

INFORMATION
HANDBOOK

Vernacular Architecture of North - Western Himalayas

Tradition, Resilience, and Sustainability





Rammed earth architecture harmonising with the valley landscape of Lahaul and Spiti district, Himachal Pradesh.

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“ Vernacular architecture is a process, not a product,
an evolution of tradition shaped by local needs and
knowledge. ”

-Paul Oliver

About CEVA

The Centre of Excellence on sustainable Vernacular Architecture (CEVA), under the Department of Civil Engineering at IIT Ropar, documents and studies traditional housing systems of the Indian Himalayan Region. By examining their structural techniques and climate-responsive design, CEVA works to revive resilient vernacular practices capable of withstanding earthquakes, landslides, and extreme weather. Integrating indigenous wisdom with modern research, the Centre promotes environmentally sustainable and disaster-resilient construction while preserving cultural heritage and empowering communities to build safer, more sustainable habitats.

Our Vision

CEVA envisages inspiring and empowering Himalayan communities to adopt sustainable vernacular building practices over incompatible modern construction, fostering harmony with the environment and ensuring a resilient future for generations to come.

Our Objectives

- Identification of all the vernacular housing typologies of the North-western Himalayan region.
- Identification of climate-resilient architectural features in housing typologies of the North-western Himalayan region.
- Identification of disaster-resilient structural features in housing typologies of the North-western Himalayan region. Disasters include earthquakes, landslides, forest fires, floods, and cloud bursts.
- Studying earthquake-resilient features using simplified analytical assessment, numerical, and experimental modeling, along with the suggestive alternative option.
- Suggest measures to further improve the climate and disaster resilience of vernacular housing using modern interventions.
- Knowledge dissemination on identified climate-resilient architectural features and disaster-resilient structural features in housing typologies of the North-western Himalayan region.
- Training of local masons and communities to adopt best practices to achieve climate and disaster resiliency in housing.

Our Team



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ACTION PLAN

The CEVA Action Plan is structured around five focus areas that collectively aim to document, evaluate, disseminate, and mainstream vernacular architecture of the North-Western Himalayas. These actions integrate field-based knowledge, scientific research, academic engagement, social outreach, and future-oriented strategies to ensure that traditional building practices remain relevant, resilient, and scalable in contemporary contexts.

Field visits across the North-Western Himalayas involve studying vernacular building traditions through engagement with local communities and artisans, and then documenting climate-responsive materials, construction techniques, structural detailing, and cultural context.



01 FIELD INVESTIGATIONS AND DOCUMENTATION

RESEARCH AND DEVELOPMENT 02



Field-based and analytical studies assess the environmental and structural performance of vernacular buildings using on-site monitoring and data-driven methods, generating evidence to support climate-responsive and informed contemporary application.

Traditional knowledge systems are integrated into formal curricula through coursework, experiential learning, and capacity-building initiatives, enabling critical understanding and application of vernacular architecture in contemporary practice.



03 ACADEMIC CURRICULUM INTEGRATION

SCIENTIFIC SOCIAL RESPONSIBILITY 04



SSR translates research into societal impact through ¹ engagement with artisans, communities, institutions, and government agencies, supported by capacity building, outreach, and open-access knowledge dissemination.

Vernacular architecture offers valuable lessons in sustainability and resilience but faces pressures from urbanization and climate change. The way forward lies in evidence-based integration of traditional knowledge with contemporary practice, supported by community engagement and enabling policy frameworks.



05 OPPORTUNITIES, CHALLENGES, WAY AHEAD

CEVA's work is aligned with the United Nations Sustainable Development Goals (SDGs) 2030. The specific goals addressed are highlighted below.



Field Investigations and Documentation

Introduction

This booklet documents and celebrates the living wisdom of Himalayan vernacular architecture, highlighting how traditional building practices embody resilience, sustainability, and cultural identity. Drawing from diverse regions of the North-Western Himalayas, it reflects the deep relationship between communities, local materials, and the mountain environment.

Through illustrations and community insights, the booklet seeks to:

- Preserve traditional knowledge of indigenous construction systems and craftsmanship
- Promote awareness of the ecological and cultural value of vernacular traditions
- Encourage adaptation of these techniques in contemporary design and construction
- Support education and policy engagement through CEVA's open-source platform, fostering sustainable and disaster-resilient development

The booklet envisions Himalayan architecture not as a relic of the past, but as a living and evolving model for sustainable mountain living.

Traditional Knowledge: A Foundation for the Future

Traditional knowledge in the Himalayas lives in the skills and lived experiences of local builders rather than written manuals. For generations, they have understood the land—how materials behave, where to build, and how to respond to seasonal and seismic conditions—shaping systems uniquely suited to the mountain environment.

Local craftsmen, through intuition and experience, balance stone, timber, and earth to achieve strength, comfort, and sustainability. Their construction techniques reflect deep ecological understanding, using materials that breathe, respond, and age gracefully with the environment. Every element, from wall thickness to roof slope, carries purpose and meaning rooted in local life.

In the face of climate change, these vernacular practices offer valuable lessons for resilient and context-sensitive housing. Preserving this wisdom sustains time-tested, climate-responsive strategies that can guide future development in the Himalayas.

What is Vernacular Architecture?

Vernacular architecture refers to buildings developed by local communities using readily available materials and traditional construction skills. Shaped by regional climate, culture, and customs, it reflects a way of building that evolves from lived experience and is passed down through generations, ensuring harmony between people and their environment.

Why Vernacular Architecture Matters in the Himalayas?

The North-Western Himalayas, spanning Jammu & Kashmir, Himachal Pradesh, and Uttarakhand, face significant environmental challenges that have shaped its vernacular architecture over centuries. Steep slopes, fragile soils, heavy snowfall, and frequent earthquakes influenced building traditions rooted in experience and respect for nature.

