unsound.

**Right:** Termite attack makes timber elements completely hollow from inside. So the whole timber beam, which bears the load of the top structure, could collapse.

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**Timber structure**

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Lrql

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There are not many insect attacks in the valley but in the villages closer to the forest they are more pronounced. In some places one can see attacks in the pine from the 'white ants' also called termites. Even the timber which looks sound externally is hollow and has very little structural strength.

**Bad repair**

After the repair work it is not possible to detect the hidden joints once they are installed on place, so they have to be looked at during construction.

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**Fig. 45. Bad repair.**

Left: Old buildings are normally not level, so to fit in new rafters with old most of the workers use an easier way by cutting the wall plate to fit rafter leveled with other.

Right: unnecessarily cut corner rafter won’t help to keep intact the part outside the wall plate.

---

**Fig. 46. Improper joinery.**

Joinery of timber is also critical for structural members. Generally homeowners don’t pay attention to this matter due to the lack of technical knowledge.

Top left: If the timber peg, which joins the rafters to the top wall plate, is not secure, the rafter will have a tendency to slide. This in turn pushes the outer wall plate from its bearing on the top of the outer wall.

Top right: The lap joint is improperly reversed where the lower rafter is held only by a small timber peg. The upper rafter is thus not sharing any of the load it would have it had been lapped above the lower.
Preventative maintenance, unless the work is of a high standard, can accelerate a problem and in the worst cases cause more damage. Be aware not only of very high cost estimates, but also of low estimates that mean that the work will not be done properly.

5.2 Condition Survey
Firstly it is recommended to make sketches of the building and to note on the elements of the structure. This doesn’t need to be a measured survey but can be used for adding notes and recommendations.

Timber assessment
In assessing the condition of a traditional building, particular attention should be paid to those areas where water penetration is most likely to have occurred.

External examination
It is not easy to tell the condition of the timber from an external examination, especially if part of the timber elements are buried inside the walls. The outside might look fair, but most of the attack is internal. The condition of timbers can be assessed first by sound, by knocking them. The second method is to assess the hardness of timber, which can be done crudely by trying to push in a sharp instrument.

The weight of the timber
This can give a guideline but unless the building has been partially dismantled this is not always possible.

5.3 Parts of the Building at Risk
The timber elements are the main structural elements so threats to them pose the greatest risk factor, which are mainly:

i. Post
In buildings such as shops and patios (resthouse) with open ground floors, the whole facade is often carried on timber posts. The lack of damp proof courses in traditional methods of construction at the base of the timber posts allows

5.2 Abnormal showers

5.3 The building at risk
decay to affect the base, especially where the stone base is covered with new layer. Posts are at more risk from fungal attack particularly where they are up against brick walls.

### ii. Beam

Timber dalan on the ground floor constructed with post and beams for open space or shop fronts carries huge load from the upper structure. Beams are not in danger with damp except the ends, which buried in the wall. If joints between beams are not in proper place, this might cause damage, when load transfers from the wall.

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**Fig. 47. Decay of timber post.**

**Left:** Decay of timber post base by the ground damp, especially when it is attached with masonry wall and damp could travel through the wall. **Right:** Normally timber posts always stand above the stone base to have a good base and protection from the ground damp. But often homeowners add new floor finishing during the repair, which raises the floor level and covers the timber post at the bottom, allows dampness to spread.

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**विवरण:**

चित्र ४७: बट्टा बनाने के बाद मूल बट्टे को लेकर नहीं आया या आया का अधिकतम बुद्धि. वह चित्र एवं टोप के लिए आया है।

**वि. निचाल:**

खुला बट्टा का पता लगात निर्माण काटना थाम और निचालहर द्वारा निर्माण संचालन द्वारा निर्माण करने वाले मध्यकालीन द्वारा निर्माण हुए वार्ता बेहतर रहेगा। गारे भवन घर्स के छोटे हवाए पांव निचालहर लाई अंदाज़ बाट बनाने रहेगा। निचाल हर चीज़का जोखी उभित टाउमा पर्यावरणा हुनेली भने यसले गारोबाट भाग सन्ते बेलामा शा गुर्दाउल सक्दछ।

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**ख. पीना:**

खुल्ला धारा वा पता: कब-फिकायत मिथ्याह। नैना पाने दबा तथा. चित्री नैना चेहा संचालन पर्यावरणा वन चौ धारा बाट। अंग दुरु हु धारा चुम्ने चकाय चेराग नैना तथा वसा पाने दबा दैग्र।

नैनालग्यू हाय हो चौहार जोखी धारा वा मलाना धारा धुम्चे अस्या पाने भाग सन्ते निर्मित धारा बाट।

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iii. Joist

The floor joist ends buried in the wall are liable to become damp particularly in the ground level. The mechanisms of capillary action and ground damp evaporating into the air as vapor condenses onto the timber and brick allow the development of humid conditions favorable to insect or fungal attack. If the walls are plastered, this can trap moisture in the walls and slow down the natural evaporation. Poor ventilation in rooms on the ground floor is a major problem.

Fig. 48. Joinery between beams.

Left: If the joint between the beams is not above the post, loads from the upper structure may weaken the joint and break the beam. Right: Even if the joint is above the post, this is not good enough if it is in wrong location. Post, where the joint rests, has already settled compared to the next one. The loads from the upper structure push down post.

Fig. 49. Damage from ground damp.

Even if some places wall are not plastered, ground damp travels all the way up to the first floor joist, especially where the wall doesn’t have good air circulation.
iv. Wall plates
The wall plates are joined at the corners with simple lap-joints. In the roof structure most rafters lie perpendicular to the wall plates and in an angle with the hips and corners. When the ties which anchor the opposite wall plates together fail then the thrust of the roof forces the rafters to spread pushing the wall plates out. If the decay occurs at the corner lap joint, this will push the corners apart, threatening the whole roof structure.

Fig. 50. Process of failure of roof via wall plate.
Top left: Sketch of hipped roof showing how the forces from many rafters are transferred to the outer wall plate corner. Top right: Photo illustrates the damage of wall plate from this reason. Bottom left: This sketch shows the outer wall plate corner connection. Failure is most likely to take place at this half notched connection. The shaded part shows the most likely area of failure under outwards pushing loads. Bottom right: When the end of the outer wall plate shears away the wall plate will be forced by the rafter loads to move, which causes the roof to collapse.

A. Masonry wall
B. Inner wall plate
C. Outer wall plate
v. Eaves board
Broken or missing tiles of the roof allow the water to soak into the mud layer. The mud can be washed away and swell and loosen adjoining tiles. Leaving a leak allows the water to travel by gravity down towards the eaves board and starts damaging the joint between eaves and rafter and rusting the metal bands on the eaves, which holds the eaves.

vi. Rafter
Rafters are the principal roof structure members. Due to the massive redundant strength of the traditional design, if some rafters fail, normally this is not bad for the roof. However there are some key rafters (kigah, rafter with the timber pegs) in a roof which are critical structurally.

Rafter end - A small portion of the rafter's end is inserted into the eaves, and has the same problems as eaves board. The decay is always parallel with the eaves.

Round timber pegs - Timber pegs are very small but important element of the roof structure. These are inserted though rafters to hold them against the wall plates and purlins. These timber pegs extend above the planking into the mud. This is

Fig. 51. Decay of eaves board.
Damage of eaves board from water penetration at the edge of the rafter. This is the most likely place for decay, because this is the last point, where water could travel from whole roof and stops here.
the only channel in the roof which has a direct connection to the mud bed and provides a direct route for moisture to the core of the rafter. Even a slight displacement of the roof tiles lets water leak into the mud bed around the timber peg and can make the peg-hole wider in a short period. When the hole is wider, the timber peg head will drop out and cause failure of the roof.

vii. Purlin
All the rafters rest on the purlin. The corner joints of purlins are much weaker than wall plates, because at least wall plates

![Diagram showing how water penetration around the peg could damage the roof.](Fig_52)

Top left: Traditional roof section (section through timber peg).
Top right: Generally unprofessional people inadvertently crack jhingati in the process of removing weed growth. This creates channels through which rain water can penetrate.
Bottom left: After a few years of exposure to water the peg holes become larger causing the pegs to slip.
Bottom right: If there only a few timber pegs in the original construction this process of deterioration allows the forces from the struts to push the purlin away from the building (C).
Eventually the strut will fall away (D) which ultimately leads to roof failure (E).
Timber structure are in horizontal position and on the top of the wall, so it is easy to make lap joints. Purlins are not in the horizontal position and rest on the struts, so it is difficult to make tight joints. Lots of the thrust loads from the rafters is transferred to the corner along with forces coming from the struts.
viii. Carved elements/Doors and windows*

Carved elements were more damaged by humans than by other reasons. Many of the important windows were lost in reconstruction of the buildings. Also many of them were cut in two parts when the house was divided vertically and some were lost due to lack of maintenance.

(*Most of the carved elements are doors and windows in the private houses so they are categorized together.)

Fig. 54. Damage of purlin through seepage from timber pegs area.

