# Comparing the wall construction techniques in the Hilly Region of Nepal and India: A Study of Traditional Practices

**Ar.Krishma Kandel[1]**

[1] *Architect, Baha Spatial Agency, Nepal*

---------------------------------------------------------------------***---------------------------------------------------------------------

**Abstract -** *Himalayan hill settlements in Nepal and India employ stone–timber wall systems that have evolved in response to climate, terrain, and earthquakes. This paper compares traditional wall construction in Jumla, Nepal and Uttarakhand, India, focusing on typologies such as Jumli stone masonry and timber-laced systems including Kath-Kuni and Koti Banal. A comparative review of published documentation and the typical assemblies from case study on Jumla is used to identify structural features that influence seismic performance, including timber bands/courses, interlocking corners, and flexible connections that improve energy dissipation. The obtained results through literature studies of Uttarakhand architecture and case studies of Jumla are then analyzed. The study highlights vulnerabilities where continuous tying and wall-to-floor/roof anchorage are limited and where heavy roof terraces increase seismic demand. Based on the comparison, the paper proposes context-sensitive strengthening measures and demonstrates their application through a conceptual socio-cultural community center that retains vernacular materiality while improving safety.*

***Key Words*: Vernacular architecture, stone masonry, timber lacing, Kath-Kuni, Koti Banal, Jumla, Uttarakhand, seismic resilience**

## 1. INTRODUCTION

Vernacular architecture can be defined as a type of local or regional construction, using traditional materials and resources from the area where the building is located. (Camilla, 2020) As such, it is always site-specific and acknowledges the geographical features and cultural values of its surroundings. It becomes unique to different parts of the world and thus serves as a strong identity marker for many nations. (Contributors, 2024)

Hilly regions in Nepal and India are known for their steep slopes, extreme climatic variations, and rich traditional heritage which have resulted in the development of different wall constructions that are both functional and resilient. (Chawha Vrushali, Kamal Mohammad, 2024). Seismic activity and harsh winters are some common challenges faced by these regions hence construction methods should ensure durability, thermal comfort and safety. (Vernacular architecture of Nepal, 2022). This study seeks to compare traditional wall constructions in hilly areas between both countries with special reference to Nepalese techniques in relation to how they can be employed in vernacular construction within Nepal towards making technology more adaptable towards earthquakes. (Sryahwapublications, 2024)

The magnificence of Sinja Valley, where the richest gifts of nature are scattered and where Nepalese culture is very much blended with natural beauty forming the most important highlights of Jumla. Nested around one river Hima of Karnali district, Sinja which lies at an elevation of 2500 m above the sea level and inhabited by Jumli people who promote Khaas language as their indigenous language. (Sinja Valley: Historical legacy and challenges, 2024)

In India, earthquake resistance is ensured through ingenious use of locally available materials such as timber and stone in techniques such as Kath Kuni, Koti Banal and Dhajji. Similarly, Nepal's hilly areas have a variety of building techniques that uses stone, mud and wood to suit the specific needs of the terrain and climate. Centuries old traditional ways like timber-laced stone masonry or use of rammed earth walls provide lasting stability. (Lipika, 2021)

### 1.1 Traditional Construction Techniques in Hilly, India

Starting from Tons-Yamuna river in the west, Uttarakhand, situated in north India reaches until Kali river in the east. The state is bounded by Supin, Tons and Yamuna rivers to its west and Himachal Pradesh. Southwards it extends up to western Uttar Pradesh plains while Tibet lies on its northern side. Its rich natural beauty, diverse flora and fauna along with sacred temples and monasteries have made it a popular destination for tourists, pilgrims, hermits, writers, environmentalists and naturalists. (Uttarakhand summary, 2022)

The area has several old temples and buildings that reflect the local culture as well as topography of land available materials geo-climatic conditions and seismic activity. The architectural styles of Garhwal as well as Kumaon regions within Uttarakhand are influenced by distinct languages spoken there.

India is famous for its rich heritage which covers all aspects of life; be it culture, religion or cuisine among others. One significant aspect of this heritage is found in the various architectural styles seen across the country where each region displays its unique character.

Mughal architecture is not the only form of architecture found in India; there is also Dravidian, Buddhist and Islamic architecture. The term vernacular architecture includes these types of buildings. One example of this kind of building is Kath-Kuni that originates from Himachal Pradesh located in India. Kath-Kuni means 'corner' (kuni) made with wood (kath). Since it was during the reigns of local kings or since early 8th century.