Communities in earthquake- and landslide-prone regions developed homes using local materials such as timber, stone, and earth. Thick walls retain warmth, small openings reduce heat loss, sloped roofs shed snow, and timber-laced masonry provides flexibility during earthquakes.

These buildings embody harmony, resilience, and sustainability, offering enduring lessons for climate-responsive and community-rooted mountain architecture.

Traditional Buildings of the Himalayan Region

The Indian Himalayan Region is a living repository of vernacular wisdom, where communities have long built in harmony with nature. Across Himachal Pradesh, Jammu & Kashmir, and Uttarakhand, traditional buildings reflect climate-responsive, energy-efficient, and earthquake-resilient design rooted in local materials and terrain.

Systems such as Dhajji-Dewari, Kath-Kunni, Rammed Earth, Thathara, and Taq reflect the architectural heritage of the North-Western Himalayas. Shaped by climate, seismicity, and local materials, they embody generations of knowledge and offer key lessons in resilient mountain construction.

Dhajji Dewari Building

Local Terminology

The term Dhajji-Dewari originates from the Persian-influenced Kashmiri language and means “patchwork wall.”

Overview

Dhajji-Dewari is a traditional, earthquake-resilient building technique from the North-Western Himalaya, particularly in Kashmir and Himachal Pradesh. Meaning “patchwork wall,” the term reflects its distinctive timber frame infilled with masonry panels.

Material Use

The Dhajji-Dewari technique makes efficient use of locally available materials—timber for the structural frame and stone or brick set in mud mortar for the infill panels. This thoughtful integration of readily available, low-carbon resources results in a construction system that is cost-effective, sustainable, and durable, making it well suited to the challenging conditions of the Himalayan terrain.

Architectural Characteristics

Dhajji-Dewari buildings are generally rectangular in plan, with aspect ratios ranging from 1 to 3. These buildings are observed to be up to four storeys high, with typical storey heights ranging from 2.5 to 3.2m. Plan dimensions usually range from 10 to 15 m in length and 5 to 15m in width. Openings are well distributed on both sides, covering approximately 20-30% of the wall length. Large upper-floor halls with spans of 8 to 10m are common, and horizontal projections range from 1.5 to 1.8m. These buildings are typically isolated in rural areas, but in dense urban settings such as downtown Srinagar, they are often built in continuous rows with shared walls.



Traditional Dhajji Dewari Building



Regional Presence: Jammu & Kashmir, Himachal Pradesh

Traditional Dhajji Dewari Building

Structural Characteristics

Dhajji-Dewari buildings typically rest on stone masonry strip foundations, approximately 0.4 to 0.6 m deep and 0.6 to 1.8 m wide, depending on soil conditions. The timber frame—consisting of vertical studs, horizontal members, and bracing—forms rectangular or diagonal panels. Wall thickness ranges between 0.11 and 0.23 m, with panels infilled using rubble stone or brick masonry in mud mortar.

The ground floor is often constructed with stone infill and finished with a mud or timber floor, while upper floors consist of timber planks supported on joists fixed into the wall frame. The roof system typically spans 4 to 12 m and comprises timber trusses or rafters covered with corrugated galvanised iron (CGI) sheets or traditional stone slates.

Hazard-Resistant Features

Dhajji-Dewari buildings are earthquake-resilient due to lightweight timber framing, thin walls, and timber bracing. Controlled cracking of mud-mortar infill dissipates seismic energy, while elastic timber joints and regular plan geometry ensure stability during earthquakes.

Energy-Efficiency Features

Dhajji-Dewari buildings are energy-efficient, with timber frames and masonry panels providing natural insulation. Small openings reduce heat loss, while the lightweight structure manages snow and seismic loads, and the use of local timber and stone makes them sustainable.

Sustainability

Dhajji-Dewari buildings use locally sourced timber and masonry, reducing transport energy and environmental impact. Flexible timber frames and lightweight walls provide thermal comfort, durability, and resilience in harsh Himalayan climates.

Kath-Kunni Building

Local Terminology

The term Kath-Kunni translates to “wood and corner,” referring to the alternating courses of timber (kath) and stone masonry (kunni) that define this construction style.

Overview

This traditional construction system is widely used across socio-economic groups, particularly in high-altitude regions where timber and stone are abundant. The Kath-Kunni style efficiently combines locally available stone and timber, reflecting resource sensitivity and structural wisdom.

Material Use

The Kath-Kunni technique makes efficient use of locally available materials. These include river or field stones for foundations, semi-dressed or dressed stones for foundation platforms and walls, and timber (Deodar or Kail) for walls, floor planks, and roofing systems.

Architectural Characteristics

Kath-Kunni buildings typically have a rectangular plan with an aspect ratio ranging from 1.1 to 1.4 and a uniform elevation featuring a balcony on the top floor. The typical length and width of Kath-Kunni buildings range from 3.5 to 8 m.

These buildings usually have three to five storeys, with lower floors measuring 1.2 to 1.5 m in height and upper living floors measuring 2.0 to 2.2 m. Openings are few, with the Kath-Kunni construction style incorporating doors and windows of minimal size. The lower storeys are traditionally used for cattle shelter and storage, while the upper storeys are reserved for residential use. The alternating timber and stone layers define its distinctive façade and structural character.