As the diagram illustrates, the element of the roof structure most susceptible to water damage is the timber peg. Water eats the rafter and due to the heavy clay and tile load, the rafter overhangs often break off at this point. If the upper timber pegs in the wall plate are not secured the struts will push the purlin away and ultimately cause roof collapse.

The photo illustrates the given diagram in which the whole length of the overhang beyond the purlin has fallen away. The roof is now held only by the upper timber pegs in the wall plate.

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(*Most of the carved elements are doors and windows in the private houses so they are categorized together.)
In the 19th century, people still valued art works. Even if they had to cut an opening they would not leave it incomplete and would add a frame - like the left side of this window. Right: But today people cut beautifully carved windows even they need only minor repair. Right part of this house was not reconstructed, only replaced with new openings. It is understandable that if the house was reconstructed with different floor heights they would have to cut to adapt with new floor height.

**Fig. 55. Damage of carved elements.**

*Left:* In many places old lattice was cut out partially for no reason, because it is not helpful for looking out, it was for more air, for more light, or perhaps for throwing trash. *Right:* Damage from lack of maintenance, which will decay carved elements easily in a few monsoons.

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5.4 Repair/Conservation Techniques

Repair always maintains the maximum amount of original fabric and always involves less work. Normally when people are proposing to undertake renovation or repair to their houses, there is always an assumption that there is more work needed than new construction. Many people are not aware that repair is easy and cost less. It might be combined with some kind of consolidation and appropriate modernization. For example, often a timber is not decayed its whole length, but only at one end. In such case, it is possible to join a piece to the damaged end rather than replace the whole timber. First, it helps to retain more of the original fabric of the building, and therefore maintains authenticity, and second, it reduces the amount of work, which saves cost and shortens the duration of the project.

Traditional timber buildings incorporate a certain flexibility in their design, which is thought to be one reason why they usually perform well during earthquakes. We should therefore carry out using traditional carpentry methods, retaining all sound existing materials and replacing only damaged parts.

Fig. 57. Replacement of timber post.
Lower floor of this house was gutted space (semi private). After vertical division the left part was reconstructed, but the old carved columns were not reused. The space is still served as a gutted space as well as reconstructed with timber columns, but in a much simplified version. The carved timber cornice above the beam has been lost.

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i. Post
If the post is only partially damaged, instead of replacing the whole post with a new design, there are many traditional joints for repairing the bottoms of posts.

Cruciform joint
Many of these traditional joints need to be lifted from underneath, for in situ repairs. Such joints can be fitted by removing the beam, which is not always possible or by digging a pit underneath the post and backfilling it afterwards, but such a procedure risks reducing the load-bearing capacity of the soil on which the post rests. Since posts transmit the principal load of the building down to the ground, this involves risk of settlement of the structure.

With a new tenon
Slip a new tenon from the top of the beam into the post. This is only possible if the wall above the timber beam is removable. First the beam has to be supported temporarily. Take out the damaged post after cutting the tenon on the top of the post. After repairing the damaged post, the new hole on the top has to be made to insert the new tenon.
In some cases all of these solutions might not be practical, so it is useful to have alternative joints, which can be slid in sideways with metal plate on both sides.

**Fig. 59. Repair of timber posts with new timber peg.**

For any part of the post to be replaced with any joints, if possible insert the new timber peg from the top of the beam. This process doesn’t need to dismantle the foundation of the timber post and is equally good as the original. **Left:** Diagram shows inserting of peg from the top. **Right:** Sled down timber peg from top.

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<table>
<thead>
<tr>
<th>A. Wooden pegs (chukul)</th>
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<tbody>
<tr>
<td>B. Joint</td>
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<tr>
<td>C. Beam (ninah)</td>
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<tr>
<td>D. Bracket (meth)</td>
</tr>
<tr>
<td>E. Timber post</td>
</tr>
<tr>
<td>F. Base stone</td>
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</tbody>
</table>
ii. Beam

There is no solution for settlement of the beams to bring them back in level. So the most effective solution is reinforcement of the existing condition to prevent any further damage.

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Fig. 60. Repair of timber post with metal plates.
After shoring up the structural members, the damaged part of the post could be removed. The new piece has to be made properly to fit tight with the remaining part. Then fix the upper piece first and slide the new piece in the proper position. Half lap joint is not advisable, because it could move in both directions. Scary joint prevents movement in two directions and bolted metal plates prevent movement in the other two.

---

Fig. 61. Reinforcement of old beams.
Left: One new beam in steel could be added in between two beams, if there is enough space for the beam. Middle: If there is not enough space in between the inner and outer beam, one extra new beam could be added just beside the inner one. Right: If it is only one layer of post and beam, it is easier to reinforce. But all of this reinforcement depends upon the existing condition in place.
Originally these dalans are open arcade, but nowadays many of them were converted into rooms for more space. This prevents further settlement of the timber beams from the upper loads, because the new added walls also share the loads. In case a beam needs to be replaced, it is advisable to make joints above the timber post.

Fig. 62. Settlement of beam.
Left: The beam has already settled about 2.5", but filling in the open dalan with brick work stops further settlement. Right: In this house the beam, settled almost 6", is still structurally not bad, but definitely needs reinforcement. However, there are also some disadvantages from these walls, like they will transfer moisture to those timber posts.

Fig. 63. Joints between the beams.
Top: Half lap joint or scarf joint on the beam and tenon centered on the post and pinned through is the safest way. Bottom: In case the beam is not available in the right length, it is also possible to make joints above the metha. However, the longer beam has to be at the bottom to prevent from overloading the metha.
iii. Joists
Joists are not at much risk because they are inside the room, not directly exposed to weather, except the ground floor joists, which are mainly damaged by ground damp. If the whole length of the joists is damaged, it is not hard to replace them. For repairing the joist, a joint using a long tenon fixed with steel bolts is very efficient. This is an appropriate joint to use on timbers smaller in section, such as rafters and joists.

iv. Wall plate
A wall plate is safer from water damage compared to other timber elements. But in case the roof has to be opened totally during repair, it is recommended to replace the wall plate with a new one rather than to repair it partially because it is not easy to replace after the roof is put back on. It is also possible to add a metal plate in the corner to protect from collapse from horizontal thrust loads from the rafters. A metal plate is recommended even in reusing old wall plates.

Fig. 64. Mortise and tenon joint. Diagram shows techniques of joining smaller sections of timber members. Diagram source: UNESCO Training Workshop report.
v. Eaves board
If there is any water leakage on the jhingati roof, the eaves board is the lowest place to drain seepage from the roof. So normally eaves boards are not found in good condition, but it is easy to replace them partially.

vi. Rafter
Huge quantities of damaged timber are always found in the roof structure, especially rafters. So it makes sense to use repair or reinforce these elements to reduce the cost of the project. Rafters are generally found damaged in the timber peg area, ridge area, eaves board and joint in between. But generally the long portion of the rafter remains undamaged, which could be joined with a new piece.
The diagram shows the correct lap joinery. The upper rafter lapped above the lower rafter and bears the load. Metal plates are added above and below for increased reinforcement. Sketch shows joinery of the rafters with metal plate, just above wall plate so both rafters can rest on the wall plate. With this solution it is possible to reuse more historical timber and save money. Long timbers are difficult to find, so even short timbers can be reused with proper mortise and tenon joints.

Fig. 66. Repair of rafters with lap joint.

A. Masonry wall
B. Wall plate
C. Tie piece to brace wall plate
D. Rafter
E. Timber peg
F. Metal plate bolted on both side of the rafter
vii. Purlin

Often the joint between purlin is not in the proper place. It is recommended to place joints in between the purlins always above the struts. Loads from the roof try to break the joint or push downwards in between the purlins. As in the wall plates, it is also recommended to add a corner steel plate tying the purlins together.

Fig. 67 Purlin corner joint.
Corner joint in between purlins with steel plate.

viii. Carved elements/doors and windows

A careful evaluation of the existing physical condition of the carved elements is necessary to determine which of the original elements are sound enough to be retained. Many factors such as moisture, vandalism, insect attack and lack of maintenance can contribute to the deterioration of these elements. Timber decorative elements which were damaged from wet rot have to treated very carefully by skilled craftsman. Treatment can be rather time consuming largely because of the small scale tools that are used. Decorative elements which have deteriorated beyond repair can be reinstated through reconstruction by:

1. Proper and precise measurements to be taken in order to replicate the original detail.
2. Documentation of the original decorative elements through the study of archival records.
3. The use of photographic records to register the existing details/features/ornaments.

Retention of the existing elements is always desirable and encouraged. If there comes a point when the condition of elements may indicate the need for large repair, this should be based on the original design, proportion and detailing, and not replaced with modern elements.

Doors and windows
The doors and windows in the old buildings give the facade a sense of scale and architectural expression, and identify the construction period from the quality and style. They also contribute to the harmony of the streetscape. Many of the historical doors and windows are never reused during reconstruction. It is, therefore, unfortunate that many of the traditional elements of houses have been replaced due to the lack of awareness of techniques for evaluation and repair. These elements when repaired and properly maintained continue to service the buildings while retaining their historic character.