Constructing buildings at high altitudes has been facilitated by using locally available materials. Traditional methods of construction in India's hilly regions have adapted to stone, wood and mud for constructing strong weather-resistant earthquake-proof structures. Some techniques include:

1. Kath Kuni: This method involves alternating layers of wood and stone. This utilizes stones, woods (usually deodar), and mud as basic elements. These layers make the structure flexible enough to withstand an earthquake. (S. K. Negi, H.K. Jein, Vandana Singh, 2017)

2. Koti Banal: It is suitable for massive multi-storeyed structures that are built with huge rocks and thick wooden beams. The materials used are large dressed stones, wood (typically Deodar or Pine), and mud. This makes it earthquake resistant. (Smriti, 2017)

**Building Techniques**

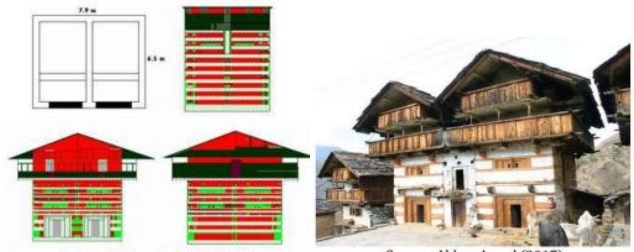
Humans have been able to come up with better ways of managing resources & ensuring that they can still live well even under immense pressure. It is possible for a species that does not have many special features and that exists on many different continents or islands to still be around today as proof that people are very good at overcoming long odds when it comes down to their own survival. (Smriti, 2017)

The first assumption made concerning earthquake safety is that the integrity of structures is vitally important to safeguarding human life against the effects of such natural catastrophe. This idea was rapidly grasped by societies residing in seismic regions leading to innovation aimed at minimizing fatalities due to collapses. For example Dhajji-dewari, Taq as well as other notable Kashmiri construction techniques use timber and stone available around them but in a particular manner so as to make sure that the house remains standing even if there is a tremor. The "Quetta bond" is another method employed towards this end.

It may be assumed that some traditional buildings surviving several centuries in earthquake-prone areas are resistant against earthquake loads. If thoroughly examined, these structures can provide information on improved local construction practices which might then be incorporated into wider plans for regional development. (Rautela Piyoosh, Joshi Chandra Girish, 2008)

**Structural Safety Factors**

The design of Koti Banal is based on the practical application of wood, which offers many advantages as a building material. Wood's strength and light weight make it ideal for construction, as it reduces the energy released by ground acceleration compared to other materials. Additionally, wood-frame systems have the advantage of dissipating energy through greater flexibility than structures made from other materials. (Rautela Piyoosh, Joshi Chandra Girish, 2008)



Source: Rautela &Chandra Joshi (2008) Source: Abhay Aswal (2017)

*Koti Banal: Structural Safety*

When an earthquake strikes, the forces acting upon a building are proportional to its mass and the ground acceleration. However, a building's response to an earthquake depends on its dimensions and stiffness. Since a building's mass is typically concentrated near the top and bottom, these areas experience the greatest lateral forces during ground motion. To withstand these forces, walls must remain crack-free, and the entire structure must be securely anchored to the ground. (Abhay, 2017)

Koti Banal's design incorporates several unique features to enhance seismic resistance (Rautela Piyoosh, Joshi Chandra Girish, 2008):

- Symmetrical Mass and Rigidity Distribution: The mass and rigidity are distributed symmetrically, ensuring that the points of earthquake forces and resistive forces coincide. This alignment prevents or significantly reduces torsion, enhancing shock resistance

- Rectangular Girders: The primary girders are rectangular with a width-to-weight ratio of 2:3, making them suitable for bending. These girders are larger than necessary for safety, ensuring that the structure meets space rigidity and strength requirements, further improving shock resistance.

- Wooden Structures: Wood, when properly built and utilized, has minimal structural limits. Wooden structures have a higher strength-to-weight ratio than steel and concrete, resulting in weaker inertial forces during a seismic event. The architecture of Koti Banal uses various timber assemblies to withstand earthquake stresses from inertial forces. (Abhay, 2017)

- Elastic-Plastic Material: Wood is an elastic-plastic material capable of absorbing earthquake forces. Wooden components are joined using both housing and nailing techniques, creating semi-rigid joints that combine the benefits of pin joints and rigid junctions. This configuration supports significant loads and high ductility, allowing the structure to absorb considerable force before breaking.

Studies show that this type of construction is prevalent in northern Uttarakhand and other regions in India and neighboring countries. Field research identifies three styles of this architecture:

1. Modified Style
2. Original Style
3. Original Morphology with New Materials

## 1.2 Traditional Construction Techniques in Hilly, Nepal

The town of Jumla in Nepal's Karnali region is popularly recognized for having an architectural heritage that is specific to it which is seen through its houses and buildings. This kind of architecture is unique because it is constructed from materials that are readily available around the area such as stones, woods and mud & also very strong type of structures which can be able to accommodate in any landform which experience difficult weather conditions like those of mountains areas. (Vernacular architecture of nepal.pptx, 2022)

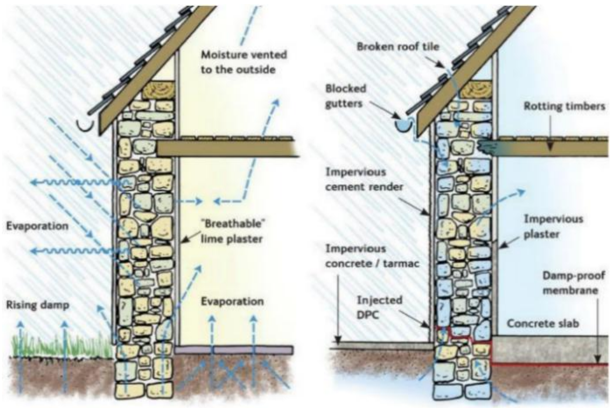
A common design for traditional houses in Jumla consists of roofs that slope down and are either covered in slate or with wooden shingles so that they can resist collapsing under the weight of snow. The buildings are also equipped with thick walls made up of stones to keep out cold from outside. Additionally there is incorporation of ornate carpentry work on some openings like doors & windows hence breaking monotony within design but enhancing beauty when viewed at by people passing near them.