Traditional Kath-Kunni building



Regional Presence: Himachal Pradesh & Uttarakhand

Traditional Kath-Kunni building

Structural Characteristics

In Kath-Kunni buildings, the foundation width is equal to or up to twice the wall thickness, with a typical depth ranging from 1 to 2 m. Kath-Kunni buildings exhibit wall thicknesses ranging from 0.30 to 0.90 m, with 0.45 m being the most common. Floors consist of timber planks supported on joists spanning in the shorter direction. Roofs are typically Dutch gable in form and are covered with stone slates or timber planks supported on timber elements. This roof configuration allows snow to slide off easily during winter, making it well suited to the heavy snowfall conditions of the Himalayan region.

Hazard-Resistant Features

Kath-Kunni buildings are inherently earthquake-resilient, with near-square plans, low storey heights, thick walls, and small, centrally placed openings that enhance stability. A heavier stone base combined with lighter timber upper levels improves structural balance, while timber bands, long stones, and semi-flexible joints ensure strong wall connections and reduce out-of-plane failure. Well-anchored yet flexible floors and roofs efficiently transfer lateral forces, and the natural damping of the stone-timber system helps dissipate seismic energy during earthquakes.

Energy-Efficiency Features

Kath-Kunni buildings are energy-efficient, with thick stone walls and timber bands providing natural insulation. The stone mass helps regulate indoor temperatures, while small openings reduce heat loss. The use of local stone and timber makes this construction system both sustainable and climate-responsive.

Sustainability

Kath-Kunni construction uses locally sourced stone, timber, and mud, reducing embodied energy and environmental impact.

Rammed Earth Building

Local Terminology

Often referred to locally as Tapkha or Mud Wall Construction, the term Rammed Earth describes the method of compacting successive layers of damp earth inside temporary formwork to create solid, load-bearing walls.

Overview

Rammed Earth, or Tapkha, is a Himalayan building technique that uses compacted local soil to form thick, strong walls. It emerged from the scarcity of timber and stone and offers both strength and insulation for harsh climates.

Material Use

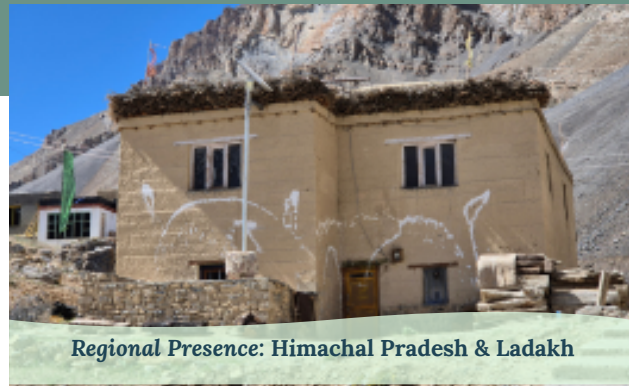
This building typology uses locally available materials—stone for the foundation, rammed earth for the walls, and either a flat earthen roof or CGI sheets for roofing.

Architectural Characteristics

Rammed earth buildings in Spiti and Ladakh display varied plan and elevation forms, though many lack the regularity recommended for earthquake safety. While some follow simple rectangular plans, others include setbacks or re-entrant corners. Primarily residential, these buildings typically have plan areas of 50 to 75 m², with lengths and widths of 4 to 10 m and storey heights of 2.5 to 3.2 m. Most are single-storeyed, though two- and three-storey examples exist. Openings range from 15 to 75% of wall length, often concentrated on one façade. Buildings generally avoid projections and are spaced apart in rural areas, with closer clustering observed in towns such as Leh. The construction reflects adaptation to local materials and climatic conditions, prioritizing thermal comfort over formal structural regularity.



Traditional Rammed Earth building



Regional Presence: Himachal Pradesh & Ladakh

Traditional Rammed Earth building

Structural Characteristics

Rammed-earth buildings use stone strip footings raised 0.6 to 1.0 m above ground level to protect walls from moisture and snow, forming a sturdy plinth for load-bearing earthen walls. Older structures typically have walls about 0.40 m thick, while newer buildings use walls approximately 0.35 m thick. All walls are constructed in 0.30 m lifts, creating visible horizontal layers. At least three walls run in each direction, resulting in a structural wall density of 15 to 25%. Both interior and exterior wall faces are plastered with insulating local mud. In several buildings, wall-to-wall connections are further strengthened using ashlar stones or lintel-level reinforced concrete (RC) bands, enhancing overall structural stability.

Hazard-Resistant Features

Rammed-earth buildings exhibit several features that support earthquake resistance: they are predominantly low-rise, often rectangular in plan, and generally maintain a low height-to-width ratio.

Energy-Efficiency Features

Thick earthen walls provide high thermal mass, absorbing heat by day and releasing it at night—suited to the extreme climate of Himalayan cold deserts. Flat mud roofs add insulation, while small recessed openings and compact layouts reduce heat loss and cold wind exposure. South-facing orientation supports passive solar gain, ensuring year-round thermal comfort.

Sustainability

Rammed earth construction uses abundant local materials with minimal energy and waste. Its recyclability, low embodied carbon, and strong thermal performance make it a highly sustainable system that supports ecological balance and cultural continuity.

Thathara Building

Local Terminology

The term Thathara derives from local terminology for timber planks used as vertical structural members, known as **Tholas**.

Overview

Thathara is a traditional residential building typology of the Chamba district, practiced for over two centuries in high-altitude Himalayan settlements. It combines timber and stone masonry to create durable, well-insulated homes adapted to local materials and seismic-climatic conditions. Historically, it has served as an affordable and resilient housing system for middle- and lower-income communities.

Material Use

Thathara construction primarily uses locally available rubble or semi-dressed stones for walls and columns, combined with Deodar timber for structural elements. The foundation consists of strip footings made from field or river stones, while roofs are typically covered with stone slates (and occasionally timber planks or RC slabs in later adaptations).