3. 3. Видачmana вислпътийц/вишепатаб/Амвръмовъкъфотонъографии

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Fig. 68. Reusing historical elements.
Before and after reconstruction. In reconstruction only one sanjhyah was reused, but the rest of the openings were lost in the reconstruction. The new facade is completely different from the original house and doesn't give any trace of the original.

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Before and after reconstruction. In reconstruction only one sanjhyah was reused, but the rest of the openings were lost in the reconstruction. The new facade is completely different from the original house and doesn't give any trace of the original.
Fig. 69. Repair of carved elements.

Top left: Upper part of the strut was missing and was replaced with a new piece with reinforcement at the back. Top right: Diagram shows how steel reinforcement is attached to the historical struts at the back of the struts. Bottom left: Pataniko Agache, Patan Durbar WHS. Many parts of the sanjhyah were missing and damaged. Bottom right: Recarved lost parts based on the original remaining pieces. Photos: KVPT.

A. Historical strut
B. Metal reinforcement
C. One layer plank
5.5 Adaptation of Windows

There is no doubt that some of the historic openings are not comfortable for modern use, but they could be adapted to meet modern standards of comfort and demands of new users. For example homeowners can add glazed shutters inside lattice window for insulation, replace paneled window with glazed for more light, add new shutter for screen, etc.

5.4 भूगोलस्वरूप परिवर्तन

यसमा केही शक्त्व छैन कि केही ऐतिहासिक भूगोलस्वरूप आधुनिक उपयोगको लागि सुविधायुक्त हुननु, तर यसमा केही परिवर्तन गरेको आधुनिक स्तरमूलक सुविधा र नयाँ उपयोगहरूको माप पुरा गान सक्नु। उदाहरणार्थ अखिल भूगोल भित्र ताप नियन्त्रणको लागि ऐति भएको खापाहर, बिड फराडको लागि दिलाको सट्टा ऐति खापाहर, झालीका नयाँ क्षेत्रहरू छन् आदि।

Fig. 70. Repair of carved elements.
Left: A few carved timber grills were missing in this 19th century house. These missing window grills were recarved with original design to fit in place. Right: Two pieces are new, which are easy to identify from color. To reproduce lost pieces is not difficult, not expensive too.

फिग. ५० ूँहाउसका सतहको समस्या

लाई: यस १९ वर्षाको घरमा केही ऐतिहासिक खिदाव हस्तिङ्गे छिद्रै। यी हस्तिङ्गको व्यापार दृष्टिकोण मान सोचको छैन। यसमा केही परिवर्तन गरेको आधुनिक स्तरमूलक सुविधा र नयाँ सचिकाहरूको माप पुरा गान सक्नु। हस्तिङ्गका दुकानहरूको सक्ल नयाँ क्षेत्रहरू छ भने बारे।

* timber structure *
Fig. 71. Vertical windows vs. modern windows.

One modern house in the middle disturbs the cityscape of the row houses. Metal rolling shutters on the ground floor and all other new openings on the upper floors makes a huge difference in the cityscape. The retention and repair of the doors and windows are recommended wherever possible because these are major elements contributing to the urban texture of the conservation area.
Fig. 72  Glazed shutter in lattice window.
Detail of the new additional glazed shutter inside the lattice window for insulation. If screen is desirable, this could be fixed on top of the lattice, so the glazed shutter is still possible to fix in the same place as above.

New glazed shutter
Existing historical lattice window
Fig. 73 Glazed shutter in sanjhyah.

If someone desires to make openings separate, the existing lattice shutter could be moved back to install a new glazed shutter. In this case the lattice shutter could be opened all the time, which makes it easier for homeowners too.

Fig. 74. Old historical lattice window opens up

New glazed shutter

Old historical lattice shutter moved back from original position to fit new glazed shutter

Existing historical lattice window opens up

New glazed shutter
Fig. 74. Glazed shutter in sanjhyah.
Detail of the new additional glass in the sanjhyah's shutter for insulation. Adding a glass with listi at the back of the existing lattice shutter. This will help to retain the old look of the windows from outside.

Timber structure
Fig. 75 Make fixed lattice openable.
In the worst case if the homeowner wants to make the lattice also openable, the lattice has to be taken out from the original frame and installed on a new shutter frame to hinge on the existing frame. It is not advisable to take lattice out from the original frame to be openable, but it is better than cutting out part of the lattice window.

**Fig. 75**
Old lattice adapted as openable shutter (with or without jali)

New glazed shutter

New piece of timber to hinge new glazed shutter

Old lattice adapted as openable shutter (with or without jali)
Introduction

Fig. 76. Adaptation of 19th century openings (panel shutter).

Most of the window shutters are timber paneled shutters which homeowners don’t like because they don’t allow light in and sometimes they want to have screen for protection from insects. But to adapt to homeowners demand is not difficult. If they just want glazed shutter, the existing panel shutter’s frame is usable, only the timber panel has to be replaced with glass. If they need screen too, then the screen has to go in the existing shutter frame (replacing the timber panel) and the new glazed shutter has to go inside that.

**Diagram Description**

- **Replacement of timber panel into jali on upper two panel**
- **New glazed shutter**
- **Shutter with jali, replacement from panel shutter**
- **New piece of timber to hinge new glazed shutter**
- **New glazed shutter**

Timber structure
Fig. 77. Adaptation of 19th century openings (louver shutter).

Normally louver shutters open outside and inside the panel shutter. Detail of new replacements: outer louver with screen for air circulation and inner panel shutter with glazed shutter for light.

- Inner panel shutter replaced with glazed shutter.
- If jali is required possible to replace with louvers or add on top of louver
Many homeowners complain that old houses have very minimal size openings. In the worst case it is also possible to replace smaller openings with larger ones (depending upon the condition of the building and the importance of existing windows) for more air circulation, light and comfort. This occurs mainly on the first floor, where small lattice windows are located.

Fig. 78. Security bars.
Left: Today people install metal grills for security, no matter either in the historical windows or in the modern. Right: There are some old solutions too for security, such as plain steel bars with brass holders on both ends which is much simpler as well cheaper.

Fig. 79. Replacement of old openings.
Left: A house with different period windows. Most probably the first floor openings were replaced in the 20th century, which is compromisable. Middle: In this house the first floor openings were replaced with new ones, for comfort rather than for more air circulation, because the opening area is not very different between the old and new. Right: It could also be possible to remodel with vertical windows, which go together with the rest of the façade and adjoining buildings.
5.6 Timber Floor

A timber floor can be adapted to raise floor height. Most of the old floors have a thick mud layer, about 6" high which homeowners don't want to maintain. Removing the mud floor and adapting a new timber floor will add a few inches in the floor to ceiling height. This will give a nice look to the floor, allow easy maintenance, warmth and good health too. If someone wants to install sukuls or carpet, it is also possible to put plywood above the joist, which give a leveled surface and is cheaper.

Fig. 80. Old mud floor vs. new adapted timber floor.  
Top left: Traditional mud floor, showing different layers of materials used.  Top right: New proposed floor with eliminated mud floor, which adds a few inches more to the floor to ceiling height, doesn't require dealing with the mud floor.  Bottom: Advisable joints in between the planking floor, if only one layer planking applied: a) ship lap joint, b) spline joint, c) fillet joint and d) tongue and groove joint.

**Fig 50.** Purnoe मटोको मूईं र तरह निवासको काठको मूईं  
मध्य बागः पुर्खो गदिको विभिन्न समाधीका तम्खने भेडाइको परम्परागत मटोको मूईं । मध्य मध्ये नयौ प्रज्ञानीय मटोक हत्ताइको मूईं जसले कोटको उपायको भेडाइको केही इन्का मूईं र सभी मटोको मूईं मास नगः कभाडृ। तब जब एक ता मास फल्दौक राख यो मध्य मध्यी भने नभेलाई फल्दौक जोनी राख तिनाब बिन किनिकृ। क. शीर्ष यथा जोनी क. स्मायण जोनी ग। हिनेट जोनी घ। टप। एम यो जोनी ज।  

**Fig 50.** पुर्खो बाहार र तब कल जिहेको भन्छ तेहनिया भन्छ  
तब जबै: दुबारा तनु खिल भने सामान्यतया तनु तनु तनु प्रमाणण भाक ज। को जले । मैतृ प्रज्ञानीय खिलिका तनु बृह गुरु शिक्षाको जी तबै दुबारा तनु तनु तनु तनु तनु तनु तनु तनु तनु तनु तनु तनु तनु तनु तनु तनु तनु तनु तनु तनु तनु तनु तनु तनु । क. शीर्ष लाटो चल्दौ। स्मायण चल्दौ। हिनेट चल्दौ। टप। एम चल्दौ। स्मायण चल्दौ। हिनेट चल्दौ।
Timber structure

Planking could be done also as a stiffening rigid horizontal plate in double layer, perpendicular to each other and diagonal (45 degree) with the load bearing wall.

**Fig. 81. Double layer planking as new adapted floor.**

Left: Axon showing stiffening of the building floor, achieved with double layered planking at 45 degrees with masonry wall and perpendicular to each other together with the floor joist, which creates a three-layered rigid plate. Right: Detail at the corner with border layer. The border layer is not important structurally, and is only for decoration. This solution was implemented only in Patakwa Agache at the moment.

- A. Timber border 2"x 6" (mainly for decoration)
- B. Two layers of planking on diagonal (1" thick)
- C. Existing joist
- D. Existing wall plate
- E. Brick masonry

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B. Two layers of planking on diagonal (1" thick)
C. Existing joist
D. Existing wall plate
E. Brick masonry
5.7 Timber Treatments

Buildings are at risk from two types of fungal attack: wet and dry rot. Wet rot arises where timbers are damp from contact with a wet wall or floor or water leaking from roof. Dry rot (serpula lacrimans) can usually be found in upper parts of buildings where there have been leaking roofs.

Dry rot spreads by root-like strands, which can join together to form a white mass over the surface of the timber. The strands of the dry rot fungus can even pass through brickwork to find more wood on which to feed. The fungus will, in favorable conditions, produce a brown fruiting body, that generates millions of spores which look like brown dust.

Timber can be treated by chemicals, but the best treatment is to control the environment, by keeping the building dry and well-ventilated with a sound roof, so that conditions are unfavorable to fungal attack.

5.7 ग्राहक के उपचार

ग्राहकों के आकरण में दो श्रेणियाँ हैं: नारिल और विद्युत दराज। नारिल दराज का कारण नीचे से नीचे है। नीचे के कठोरता से ग्राहकों के उपचार अधिक अधिक होते हैं। नीचे के कठोरता से ग्राहकों के उपचार अधिक अधिक होते हैं।

5.7 सिस्या इलाज

छूट निगम के लिए हस्तक्षेप पाक़े आकरण पाक़े आकरण। छूट, प्यारो जयभारा ग्राहक के लिए उपचार, लगभग ग्राहक के लिए उपचार, ग्राहक के लिए उपचार, ग्राहक के लिए उपचार,
CHAPTER 6

MASONRY WALL
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MASONRY WALL

The facade brickwork in old buildings is finely finished dachi apa, one of the most characteristic features of traditional Nepali architecture. Specially-designed tapered, trapezium-shaped bricks allow construction with only a hairline joint visible at the front but enough mortar space at the rear of the brick to allow solid fixing. The minimal exposure of mortar to the elements helps prevent erosion by rain.

The walls of traditional homes are constructed in three layers. The outer layer is constructed using dachi apa bricks with a very tight mortar joint or ma apa bricks using mud mortar or lime surkhi mortar with a regular, broader joint. The middle layer is filled with brick bats, rubble and mud. The interior layer is constructed with normal rectangular shaped ma apa bricks with mud mortar and normal joints. Many traditional homes have walls with exterior surfaces made using fired bricks and the inner layer of sun dried bricks. Sun dried bricks are no longer used for construction in the cities.

Fig. 82. Three-layered wall construction.
Wall construction in traditional dachi apa, the most commonly used brick for the exterior which is tapered at the back to allow mud mortar. Drawing: N. Gutchow, Newar Towns and Buildings.

पर्मस्मार्ग घरहरूको गारी तीन तहमा निमाण गरिएको हुँदै। बाहिरको भाग बीच वर्गांको हुँदै जसमा किरकिरी गरी मसला प्रयोग गरिएको हुँदै या मटोको मसलामा भए प्रयोग गरिएको हुँदै। अथवा चुनौती सुकी मसला सहित सावधानी भएका जोडीहरू प्रयोग गरिएको हुँदै। बीचको भाग ईंटको दुरु र मटोकी भएको हुँदै। भन्न समाधान घर गर्ने आकारको मा अथ भए मठो, मसला र साधन जोही सहित प्रयोग गरिएको हुँदै। भन्न पर्मस्मार्ग घरहरूमा घरको बाहिरी भागको आँग्न गोलोको ईंटको दुरु र भन्न भए, मसला सुकी हाँचामा सुकाएको ईंट फिर्को प्रयोगलाई लाईनु। आज भन्न सभी भए, सुकाएको ईंट शहर ति प्रयोग गरिएको हुँदै।
These thick traditional walls are best left in place if they show no signs of movement, settling or other damage rather than being replaced for the sake of modernizing. They exhibit better seismic resistance due to their thickness and flexibility and are more durable than modern equivalents. These thick walls have the advantage of providing thermal insulation from outside temperature extremes as opposed to modern walls only one brick thick, which provide little thermal resistance and allow easier thermal transfer so homes become hotter in summer and colder in winter.

6.1 Symptoms and Causes of Decay

In most cases dampness is visible on the wall surface and therefore easy to detect.

Moisture transfer

Efflorescence is caused by the transfer of moisture and is the process by which salt crystals appear on the surface of the wall. In the situation when a wall is damp in the wet season but which dries out in the dry season, moisture transfer is concentrated in a horizontal band where the wall is damp in the wet season, but which dries out in the dry season.

Fig. 83. Damage from ground damp.

Left: Because old buildings do not have damp proofing, moisture travels upwards and mud mortar enables easier transmission of moisture. It is common to encounter rotten joists due to damp, especially the section of joist, which penetrates the wall. Dampness of the timber can be seen in the photo.

Right: Salt damage is evident on the surface of the brick.

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Right: Salt damage is evident on the surface of the brick.
Dampness from the ground
Old houses often suffer problems with damp caused by the absence of the damp proof course. For this reason the ground floor of old houses are generally not used as living spaces but rather for storage, stables or shops.

Fig. 84. Air holes for air circulation.
Top: Amatya house, Na Tol, Patan. Beneath every door on the ground floor was an opening for air circulation, however, the opening was closed when the steps were recently repaired. Bottom: Some of the 19th century houses have air holes under the floor to keep the ground dry.
Ground dampness is a typical problem in old houses. In Rana palaces primitive techniques for damp proofing were used such as ventilating under the ground floor crawl space through small round or arched ground level vents. This system is also used in some of the 19th century town houses.

**Moisture from the roof**

Water leakage into the top of walls at roof level causes structural damage. In the traditional three-layered wall, downward seepage through the middle mud and brick bat layer causes the outer layers to bulge. Poor connectivity between the outer and central layers accentuates the problem.

![Fig. 85 Damp from roof leakage.](image)

The outer layer of the three-layered wall is more prone to separation because the connection between exterior layer and middle fill is not as strong as that between the inner layer and middle fill. Roof leakage into three-layered walls is likely to cause exterior bulging.

Left: Detail photo shows separation in between the layers of the wall structure.

Right: Bulging by a few inches in traditional, thick walls is not problematic. The upper two floors have been added above the bulging wall.
6.2 Remedial Measures
Letting the wall breathe
A wall should be able to absorb moisture and then release it in the form of water vapor when the weather becomes drier. This transfer of water vapor should occur principally through the mortar joints, rather than through the bricks themselves, to avoid damage by efflorescence. This natural process should be allowed to take place without hindrance. To cover the surface of the wall with an impervious layer, such as cement render, will tend merely to send moisture higher up the wall by capillary action.

Fig. 86. Moisture rises more on the plastered wall.
Left: Diagram shows how moisture rises more on the plastered wall than the unplastered wall. The plaster on the wall surface blocks the route for moisture to escape and draws the moisture higher. Right: Even cement plaster cannot adhere to the wall for very long where damp exists. Some people try to beautify their homes by rendering their walls, unaware that they are increasing the chance of water damage.
French drains
A partial remedy for moisture in walls is to build a French drain along the outside of the wall. A trench is dug and then back-filled with coarse rubble and sand. Any water which collects is drained away to a soak pit or to a pipe in the French drain.

Damp proof courses
Historic masonry, which was always constructed without a damp proof course (dpc), is best left in its original state if possible. However, in some circumstances a wall may present such problems of rising damp that a dpc must be added. In this case, a dpc can be introduced in stainless steel sheet or cement concrete.
The historical wall must be cut horizontally to slide the metal sheet or cement concrete. This is a complex procedure and not recommended. In many old houses vertical timber members sunk into the wall constitute the frame of the building. To cut through the timber elements to insert a dpc compromises the structural integrity of the whole building.

Many of the old houses remain structurally sound with only minor moisture problems. In such cases major structural changes such as inserting a dpc is not recommended as the cure may be more damaging than the initial problem.

Desalination with clay poultices (sacrificial clay render)
Efflorescence is the buildup of salt crystals on the outside of masonry. Salt is drawn from the inside of the brick to the outside. This process is called efflorescence and can be a problem in old buildings.

**Fig. 88. Inserting damp proof course.**

New damp proof courses are more easily introduced in the 19th century buildings without timber frames than those built earlier.

Left: Slots are cut every 3' - 4' with the same length left uncut to support the wall.

Right: Cement concrete is then poured into the slots. The process is repeated and slots cut between the newly dried concrete.
6.3 Repair/Conservation Techniques

Stitching

Old walls sometimes have cracks which result from movement in the masonry. These cracks can be stitched. The technique involves cutting out cracked bricks at intervals along the crack and inserting new bricks. Cracks in masonry can reappear if there is even minimal further movement. The risk of movement can be reduced by including strips of non-ferrous mesh in the mortar beds between the bricks, set back from the face of the wall, so that they cannot be seen. These

6.3.1 Repair/Conservation Techniques

Stitching

Old walls sometimes have cracks which result from movement in the masonry. These cracks can be stitched. The technique involves cutting out cracked bricks at intervals along the crack and inserting new bricks. Cracks in masonry can reappear if there is even minimal further movement. The risk of movement can be reduced by including strips of non-ferrous mesh in the mortar beds between the bricks, set back from the face of the wall, so that they cannot be seen. These

Fig. 89. Salt crystal on wall surface.