Architectural Characteristics

Taq buildings typically have square or rectangular plans with aspect ratios between 1 and 2.5 and overall dimensions of approximately 10 to 20 m in length and 10 to 12 m in width. They rise up to four storeys, with storey heights ranging from 2.8 to 3.2 m. Large window openings—often 1.5 to 2 m wide and covering 70 to 80% of the wall length—are provided on all sides and are traditionally fitted with solid wooden shutters and external wooden jalli screens. Horizontal timber projections, known as Taqshe, extend 1 to 1.5 m from the façade.



Traditional Thathara building



Regional Presence: Himachal Pradesh

Traditional Thathara building

Structural Characteristics

Thathara buildings use strip foundations made of field or river stones, typically 0.45 to 0.9 m wide and 0.6 to 1.5 m deep, depending on soil conditions. Tholas—timber, column-like elements typically measuring 0.45×0.45 m—are interconnected with timber bands, and floor beams are fixed using wooden nails.

The lowest storey has 0.45 m thick drystone walls with height-to-thickness ratios below 6, ensuring stability, while the upper storeys use 0.02 m thick timber plank walls to reduce weight. Timber bands are tied to the Tholas, and multiple timber extensions extend approximately 0.3 m into the walls, ensuring strong Thola-to-wall connections.

Hazard-Resistant Features

Thathara buildings are inherently earthquake-resilient, with rectangular plans and low storey heights that enhance stability. The Thola timber-stone system, interconnected timber bands, and thick walls enable effective load transfer and energy dissipation during seismic events.

Energy-Efficiency Features

Thick stone walls with mud plaster provide thermal mass and insulation, helping retain warmth during cold Himalayan winters. Small openings, compact layouts, and low storey heights reduce heat loss, while timber elements and stone slate roofs contribute to improved indoor comfort and climate responsiveness.

Sustainability

Thathara buildings demonstrate sustainability through the use of locally available stone, Deodar timber, and mud, reducing embodied energy and transport impacts. Their durable, climate-responsive design ensures long service life with minimal maintenance, supporting resource-efficient construction.

Taq Building

Local Terminology

The term Taq refers to the bay spacing between two load-bearing piers within a wall.

Overview

Taq is a timber-laced masonry system practiced in prevalent in Western Himalayas since at least the 12th century, used in houses, temples, and mosques. These traditional buildings are considered the choice among the low-to-middle socio-economic groups.

Material Use

Taq buildings use brick and rubble stone or sun-dried brick masonry in mud mortar, with fired brick exteriors and sun-dried brick interiors, strengthened by Deodar or Kail timber lacings. Floors and roofs are timber-based with mud finishes, resting on shallow rubble-stone foundations with raised plinths and timber plinth bands (dassa).

Architectural Characteristics

Taq buildings are two to four storeys high, with rectangular or square plans that maintain symmetry and stability. The ground floors often serve as kitchens or shops, while upper floors are used for living and storage. Windows with wooden jalli screens allow ventilation, privacy, and soft light, while projecting balconies (Taqshe) extend 1–1.5 m, adding shaded outdoor space. Interiors feature timber floors and ceilings with simple ornamentation, sometimes showcasing Kashmiri woodwork or khatamand panels. The unplastered brick-and-timber façades, deep-set openings, and sloped roofs give these buildings a distinct and enduring Kashmiri charm. Together, these elements create comfortable, climate-responsive spaces well suited to the region



Traditional Taq building



Regional Presence: Jammu & Kashmir

Traditional Taq building

Structural Characteristics

Taq buildings use wide and deep rubble-stone strip foundations suited to soft soils, topped with a 0.3–1.0 m high stone plinth and a timber dassa plinth band for added stability. Walls combine brick and stone masonry, tied together by continuous timber bands at floor and ceiling levels. Masonry piers are typically 0.75–0.9 m thick, with bay spacing of 1.4–1.8 m. Floors consist of timber joists and planks finished with a mud layer, while roofs are gable-form timber trusses with tie beams, king and queen posts, rafters, and purlins. Flexible connections between masonry and timber allow controlled movement during earthquakes, preventing brittle failure and enabling effective energy dissipation under seismic loading.

Hazard-Resistant Features

Taq buildings resist earthquakes through regular rectangular plans, reduced upper-storey mass, and a low centre of gravity for stability. Heavy masonry piers with continuous timber bands (dassa) form a box action, ensuring a clear load path. Unbonded infill, weak mud mortar, and timber elements enable controlled cracking, energy dissipation, and enhanced damping.

Energy-Efficiency Features

Thick masonry walls and mud-plastered interiors provide high thermal mass, moderating indoor temperatures across Kashmir's seasonal extremes. Timber floors and ceilings add natural insulation, ensuring winter warmth and summer coolness with minimal energy demand.

Sustainability

Taq buildings are sustainable due to their use of local, low-embodied energy materials like timber, brick, stone, and mud. Their passive thermal design reduces energy demand, while the repairable timber-masonry system ensures durability and minimal waste.

Key Characteristics of Vernacular Architecture

With increasing earthquakes and landslides in the Himalayan region, vernacular architecture is more relevant than ever. Developed through centuries of local knowledge, these traditional systems are designed to flex, absorb seismic forces, and reduce collapse, consistently safeguarding lives. As hazards intensify, their embedded wisdom offers vital guidance for building safer, more resilient Himalayan communities. We now turn to the key features that define this enduring tradition.

- **Climate-Responsive Design**

Vernacular buildings are oriented and proportioned to respond to local climate conditions such as temperature, rainfall, snow, and solar exposure. Thick walls, small openings, mud plaster, and timber elements provide natural insulation and passive heating and cooling, ensuring year-round comfort without mechanical systems.