Damage can be caused to bricks when salt crystals form and destroy the surface over time.

Fig. 90. Different types of cracks.

help to spread the load to the masonry on either side of the crack. There are several types of cracks seen in brick walls. Most are not dangerous and appear due to minor settlement.

**Improvement of wall bonding**

During the restoration or repair of old houses, many areas might be in need of repair. The advantage of a three-layered wall is that it is not difficult to repair small parts. If the inner wall and middle fill are sound, they can carry the load while the outer layer is repaired. It is advisable to use yellow clay during repair rather than normal black clay which may carry vegetation and has weaker bonding strength.

**Bricks for conservation**

When repairing old houses most of the old bricks are unusable. However, where possible it is best to re-use old bricks, which are of higher quality and a better color match than new bricks.

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**Garage (bonding)**

Garages are made of three layers. The external layer is made of the existing material and the middle layer is made of an intermediate material. The internal layer is made of a new material.

**Fig. 91. Improvement of wall bonding.**

*Left:* The external dachi apa layer is bulging outwards, however, the inner layers remain sound. This type of damage only requires the outer layer to be repaired. *Middle:* In old buildings the walls were made in three layers so, given the correct support, it is not difficult to remove the outer layer for replacement. *Right:* It is not recommended to reconstruct intact walls to rectify minor faults. Where there are major problems connecting butterflies must be inserted to connect the three layers of the wall, they must be made of stainless steel or other metal which will not corrode.

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**Non corroding metal butterfly**

- **Connecting butterfly**
- **Connecting butterfly (connecting)**
- **Connecting butterfly (connecting)**
- **Connecting butterfly (connecting)**
- **Connecting butterfly (connecting)**
- **Connecting butterfly (connecting)**
- **Connecting butterfly (connecting)**
- **Connecting butterfly (connecting)**
- **Connecting butterfly (connecting)**
- **Connecting butterfly (connecting)**

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**Bricks for conservation**

When repairing old houses most of the old bricks are unusable. However, where possible it is best to re-use old bricks, which are of higher quality and a better color match than new bricks.
6.4 Mortar

This is the bedding and binding material used to form a wall or a surface. This refers to lime mortar but mostly mud mortars. The recent notion of adding cement to make the mortar stick is not recommended in conservation as the imperious nature of the cement mortar is usually detrimental to the wall materials.

Mud mortar

This is a natural material which has no fixed life span as it can be regularly and easily repaired. Used in combination with timber, it provides structural flexibility. However, when mud remains wet for a long time it deteriorates so it is very important to protect buildings from water leakage and attack.

The most common areas to find damage on walls with mud mortar is mainly on unsheltered parts of the walls. It is recommended to repair or repoint only the damaged areas rather than the whole wall.

Lime mortar

During the 19th century when lime mortar began to be used, walls were still built with mud mortar and lime surkhi plaster or outer layers pointed. Today few homeowners trust the longevity of lime mortar and locally available lime is of very poor quality so builders and homeowners mix cement into the lime.

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Lime mortar

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Sources of lime
Lime is produced through the process of burning and slaking. Local procedures should always be adhered to unless there are proven defects with the method. The procedure is to mix water with burnt, fragmented lime. Depending on the exact nature of the base lime material this can be an explosive reaction with a great deal of heat generated and steam given off. The base lime will absorb water and expand to two times its original volume. Then it is left in a covered pit for a period of not less than two weeks. The material can then be decanted into other containers and stored. The result is slaked lime otherwise known as ‘lime putty’ which is the consistency of cream.

Pozzolana for use with lime mortars
Pozzolana is added to lime mortar to achieve a more rapid set. A traditional pozzolana used in Asia is crushed brick. Bricks fired at lower temperatures are preferable. Crushed brick with particles

Fig. 93. Wall damage.
Left: Sketch showing how water seepage damages a traditionally constructed wall. (a) If water seeps into the wall it saturates the middle fill. When mud mortar is wet and there is load from above, mud mortar tends to settle and wall bulging is the result. (b) Water trapped inside the wall may seek to escape through joints causing bulging. Right: Masonry wall bulging outwards after a few years of water seepage.

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of different sizes is best as the larger particles act as reservoirs of dissolved carbon dioxide around which the lime begins to harden. If quick-setting mortar is required, a mortar mix of 1 lime : 3 sand : 1 crushed brick works well.

The dust of bricks fired at low temperature adds to the strength and durability of mortar made of lime, sand and brick dust.

The disadvantages of using cement

Aging tests on mortar have shown that mortars containing crushed brick perform much better than mortars with cement added. Adding small quantities of cement to mortar actually reduces its strength and durability. Cement is inappropriate for use in historic buildings. Firstly, cement is extremely hard and brittle and unable to absorb the same natural movement in buildings that can be withstood by lime mortar. Secondly, there is no advantage to be gained by joining two objects with a substance which is harder than the objects being joined. Lastly, the free salts in the cement travel with the moisture, drying out through the surface of the bricks or stones. The salt crystals which form on the surface of the masonry cause cracking and erosion of the stones or bricks.
CHAPTER 7

Roofs

The roof is the most critical element of a traditional building. Once minor roof damage has taken place, the cycle of deterioration is remarkably quick. So quite often roofs need to be reconstructed rather than repaired.

7.1. Roof Tiles

Before large terracotta roof tiles were introduced to the valley all buildings were covered with small roof tiles called jhingati. Jhingati were gradually replaced with corrugated sheets or large tiles. Most recently concrete roofs have become the norm.

Today people do not like to use jhingati because it is expensive and requires regular maintenance prior to the monsoon. Many homeowners are replacing jhingati with corrugated sheet or concrete slabs. In most restoration projects builders collect the old jhingati for re-use as new jhingati is expensive and of inferior quality.

Fig. 94 Roof construction and roof tiles.
Terracotta tiles and timber members of the roof structure with their local names. Drawing: N. Gutschow, Newari Towns and Buildings.
Fig. 95. The process of laying roof tiles.

**Top left:** 1” thick sal plancking is nailed above the rafters. **Top right:** Two layers of tarfelt or multiplex are stuck onto hot bitumen paint. Another layer of hot bitumen paint covers the tarfelt completely. **Middle left:** Timber battens to retain the mud bed are nailed over the tarfelt on the diagonal so that if there is water leakage it will flow down. **Middle right:** Preparation of mud which comprises soil taken from at least three feet below ground level to ensure there are no seeds to cause vegetative growth. The anti-vegetation chemical Karmex is also mixed in. **Bottom left:** Laying of jhingati on the mud bed. **Bottom right:** The first run of jhingati is nailed on the planck to avoid shifting or loss.
7.2 Mud

There are many factors which affect the longevity of the mud under the roof tiles. If the mud is taken from the surface of the ground there will likely be problems with vegetation growing because of seed contamination. The seeds usually germinate in the monsoon and the grass growing between and underneath the tiles causes them to be displaced. Efforts to remove the grass by well-intentioned homeowners climbing on the roof leads to broken tiles and water penetration, the first step to serious structural roof damage.

Fig. 96. Stages of how old buildings collapse.

Most often damage to old buildings begins at the roof, which is the weakest point in traditional architecture. Even small leaks in the roof leave the mud bed damp, which in turn leads to rotting of the timber planks. Each monsoon the damage becomes greater. Without intervention, the ultimate effect is the total loss of the roof structure as pictured.

$$\text{Fig. 96. Stages of how old buildings collapse.}$$

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In very old buildings we do not see a great deal of vegetation in mud mortar. In the past, elderly interviewees have explained that the clay was put in a fire or fried in terracotta pots to kill the grass seeds. Today there are several anti-vegetation chemicals available in the market. However, our experience indicates that even using these modern chemicals may not work for long as such chemicals have a limited effective life. It is much better to get mud not from the ground level by digging not less than 3 feet below the natural ground level where the soil contains no grass seeds. For best effect, it is wise to add anti-vegetation chemicals.

7.3 Laths or Planking or Water Proof Plywood

Historically above the rafters, laths were used. This method is neither structurally sound nor attractive to look at. The gaps between the rough wood make it difficult to fit a water proofing membrane. Today, salwood planking or plywood are the most appropriate materials for supporting the mud bed under the tiles. In addition to providing a good surface to lay a waterproof membrane on, the whole roof structure becomes more rigid when the planking or plywood is nailed to the rafters. The thicker the plywood, the more rigid the roof.

Fig. 97. Laths above the rafters.
A historical house with traditional laths above the rafters in the roof structure.

Fig. 98. Planking above the rafters.
Restoration of old house with sal wood planking on the roof structure.

Fig. 99.  Water Proof Plywood on the roof structure.
Restoration of old house with sal wood planking on the roof structure.
7.4 Underlays for Jhingati

The correct method of laying jhingati is important to ensure maximum thermal protection and a sound waterproof roof structure.

**Tarfelt**

A common underlay for the tiles is tarfelt. It is generally applied as a double layer using hot bitumen paint between and over the top of the tarfelt. Battens are nailed to secure the mud bed which has been applied with bitumen. This layer will protect the planking from direct contact with the mud bed.

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![Diagram](image_url)

**Timber peg (chakul)**
Roof tiles
Mud bed with sleepers
Planking (mixed timbers)
Rafter (pine or sal)

**Tarfelt**

The correct method of laying jhingati is important to ensure maximum thermal protection and a sound waterproof roof structure.

**Timber peg (chakul)**
Roof tiles
Concealed bolts
Mud bed with sleepers
2 layers tarfelt/bitumen
Planking (sal wood)
Rafter (pine or sal)

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![Diagram](image_url)

**Timber pegs (chakul)**
Eavesboard
Purlin (pine or sal)
Roof struts

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**Fig. 99. Traditional roof structures - the problem and solution.**

*Left:* Traditional detail roof structure, where timber peg and planking is directly connected with mud bed. *Right:* Improved roof structure with waterproof membrane between mud bed and timber structure.
According to the manufacturer, tarfelt lasts for 12 -15 years. It is likely that after that time leakage will begin and damage done to the roof structure. Tarfelt is also brittle and breaks easily, especially in cold weather.

**Multiplas**
A better solution, still new to the valley at the time of writing, is multiplas. It is better in quality than tarfelt and lasts at least 50 years as claimed by the manufacturer. Multiplas remains flexible, is easily installed and is supplied with its own sticking agent to secure it to the planking or plywood.
CHAPTER 8

Finishes
CHAPTER 8

FINISHES

Most houses from the Malla and early Shah periods were constructed with exposed brick surface. The homes of wealthy people, temples and palaces were built using dachi apa bricks while those belonging to the middle class were built of ma apa bricks and those belonging to poor families were built of sun-dried bricks.

8.1 Plaster

Mud or lime plaster has traditionally been used as a finish for walls, floors and decorative elements. The main cause of decay to plaster surfaces is damp or neglect.

Traditional mud plaster

Buildings are often mud plastered on the inside walls. Normally, ground floors were not plastered from the inside because of ground floor rising damp. Modern day homeowners don’t wish to maintain mud plaster and prefer to replace with cement plaster. Many people no longer know how to apply mud plaster. However, while there is no doubt that mud plaster needs periodic maintenance, it is an effective heat insulator and does not trap the damp.

Fig. 100. Damage to plaster by ground damp.

Left: Mud plaster and bricks damaged at ground level by ground damp. Right: Lime surkhi plaster damage by rising damp. Damaged is usually caused in areas which become damp then dry out often. Areas which usually remain damp are less affected.

पर्यावरण माटो प्लास्टर

धर्मधै ग्रा: जस्य विशिष्ट विभागमा माटोको प्लास्टर गरिन्छ।

साधारण भूमि तलबाट विशिष्ट विभागमा जमीनबाट उत्तरे ओझो इस्तेले पैन प्लास्टर गरिन्छ। आजारक धर्मधै माटोको प्लास्टर कायम राख्न इच्छाहरु र माटोको सट्टा सिमेंट प्रयोग गर्न विश्वास र भान छैन। माटोको प्लास्टरगति निर्माण हरेकाको आवश्यकता हुनुले भने वास्ता गर्न छैन। माटोको प्लास्टर द्वारा तप प्रतितिहासको काम गरिङ र औद्योगिक राख्न गरिन्।

Fig. 100. Damage to plaster by ground damp.

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पर्यावरण माटो प्लास्टर (विन्यास)

झैखाने प्राणायाम अथवा स्थानको चालान चालान प्लास्टर वाही, ख। साधारण खुल्ला तथा दुनिया अर्थ व पारियों ओझो चालान चालान प्लास्टर वाहीमा ख। चौको नुमा चालान चालान प्लास्टर वाहीमा अर्थ अथवा चालान प्लास्टर वाहीमा ख। चालान प्लास्टर वाहीमा अर्थ अथवा चालान प्लास्टर वाहीमा ख।
**Base coat**

Materials required

1. *Black clay or yellow clay* 2 parts
2. Cow dung 1 part
3. Rough rice husks 2 parts

(*excavated from 4 - 5 ft. below the ground level to avoid grass seeds)*

These materials are mixed with water until it is a homogeneous paste. Some water is added in the pit and the mixture is allowed to remain in the open air for at least 2 - 3 weeks. It has to be checked everyday and water added from time to time to keep the whole mass wet all the time. Before the mud plaster is applied to the wall, the wall must be cleaned properly and washed with cow dung slurry to make the wall surface sticky. Then a base coat of mud plaster ½" - 1" thick should be applied to the wall surface.

**Final coat**

Materials required

1. Fine sticky clay 1 part
2. Cow dung 1 part

After the base coat is dry cracks will probably form. These must be filled with mud plaster before applying the final coat. Only when the plaster is dry can the final coat be applied. The process of mixing is the same as but the ratio of cow dung to clay is 1:1. The clay must be fine plastic clay. The fine clay can be found in particular parts of the field. The use of cow dung prevents cracking of the plaster because it contracts upon drying. Cracks will develop if the cow dung is not used in the required quantity. Thickness of the plaster should be minimal.

**Traditional lime plaster**

Lime plaster is always recommended because of its porosity. It is especially useful on walls in hot and humid climates. Lime prevents excessive moisture being trapped within walls, letting them breathe. Lime plaster is prepared in the same way as lime mortar, however the layers are built up differently.

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**भाषार तह: कोरा**

| माण्डळ सामानहुँ  | 1. कायो बाटो वा पहलो बाटो 2 भाग  |
| 2. गाइंगॉ गोवर  | 1 भाग  |
| 3. बड्डी गाइंगॉ मुस  | 2 भाग  |

(*भेमी वाट 4.५ फिट मुहम्बा निकलिएको ता च नक त्वम्या धाकाको विशुद्ध नयाः)*

यी माण्डळ सामानतमुक्का एकनाथको लेनो नने सय हाँगु नगरी मिसावा। दोषमाध्यमा कोटी हाँगु भर्तिः र त्यो समयमाध्यमा कम समे कम 2-3 हजऱ्वा सय हाँगु अकार्य विश्वाची कृघ्छ हो।

यस्यालाई दिनान्ते होर राज्य र बिने बालाई बालन समह तयारी हाँगु पाल्छ। भिन्नता माण्डळको द्वारा लागून आँगाठ पहले मिसालाई राम्यरी सका दारी सयहमा टाइपस्ने गराउन गोवर र पाल्नो मिसालेने राम्यरी पोस्तु पाल्छ। दोषमाध्यमा ½.२-१" मोटाई माण्डळको प्लस्टरको आँगाठ तह मिसालमा लागून पाल्छ।

**अलिम तह**

| माण्डळ सामानहुँ  | 1. मिसालो टाइपस्ने माटो 1 भाग  |
| 2. गाइंगॉ गोवर  | 1 भाग  |

आँगाठ तह सुकैपछि त्याहाँ तयारमा: फुटर्बन बाटो। अलिम कोट लागून आँगाठ बी फुटर्बनलाई माटो प्लास्टर राम्यरी मुस 2 भाग।

प्लास्टर राम्यरी सुकैपछि बाट अलिम तह लागून पाल्छ। मिसाल गने प्रकाश पहले जलने हो तर गोवर र माण्डळको अनुच 1:1 को हो।

यी माण्डळ जमीनको दुःख बालाई पाल्न सक्निः। गोवरले प्लास्टरलाई फुटर्बन प्लास्टर जोगाउन रूपीक मो शुद्ध।

प्लास्टरको माण्डळ सस्मेम च कम हुन पाल्छ।

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**पर्मरमारण पूल प्लास्टर**

प्रमिकलाई गद्दी पूल प्लास्टरलाई सोगी मिसाल गिर्नु। गर्मी र आँगाठको सक्रियता बायाङ्ग र या उपयोगी हुनु। प्रमिकलाई मिसाल बने बायाङ्ग जम्मलाई गोवर इसाई सस्मेम दिन्छ।

प्लास्टर पनि गुण मलाने जस्तो नै बनाउने तर सयको तह फरक किमिस्ने बनाउन।

**पर्मरमारण पूल प्लास्टर**

प्रमिकलाई गद्दी पूल प्लास्टरलाई सोगी मिसाल गिर्नु। गर्मी र आँगाठको सक्रियता बायाङ्ग र या उपयोगी हुनु। प्रमिकलाई मिसाल बने बायाङ्ग जम्मलाई गोवर इसाई सस्मेम दिन्छ।

प्लास्टर पनि गुण मलाने जस्तो नै बनाउने तर सयको तह फरक किमिस्ने बनाउन।
Finishes

Base coat

Materials required 1. Surkhi 3 parts
2. Slaked Lime 1 part
3. Sand 2 parts

This is a general mixing ratio for lime surkhi plaster. Before application, the surface needs to be cleaned properly. The thickness of this base plaster should be 1/2" - 3/4".