Twin Towers of Raila (Dhaliara Kothi), Kangra district, Himachal Pradesh — a ~55-foot-tall Kath-Kunni structure.

- **Locally Available Materials**

These buildings use locally sourced materials—stone, timber, earth, mud, lime, and bamboo—selected for availability and climatic suitability. This minimizes transportation energy, reduces costs, and ensures ease of repair while blending harmoniously with the landscape.

- **Community-Centred Craftsmanship**

Vernacular architecture is built by local artisans who carry deep generational knowledge of materials, climate, and construction techniques. Their intuitive understanding of structural behavior, detailing, local site conditions, and proportions ensures buildings are resilient, functional, and culturally authentic. This community-driven process reinforces local identity and helps preserve traditional skills.



Close-up of timber bands and stone joints forming the seismic-strengthening core of Kath-Kunni construction.

- **Earthquake-Resilient Construction**

Traditional Himalayan systems use flexible joints, timber bands, diagonal bracing, and lightweight upper floors to safely dissipate seismic forces. Thick walls, balanced openings, and hybrid timber–stone or timber–earth assemblies allow buildings to bend without breaking, enhancing stability during earthquakes and reducing the risk of collapse.

- **Energy Efficiency & Thermal Comfort**

Thick masonry walls, mud plaster, insulated timber floors, and compact layouts stabilize indoor temperatures. Passive design keeps interiors warm in winter and cool in summer with minimal energy use.

- **Long Lifespan with Low Maintenance**

Thick masonry walls, mud plaster, insulated timber floors, and compact layouts ensure durable construction that withstands time and weather. Their passive design maintains stable indoor temperatures year-round, reducing wear from energy systems and keeping the building comfortable for decades.



Chehni Kothi, a 350-year-old Kath-Kuni-style watch tower with a temple inside, is located in Chehni village, Kullu, Himachal Pradesh, India.

Field Investigation & Documentation

Example: Pattern of Change in Traditional Building Practices After the 1991 Uttarkashi Earthquake

Post-earthquake reconstruction in the Himalayan region significantly altered local construction practices. Poor performance of unbanded drystone and stone masonry led to widespread damage, prompting a rapid shift to modern materials and methods, often without adequate technical understanding or contextual adaptation.

Consequences Identified

- **Misinformation:** Misinterpretation of failure causes led to the blanket rejection of traditional systems rather than improvement of their seismic detailing.
- **Alien Materials:** Increased adoption of RCC and incompatible materials disrupted established structural logic and material harmony.
- **Skill Mismatch:** Local artisans trained in traditional methods faced challenges adapting to reinforced concrete construction, affecting workmanship quality.



Introduction of dry stone compromising the structural integrity and Cultural authenticity.



Introduction of dry stone compromising the structural integrity and Cultural authenticity.



Application of traditional materials maintaining structural integrity and cultural authenticity.



Application of traditional materials maintaining structural integrity and cultural authenticity.



Introduction of dry stone compromising the structural integrity and Cultural authenticity.

The post-earthquake transition underscores the need to strengthen and refine traditional systems through informed seismic detailing rather than abandoning them in favor of incompatible modern interventions. By improving indigenous techniques and enhancing structural connections, vernacular buildings can evolve safely while preserving material compatibility, local skills, and contextual relevance.

Research and Development

As part of CEVA's research and development initiatives, a detailed field-based study was conducted to evaluate the indoor environmental performance of traditional vernacular buildings in comparison with modern construction practices. For this purpose, environmental sensors were installed in two residential buildings located in Rumsu village, Himachal Pradesh: one modern reinforced cement concrete (RC) building and one traditional Kath-Kunni building. The sensors continuously recorded indoor air temperature and relative humidity, allowing for a direct, data-driven comparison between modern and vernacular building systems under the same climatic conditions.



Kath-Kunni building fitted with sensors to track climate performance and compare with modern buildings

What is IMAC ?

The Indian Model for Adaptive Comfort (IMAC) is a thermal comfort model developed specifically for Indian climatic, cultural, and socio-economic conditions. It recognizes that people in India naturally adapt to their environment rather than relying heavily on mechanical heating or cooling. IMAC follows the adaptive comfort approach, which assumes that occupants' comfort temperature changes with outdoor climate, acclimatization, clothing habits & natural ventilation and occupant control. Instead of a fixed "ideal" indoor temperature, it defines a comfort range that shifts with outdoor conditions.

In cold regions such as the north-western Himalayas, space heating accounts for a major share of household energy use. This study shows that traditional Kath-Kunni buildings have lower heating demand due to superior thermal performance. Thick stone masonry walls, timber bands, and their composite system provide high

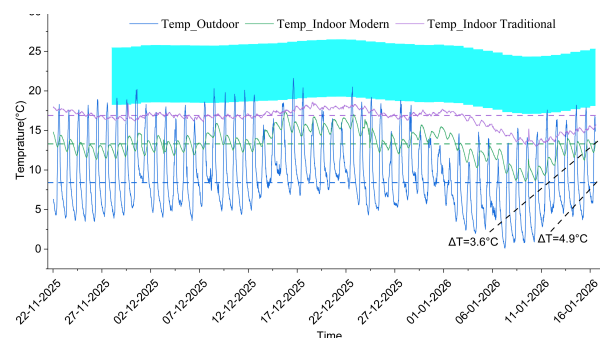


Newly installed sensors in a traditional Kath-Kunni building.

thermal mass, effective insulation, and delayed heat loss, improving indoor comfort during winter, thereby improving indoor comfort during colder periods.

Night-time analysis further highlights the thermal efficiency of the traditional structure. The Kath-Kunni building achieves an indoor-outdoor temperature difference of approximately 12 °C, compared to about 8.6 °C in the modern RC building. This enhanced temperature retention reflects better insulation characteristics and reduced heat dissipation, enabling the interior spaces to remain warmer for longer durations during night hours.

Overall, the enhanced thermal stability observed in traditional Kath-Kunni buildings contributes to reduced operational energy requirements and, consequently, lower associated CO₂ emissions. These findings underline the relevance of vernacular construction practices as climate-responsive, energy-efficient, and environmentally sustainable solutions, particularly in cold and mountainous regions. The research reinforces the potential of integrating traditional building knowledge into contemporary design and policy frameworks to promote low-energy and resilient built environments.



The temperature-time plot derived from sensor data, showing a comparison of Temperature outdoors and within modern and vernacular buildings.

Research and Development

Humidity-time analysis shows that traditional houses maintain consistently lower indoor relative humidity than modern reinforced concrete (RC) buildings, while remaining within acceptable thermal comfort limits under the dry seasonal conditions of the study period. Indoor humidity in traditional houses is approximately 24.2% lower than in modern buildings and about 16.7% lower than outdoor levels, demonstrating their effectiveness in naturally moderating moisture.



RC structure where sensors have been installed to monitor climate-responsive parameters, enabling comparison with modern buildings.

This performance is largely attributed to breathable and hygroscopic materials such as clay plaster, mud, stone masonry, and timber, which enable controlled moisture exchange between indoor and outdoor environments. Clay-based plasters play a key role by absorbing excess humidity when levels rise and gradually releasing it as the air dries, thereby reducing condensation risk and stabilizing indoor conditions. Unlike sealed modern construction systems that often restrict airflow and trap moisture, traditional buildings promote passive moisture regulation through inherent material properties and construction techniques. These characteristics enhance indoor thermal comfort, improve material longevity, and create healthier living



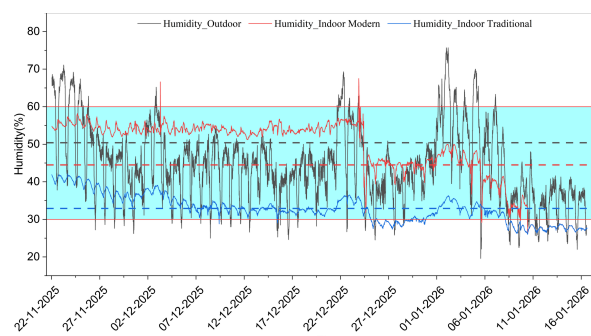
Installation of sensors in a traditional RC building.



Newly installed sensors in a traditional RC building.

environments without reliance on mechanical ventilation or dehumidification systems, demonstrating the inherent climatic responsiveness and sustainability of vernacular construction.

The combined assessment of temperature and humidity highlights the superior indoor environmental stability of vernacular buildings when compared to modern RC constructions. By maintaining indoor conditions closer to the IMAC comfort range, traditional buildings reduce the dependence on space heating during cold periods. This passive regulation of the indoor environment leads to lower operational energy demand and associated carbon emissions. Overall, the integrated thermal-hygrometric performance reinforces the relevance of vernacular architecture as a climate-responsive, energy-efficient, and sustainable model for contemporary construction in the Himalayan region. Such performance enhances occupant well-being by minimizing indoor fluctuations and moisture-related discomfort, supporting the integration of vernacular principles into modern building design for resilient and sustainable development in the Himalayan region.



The humidity-time plots derived from sensor data, showing a comparison of Temperature outdoors and within modern and vernacular buildings.

Academic Curriculum Integration

Integrating traditional knowledge into formal curricula is vital for developing professionals sensitive to climate, context, and cultural heritage. Through structured coursework, experiential learning, and capacity-building initiatives, vernacular architecture can be systematically studied and applied in contemporary practice.

Course Title: Introduction to Traditional Structures



3D model of a traditional Dhajji-Dewari building system.

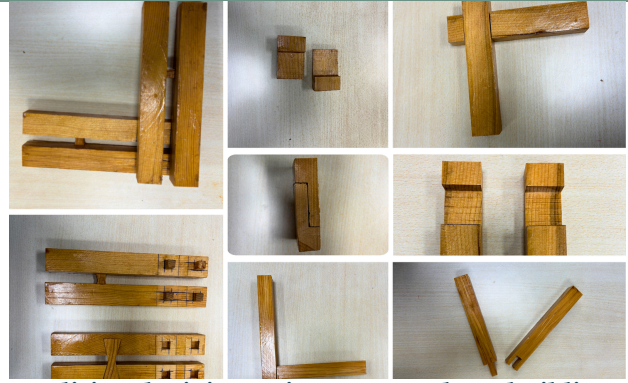
Course Modules

The course is designed to provide a comprehensive understanding of traditional building systems through the following modules:

- **Module 1:** Introduction to Traditional Housing in India
- **Module 2:** Traditional Building Materials and Relevant Indian Standards
- **Module 3:** Structural and Architectural Features of Traditional Structures
- **Module 4:** Climate Responsiveness and Thermal Comfort in Traditional Structures
- **Module 5:** Disaster Resilience in Traditional Housing
- **Module 6:** Sustainability Features in Traditional Structures

Laboratory, Field, and Project-Based Learning

Hands-on learning forms a critical component of the curriculum, enabling students to translate theoretical knowledge into practical understanding.



Traditional joints in vernacular buildings showcasing indigenous techniques.

- **Material Testing:** Testing of traditional construction materials in accordance with relevant Indian Standards.
- **Architectural Modelling:** Revit-based modelling of traditional forms and systems.
- **Life Cycle Assessment:** Environmental performance analysis using tools like SimaPro.
- **Field Exposure:** Site documentation and interaction with local communities and artisans.