Low fired surkhi adds strength and durability to lime plaster and surkhi mortar. It is best to use surkhi in the 75 - 300 microns range rather than fine dust. Because the low quality of lime available on the market, many people mix in cement which actually reduces the strength and durability of the plaster. Lime stone should be slaked for use in plaster (see on Chapter 6).

Second coat

Material required 1. Surkhi 2 parts
2. Slaked Lime 1 part

If a second coat is not applied before the final coat, cracking will develop quickly. Some homeowners use fine surkhi in the second coat to achieve a smooth finish then apply a final coat immediately on top of that, however, cracks then develop quickly. The thickness of the second coat should be minimal.

Final coat

Materials required 1. Surkhi 1 part
2. Slaked Lime 2 parts

When the second coat is completely dry, a final coat of 2 parts lime and 1 part surkhi mix is applied. In some cases only a layer of very fine lime mixed with water is applied over the second layer of lime surkhi plaster. The thickness of this final layer should be less than 1/8". It is allowed to air dry then finished with a smaller tool to make the surface plain and smooth.

8.2 Ornamental Works

Decorative ornamental works characterize traditional architectural style. They give facades architectural expression. There are still many houses which have various decorative ornamental works made of terracotta, plaster and timber. For
example, common decorative ornamental terracotta work includes door and window lintels, cornices, pilasters, carved bricks and so on. Examples of plaster work include geometrical design of arches, pediments, keystones, cornices, dentils, plaques as well decorative elements introduced by local craftsmen. Each house has its own characteristic ornamental brickwork and plasterwork which are indicative of the period in which the house was built. They also reflect traditional local craftsmanship.

Fig. 101. Examples of ornamental terracotta works

Top left: Ganesh Chhe, Bhaktapur. Only one example of a terracotta window remains in the country. Top right: Khupinchhe Pati, Patan. Carved bricks on the plinth of the pati. Middle: House in Bhaktapur with exposed brick wall. Terracotta lintel, pediment, small pilasters in the middle windows, big pilasters in the corners of the house and cornices. Right: An example of local craftsmanship in terracotta.
Fig. 102. Examples of ornamental plasterworks. 
Top: Decorative figures in pilasters. Bottom left & middle: Figures at the corner of the house carrying corner pilaster. Bottom right: The old clock tower, which was lost in the 1934 earthquake, was carved on the surface of a wall.

**Fig 102 अद्वैतकालिक भवनमण्डपांकडे उत्सर्ग
लक्ष्मी पौर्णिमाको अन्तःस्तोगको आकृतिहरू। सन २०१० देखि विश्वविद्यालय कुरुक्षेत्र रेवोलुशन मुद्रावलोकन गरेको।**

**Fig 102 आद्वैतकालिक भवनमण्डपांकडे उत्सर्ग
केले कौमान्धको अन्तःस्तो आकृतिहरू। केले खत्ते व विषय: युग र खेत्र कुरु अन्तःस्तो आकृतिहरू। केले खत्ते विषय: युग र खेत्र कुरु अन्तःस्तो आकृतिहरू। युग र खेत्र कुरु अन्तःस्तो आकृतिहरू। केले खत्ते विषय: युग र खेत्र कुरु अन्तःस्तो आकृतिहरू।**
Fig. 103. Ornamental work on different materials.
Dhanbad, Patan. A fine example of ornamental work in plaster, terracotta and timber. A mixture of traditional and 19th century imported architecture. Over the last few years, many of the houses with these ornamental works were lost. Some of such details were broken off or improperly repaired using the wrong materials including cement mortar.
During restoration, the extent of cleaning and repair required is dictated by the level of deterioration of the ornamental terracotta and plasterwork. Generally brick work is found in a better condition than plasterwork.

For plasterwork, deterioration can be assessed through visual inspection and by knocking to check for hollowness. In some cases, mold and mosses attach to the exposed parts of buildings, making them difficult to clean.

Fig. 104. Repair of ornamental works.
Left: Sukul Dhoka, Bhaktapur. Bottom of the pilaster was broken, which was repaired with cement mortar without original details. Middle: Gaddi Baithak, Kathmandu Durbar WHS. Pilasters were repaired in old design with cement mortar. Above: A capital of the pilaster was repaired with cement mortar. Unfortunately, traditional lime mortar is not popular with homeowners and craftsmen.
look dirty. Generally, proper cleaning of the surfaces, which includes careful stripping of paint, reveals physically sound plaster work beneath the unsightly exterior. Where the surface is cracked or peeling or when there are excessive layers of paint which obscure the architectural detail, paint must be stripped from the surface.

Cleaning
Intricate details of wall ornaments can be exposed by appropriate cleaning. For intricate plasterwork or decorative timber elements, a soft brush should be used by a skilled craftsman.

Organic growth such as mosses, lichens, algae and molds are often found on damp plasterwork. The use of chemical agents (bleaching powder) eliminates growth leaving residue which weathers away over time.

The agent is diluted with water and applied with a hand spray or brush. It is also possible to remove some lichens and mosses before treatment by gentle scraping with a brush.

Efflorescence is caused by the slow build-up of water-soluble salts at sheltered sections of building exteriors. The surface salt can be removed with a dry bristle brush.

External plasterwork can flake and crumble over time due to constant exposure to weather. Localized damage to plasterwork can be patched. However, it is important that the patching material matches the color and texture of the original material. Repair material should also have proper adhesive qualities.
CHAPTER 9

PAINTS
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PAINTS

Traditional houses are usually left unpainted with exposed brick on the outside and mud rendered walls on the interior. From the 19th century onwards many types of paints and pigments were introduced to the Kathmandu Valley. They were mainly used in the interiors and door and window frames. Exterior wall surfaces were lime washed on lime surkhi plaster. Artistic wall murals were often found in Kathmandu Valley, however, they are not the subject at hand.

Following the introduction of new paints to Kathmandu Valley local people began to paint historical religious monuments as a votive offering.

Fig. 105. Paint on historical buildings. Dattatrya Mandir, Bhaktapur. Local people painted 17th century objects with enamel paint. While painting the temple, gives people personal satisfaction, having made an offering-in-kind to the temple, they are unaware of the damage which may be caused by using modern enamel paints which lock in moisture.

**Abhya 9**

रंग

ऐतिहासिक घरहरूको अक्सर रंग नपोतिएका हुन्छ। बाहिर पट्टी इंग्टा खुल्ना छाडौर र भिन्नि भिताहामा माटोका प्लास्टर गरिएका हुन्छ। 1930 सम्म शालाहरूमा बेल्बाटौल उपयोगमा विभिन्न अन्तर्गतका रंगहरू र तलहरू प्रयोग गरिएका छ। रेखायो गर्न भिन्नि भागमा र ढोकार भवानको फ्रेमहरूमा प्रयोग गरिएका छ। बाहिरी भिताहामा संतुलको चुन सुबसी प्लास्टरमा चौनले पोलिएका हुन्छ। कलामका बिल्सिन्छ चिह्नहरू काठमाडौं उपत्यकामा प्रचलित छ। पनि ती अहिलेको विषय वस्तु होइन्।

काठमाडौं उपत्यकामा रगको नयाँ चलनको साथै स्थानिय जनताले भाकलको रूपमा ऐतिहासिक धार्मिक स्मारकहरू पोल धान।

स्थानियसम्बन्धी रंगहरू नयाँ चलनको नाप स्थानिय जनता भक्तनको रूपमा ऐतिहासिक धार्मिक स्मारकत पोलेस धान हल।

**Abhya 9**

रंग

ऐतिहासिक छैन तयारको अक्सर रंग पोले मायामा अवखे तीनौ त। छैन तयार पिने पाप्दामा आयु बुने भिताहामा प्लास्टर यास्ता तैछु ख। 1930 सम्म शालाहरूमा बेल्बाटौल उपयोगमा विभिन्न अन्तर्गतका रंगहरू र तलहरू प्रयोग जुँजा बन। ऐने विषयमा पाप्दामा दुई भागमा र तयारको भवानमा प्रयोग जुँ। पनि अयामा तत्कालिन चुन सुबसी प्लास्टरमा बुने पोले यास्ता तैछु या। कलामका अयामा विषयमा स्थानियसम्बन्धी प्रचलित दु तर धार्मिक स्मारक।
9.1 Medieval Buildings

Natural timber finishes
Linseed oil or mustard oil used on timber elements and carvings in a mistaken effort to beautify them. In the few days it takes to dry properly, airborne dust sticks to the oil-covered wood. Repeated applications obscure the carving details with the dust and oil mixture. A better solution for long term protection is to keep the timber carvings clean and dry.

External wall finishes
Wide roof overhangs on traditional buildings protect the façade from rain. It is unnecessary to use modern enamel paints to add water protection under such wide overhangs. Carved timber elements on external walls should be kept clean and left unpainted if they were originally so.

9.2 19th Century Buildings

The external walls of traditional 19th century buildings need more attention because the roof overhangs were usually not wide. They need to be given regular attention.

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The external walls of traditional 19th century buildings need more attention because the roof overhangs were usually not wide. They need to be given regular attention.