Capacity Building and Collaboration

To strengthen knowledge exchange beyond the classroom, the programme emphasizes interdisciplinary training and collaboration.

- **Professional Training:** Capacity-building programmes for engineers, architects, and planners on traditional systems.
- **Artisan Workshops:** Hands-on sessions with skilled artisans promoting experiential and intergenerational learning.



3D model of a traditional Kath-Kunni building system.

Scientific Social Responsibility

Scientific Social Responsibility (SSR) at CEVA focuses on translating research into tangible societal impact. Through sustained on-ground engagement, CEVA collaborates with local artisans and craftspeople to document, analyse, and strengthen traditional construction knowledge. Field interactions and hands-on workshops create platforms for mutual learning, technical exchange, and capacity building.

In parallel, CEVA engages with government officials, academic institutions, and schools to disseminate insights on climate-responsive and disaster-resilient vernacular architecture. These engagements contribute to awareness generation, informed decision-making, and policy-relevant dialogue.

Outcomes are shared through digital platforms, public outreach, and a comprehensive online compendium for long-term knowledge dissemination.



Local artisan engaged in traditional construction practices on site.

Field Interaction

The CEVA team conducts extensive field visits across villages in the North-Western Himalayas to document and study existing vernacular building traditions. Through close interaction with local communities and experienced artisans, the team gains first-hand insights into construction practices shaped by regional climate, terrain, and material availability.

These engagements deepen understanding of materials, structural systems, and joint detailing. On-site observations, combined with artisan knowledge, bridge theory and practice while situating vernacular architecture within its cultural context. The resulting field insights directly inform CEVA's research and academic initiatives, ensuring context-sensitive, practice-oriented outcomes.



Field-based interaction with artisans in Kibber village, Himachal Pradesh.



Field-based interaction with artisans in Rangori village, Himachal Pradesh.

Workshop

CEVA organized three focused workshops on Earthquake-Safe Construction and Retrofitting of Buildings, Safe Construction Practices and Assessment of Earthquake-Retrofitted Buildings, and Vernacular Structures and Indigenous Building Practices in the North-Western Himalayas. The first two workshops were conducted in collaboration with the District Disaster Management Authorities (DDMA) of Una and Mandi, while the third workshop was organized for students of Cambridge International School, Kullu, with the objective of promoting early awareness and understanding of safe and sustainable building practices.



CEVA workshop in Mandi on earthquake-safe construction and retrofitting.

Scientific Social Responsibility



CEVA workshop in Una on earthquake-safe construction and retrofiting.

Aligned with CEVA's commitment to promoting safe and sustainable built environments, two workshops were conducted in collaboration with the District Disaster Management Authorities (DDMA) of Una and Mandi, focusing on earthquake-safe construction and the retrofitting of existing buildings. The sessions addressed principles of seismic design, structural vulnerabilities in existing constructions, retrofitting strategies, and practical approaches for assessing and evaluating earthquake-retrofitted buildings to strengthen safety and resilience.



CEVA awareness workshop at Cambridge International School, Kullu, on safe and sustainable building practices.



Students practicing traditional mud plastering, demonstrating indigenous craftsmanship.



Students performing hands-on traditional wood carving, showcasing indigenous craftsmanship.

The third workshop, organized for students of Cambridge International School, Kullu, was designed as an interactive session introducing principles of safe and sustainable construction. It combined discussions on vernacular and disaster-resilient practices with hands-on activities such as mud plastering and basic wood carving, providing students with practical exposure to traditional materials, tools, and craftsmanship while fostering early awareness of sustainability and cultural heritage. The workshop concluded with an interactive reflection session, reinforcing the value of indigenous knowledge and inspiring students to appreciate resilient, climate-responsive building practices.



Hands-on demonstration of traditional mud plastering techniques by students

Knowledge Dissemination

CEVA shares the outcomes of its initiatives through social media, digital platforms, and public outreach, increasing knowledge access, artisan visibility, and awareness of sustainable traditional construction. A regularly updated compendium on the CEVA website provides a structured reference, while CEVA bridges grassroots wisdom with research and policy to promote resilient Himalayan development.

Opportunities, Challenges, Way Ahead!

The vernacular architecture of the North-Western Himalayas represents a rich repository of indigenous knowledge evolved through centuries of interaction with climate, terrain, materials, and socio-cultural practices. While these traditional systems offer valuable lessons in sustainability, resilience, and resource efficiency, they are currently at a critical juncture. Understanding the opportunities they present, the challenges they face, and the way forward is essential for ensuring their continuity and relevance in contemporary built environments.



Timber and stone band details illustrating structural integration in vernacular buildings.

Opportunities

Engaging with the rich legacy of vernacular architecture in the North-Western Himalayas presents CEVA with the responsibility to document, preserve, and interpret traditional building knowledge. By studying and disseminating these systems, CEVA seeks to ensure their continued relevance in advancing sustainable and resilient construction practices.

- **Knowledge Preservation:** Safeguarding indigenous construction wisdom through documentation of oral histories, traditional techniques, and intergenerational practices.
- **Documentation:** Measured drawings, photographs, and field surveys of vernacular structures.
- **Low-Carbon Construction:** Promoting local materials and low-energy building methods.
- **Climate Responsiveness:** Learning region-specific strategies for comfort and ventilation.
- **Disaster Resilience:** Studying time-tested structural systems proven resilient against earthquakes, heavy snowfall, and challenging terrain conditions.



Elder artisans practicing traditional construction amid declining skill transmission.

Challenges

Despite their proven relevance and performance, vernacular building systems face critical threats due to rapid urbanization, shifting aspirations, and regulatory constraints, accelerating the decline of traditional practices and necessitating the preservation and integration of indigenous knowledge into contemporary development.

- **Non-availability of Materials & Supply Chain:** Limited access to traditional materials and disrupted local supply chains hinder authentic construction and repair.
- **Cost-Effectiveness Analysis:** Absence of standardized economic and lifecycle assessments restricts comparison with modern construction systems.
- **Declining Traditional Building Knowledge:** Generational gaps have weakened the transmission of indigenous construction skills.
- **Shortage of Skilled Artisans:** A diminishing pool of trained craftsmen challenges implementation and revival efforts.
- **Lack of Awareness about the Benefits:** Inadequate understanding among communities, professionals, and policymakers limits acceptance of vernacular systems.



Modern RCC interventions within traditional settlements.

Opportunities, Challenges, Way Ahead!

Way Ahead

The future of vernacular architecture depends on a balanced and inclusive approach that integrates community empowerment, supportive policies, and traditional wisdom with modern construction practices. Amid rapid urbanization, climate change, and standardized building methods, it is crucial to reinforce knowledge systems that value context, resilience, and sustainability. By strengthening institutional mechanisms and promoting evidence-based adoption of traditional practices, vernacular knowledge can be preserved and adapted to meet contemporary needs without losing its cultural essence.

Empowering the People with Knowledge

Empowerment through knowledge is fundamental to the revival and continuity of vernacular building practices. Creating accessible and structured learning platforms can ensure the transmission of traditional wisdom across generations and professional domains.

- **Detailed Documentation (Compendium):** Preparation of comprehensive compendiums capturing construction techniques, materials, detailing, and regional variations.
- **Digital Content:** Creation of digital archives, videos, and interactive platforms for wider outreach.
- **Training Programmes:** Capacity-building for faculty, engineers, architects, and planners.
- **Curriculum Integration:** Inclusion of traditional knowledge in academic programmes.
- **E-Certification:** Online courses promoting skill-based learning and broader participation.



Field interaction with artisans to understand traditional construction practices.



Knowledge exchange with artisans during on-site interaction.

Developing a Culture of Compliance

For vernacular practices to be adopted at scale, regulatory frameworks must be simplified and aligned with traditional construction systems.

- **Thumb Rules:** Development of clear and practical thumb rules to guide design and construction decisions.
- **Simplified Guidelines and Ready-to-Use Documents:** Preparation of user-friendly guidelines and compendiums to assist practitioners, approval authorities, and communities.



CEVA envisions a future where traditional construction becomes common across Himalayan valleys.

Incorporating Traditional Knowledge into Modern Building Practices

Integrating traditional wisdom with contemporary construction methods can enhance performance, resilience, and sustainability.

- **Experiential Learning:** Using past successes and failures to improve construction practices.
- **Evidence-Based Integration:** Applying validated traditional principles within modern, context-sensitive systems.

On-Site Learning & Honouring Artisan

As part of our exploration of Himalayan vernacular architecture, we visited several regions of North-Western where traditional building systems continue to shape the cultural and physical landscape. We engaged with local communities and observed how Kath-Kunni, Dhajji-Dewari, and other indigenous techniques remain embedded in everyday life.

Through discussions with residents and on-site observations, we gained insights into how these structures respond to climate, terrain, and contemporary challenges. We also interacted with master craftsmen and local builders who have inherited this knowledge across generations. Their skills and intuitive understanding of timber, stone, and earth reflect a living tradition that sustains resilient, climate-responsive, and culturally rooted construction practices in the Himalayan region.



Field interaction with the local community in Tangnu Village, Mandi District, Himachal Pradesh.

We felicitated these craftsmen in recognition of their invaluable contribution to preserving Himalayan architectural heritage. Having inherited knowledge across generations, they continue to uphold building traditions deeply rooted in the region's culture, climate, and way of life. Their craftsmanship—evident in every joint, stone placement, and carved wooden detail—represents a living archive of Himalayan wisdom. At a time when modern construction often prioritizes speed over contextual sensitivity, their work stands as a reminder of the importance of skill, patience, and ecological awareness. These buildings are not merely physical structures but expressions of community memory, environmental intelligence, and cultural continuity.



Felicitating the artisan of the Bhima Kali Temple in recognition of his invaluable traditional craftsmanship.

Moreover, their traditional techniques offer critical lessons for the future. By demonstrating the effective use of locally sourced materials, climate-responsive design, and intuitive structural understanding, their craft bridges past and future, inspiring sustainable and resilient approaches to contemporary construction.

Conclusion

Our visits across Himalayan villages allowed close engagement with the living traditions of vernacular architecture. Through on-site observations and interactions with local craftsmen and communities, we gained deep insights into the cultural richness and practical performance of these systems, shaped by climate, terrain, and inherited knowledge.

While timber procurement requires official permissions and initial costs may be higher than modern alternatives, these buildings offer long-term benefits such as superior thermal comfort, reduced energy use, and enhanced durability. These experiences reaffirm the enduring relevance of traditional methods as sustainable, resilient, and context-responsive solutions for the future of Himalayan architecture.



Felicitating the artisans of Kibber Village, Lahaul and Spiti, Himachal Pradesh.



Engagement with a local artisan during a field documentation visit to Tangnu village, Himachal Pradesh.

Rooted in the land,
refined by generations,
and validated by
science,
Himalayan vernacular
architecture offers
enduring lessons for
building resilient
futures.

We'd love to hear from you!

Connect with us on LinkedIn, visit our website,
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and collaboration opportunities. Scan the QR
code to learn more about CEVA's research,
fieldwork, and initiatives



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