Fig. 106. House with wide roof overhang. 
Left: The wide roof overhang protects the facade from rain and sun. Right: The facade on 19th century houses weathers more rapidly.

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Painting on plasterworks

Generally homeowners undertake painting work following the monsoon or in conjunction with festive occasions. If the existing paint shows no signs of deterioration or failure then there is no need to repaint. Additional paint coats may cause peeling or cracking of the surface due to weak adhesion to the older layer. Excessively thick layers of paint are less resistant to cracking through shrinkage and thermal stress.

Proper preparation of the surface is necessary for painting. Preparation should include cleaning, light scraping, sanding and, if necessary, repair works. The removal of excessive layers of peeling and flaking paint will help windows and doors open and close properly as well as restore the clarity of the original detailing. The main aim is to only remove paint to the next sound layer using the gentlest means possible to avoid unnecessary damage, then proceed with repainting. New coats of paint will adhere better and last longer following proper preparation.

Any plasterworks must be adequately dry before the application of the base coat of paint. Two finishing coats should only be applied after the base coat has thoroughly dried. This guarantees longer paint life.

Painting on timber work

19th century buildings are generally finished with large cornices instead of huge roof overhangs. It makes sense to paint...
Fig. 107. Paint on historical buildings.

All the openings were painted in 19th century houses. If the roof overhang is not large, as in medieval houses, it is better to paint them each year to protect them from water penetration. Cantilevered balconies and verandahs are particularly exposed to rain penetration.

Fig. 108 ऐतिहासिक वस्त्रयाचा रंग
19 व्या शताब्दीच्या परस्परालम्ब स्थानांतरलं रंग घातक सम्पत्ती. जर खाता चंद्रमा स्थानकाची वस्त्रयाची खाता जगती झाडी बांधिली फिरणार भरे. विनोबासाठी हॅरेक वट्टी खाती पुन्हा खाता तिरक रंग गरून उभारला. खास गरी चार्चूंची हे तिरक्षाक गभरी विनोबासाठी वाहे प्रभावीत हुस्तें.

Fig. 109 ऐतिहासिक वस्त्रयाचा रंग
19 व्या शताब्दीच्या केवळ दक्षिण मध्यांतरलं रंग घातक तयार. यें वर्षांतरलं घातक फिरणार भरे. वास्तूंमधून घातक हॅरेक वट्टी खाती पुन्हा खाता खाती हे विनोबासाठी वाहे प्रभावीत तयार.
CHAPTER 10

MAINTENANCE
CHAPTER 10

MAINTENANCE

Regular maintenance will prevent more serious, long term damage. Timely protection and maintenance are the keys to preserving historic buildings. When undertaking maintenance it is important to ensure that material used in the repair is compatible with the original material. There are a number of maintenance principles to bear in mind:

1. Problems in old houses often begin in timber elements. Timber should be examined from time to time to ensure that there is no water accumulation. If there are any problems, early intervention will head off more expensive repairs.

2. Roof maintenance is critical to the longevity of traditional buildings. Maintenance should be undertaken by someone familiar with traditional jhingati tile roofs. Walking on the roof to replace broken tiles or remove growing vegetation can easily cause more broken tiles. Even a small amount of water seepage through the roof can cause significant damage to the building structure. Homeowners should inspect the entire roof during rain, because if there is any leakage, it is easy to trace the seepage location.

3. Regular cleaning of walls is important. Owners should not allow posters to be glued onto wall surfaces.

4. Proper preparation should be observed when repainting. Walls should be cleaned, scraped and sanded to enhance the adhesion of new coats of paint.

5. Check that there is no damage caused by leaking pipes and gutters.

6. Moisture observed on walls at the ground level indicates the need for improved air circulation.
7. The skill level of craftsmen is critical for good work. Many builders are unfamiliar with the proper maintenance techniques for historic buildings. It is far better to employ specialists for maintenance and repair work on traditional buildings.

Monitoring the condition and undertaking immediate repairs save the additional expenses of more serious repairs. Preventative maintenance will save buildings from more serious damage. The false economy of ignoring a little problem will incur future expense well in excess of the cost of the preventative maintenance.

The responsibility of preserving Kathmandu Valley’s built cultural heritage lies with all of us. Generations to come will be grateful to homeowners who have the foresight to conserve their traditional dwellings as living history.

DO WE WANT TO PRESERVE OUR HERITAGE?
LET’S ACT BEFORE IT’S TOO LATE!

के हामी हाम्रा सम्पत्तीको संरक्षण गर्न चाहन्दै ?
थैर खिलो हुनु जागाउँगै नै कोहे परी ?

छो मैरौँ कीमो सम्पत्तीको संरक्षण गर्न मेहनत ?
सिप्नै सायुङ न्यो हे छू पाउँ।
CHAPTER 11

RESOURCES

Material Resource

Wood
Laghu Kastha Udyog, Bhaktapur 6610107
Surendra’s shop, Laganхel 5323070

Brick (Traditional)
Dakshhin Barahi Ita Udyog 4482719, 4493865
Kanchha Awale’s Bhatta, Bhaktapur 6613661, 9851063801

Floor and roof tiles
Dakshhin Barahi Ita Udyog 4482719, 4493865
Kanchha Awale’s Bhatta, Bhaktapur 6613661, 9851063801
Bhaktapur Ceramics 6612551

Lime Stone
Teku shop 4245984

Surkhi
Dakshhin Barahi Ita Udyog 4482719, 4493865

Mud
Yellow mud 9841256490

Multiplas
Material Testing and Conservation Lab. 4270943, 4276197
Jay International, Teku 4252458

Stainless steel
Bishal Kitchen 4240776
Quality Kitchen 4274445

Craftsmen

Wood carver (Butta kami)
Indra Raj Silpakar, Bhaktapur 6611980
Chhara Silpakar, Bhaktapur 6615694 (R), 9841514086
Ram Gopal Silpakar, Bhaktapur 9841495920
Ramesh Silpakar, Bhaktapur 9803310676
Bijay Silpakar, Bhaktapur 9841463180
Hari Silpakar, Bhaktapur 2130013
Nati Maharjan, Khokana 6611980
Om Maharjan, Khokana

Carpenters (Si kami)
Hari Bahadur Silpakar, Bhaktapur 012130013 (R)
Sundar Birbal, Bhaktapur 5530112 (R)
Rajesh Silpakar, Bhaktapur 9841358511
Ram Silpakar, Bhaktapur 6611957 (R)
Purna Maharjan, Patan 5530112 (R)
Bishnu Birbal, Bhaktapur 9803007114

Decorative plasterwork (Bajra kami)
Tusi Bajracharya, Tapahiti, Patan 5543889 (R)
Kazi Ratna, Tapahiti, Patan 6615688 (R)
Asharam Awale, Bhaktapur 5543889 (R)

Masons (Da kami)
Jujhibai Maharjan, Chobbar 4332094 (R)
Seth Maharjan, Sundhara, Patan 9841393901
Kishor Maharjan, Pulchowk 5531398
Laxman Maharjan, Harisiddhi 5009002
Daiba Awale, Bhaktapur 6615688

Stone workers (Lohkami)
Kanchha, Bhaktapur 6617915
Surya Bahadur, Bhaktapur 6615216
Asha Kaji, Bhaktapur 6615688

Roof tile laying (Awale)
Asha Ram Awale, Bhaktapur 9841369095
Krishna Prasad Awale, Bhaktapur 9841393901

Experts
Jaicharan Kasti, Sr. engineer, DoA 4250685
Bhim P. Nepal, Archaeologist, DoA 4250687 (O), Narendra Raj Shrestha, KMC 4251429, 4231481
Mahesh Man Singh, LSMC 5540904, 5522563 (O)
Ram Govinda Shrestha, Architect, BM 6617730, 6610310 (O)
Surya B. Sangacheh, Architect 4257647 (O)
Deepak Pant, Architect 5521310 (O)
Lumanti Joshi, Architect 5540655 (O)
Jharana Joshi, Architect 5521567 (R)
Sirish Bhatta, Architect 4428307 (R)
Prabal Thapa, Architect 4434891 (R)
Kai Weise, Architect 4421871 (O)
Sudrasan R. Tiwari, Architectural historian 5521310 (O)
Prem N. Maskey, Structural engineer, PC 5521310 (O)
Jitendra Bothara, Seismic consultant, NSIT 4474192 (O)

Note:
KMC = Kathmandu Metropolitan City
LSMC = Lalitpur Sub-Metropolitan City
BM = Bhaktapur Municipality
PC = Pulchowk Campus

Contractors
Ram Gopal Silpakar 6613907
Jiju Bhai 4332094
Kaji Man Maharjan 5537881

Resources

These contacts for the resources are based on the author's professional experience. Additional entries are welcome. Please contact the with your professional experience and contact numbers.
BIBLIOGRAPHY


WHO IS THE GUARD FOR OUR OWN HERITAGE

?
KATHMANDU VALLEY WORLD HERITAGE SITE, NEPAL

HERITAGE HOMEOWNER'S PRESERVATION MANUAL

UNESCO Bangkok
UNESCO Kathmandu

Kathmandu Valley World Heritage Site, Nepal

UNESCO Bangkok
UNESCO Kathmandu