Generally the villages around Jumla are closely packed with residences indicating a collective livelihood. It serves also as a defense mechanism against environmental conditions!. Most times there are shared spaces integrated into the structures of the houses like courtyards or squares where people can come together socially. (NHDP - Welcome, 2017)

One can see how much culture and religion play into everything when looking at these monasteries or temples throughout this little town called Jumla!! A lot of them have roofs that make one think immediately about Asia; they put plenty details such as animals figures for gods everywhere.

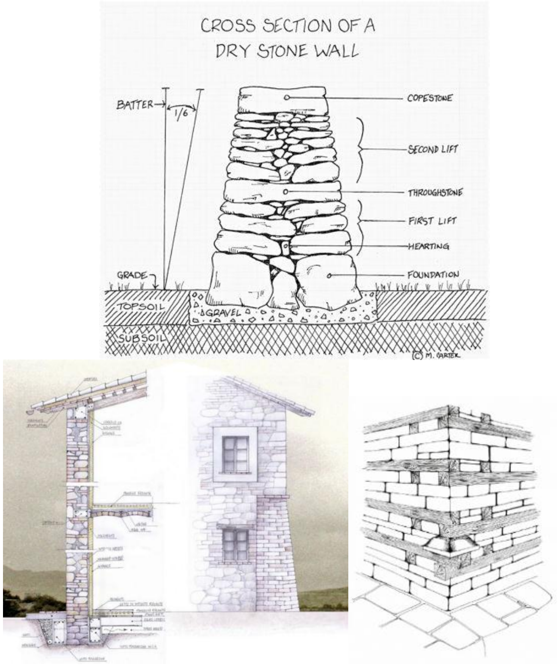
Ghumauro dhi is a unique style of housing construction practiced by the Gurung and Magar communities in the hilly areas of Nepal. These attractive circular-shaped stone buildings with timber decorations are excellent examples of anti-seismic construction.

The heartwood known as Agrakh was used by the natives in making important parts such as timber posts and rafters from trees close to them, something which they did with pride. Normally Ghumauro dhi houses stand elevated one or two floors elevated and have an excellent combination of timbers that create space for doorways, floors, and cross-ventilations at different elevations. In this sense, these houses are not just safe but also part and parcel of the cultural wealth that is found within the region. [Chaudhary Dinesh]



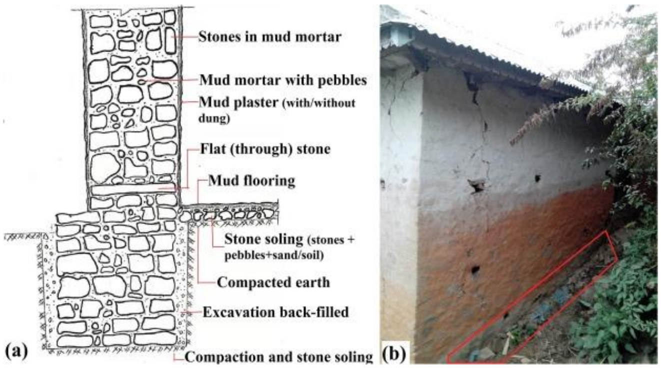

*Stone wall construction techniques*

- **Stone Masonry:**
  - Dry Stone Masonry: It is used extensively in the mid-hill and hilly regions; dry stone masonry involves stacking stones without mortar [mud, concrete, and lime]. This technique is valued for its flexibility and ability to absorb seismic shocks.



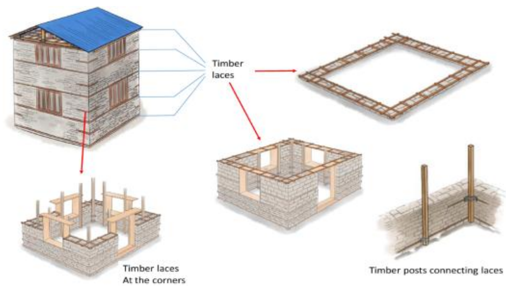

***Hilly Nepal:*** *Dry stone masonry*

- Stone with Mud Mortar: It is common in residential buildings. This technique uses mud as a binder. It provides good thermal insulation but requires regular maintenance.




***Hilly Nepal:*** *Stone with mud mortar*

Timber-Laced Masonry: It is a hybrid technique where timber beams are integrated into stone or brick masonry to enhance structural flexibility and earthquake resistance.

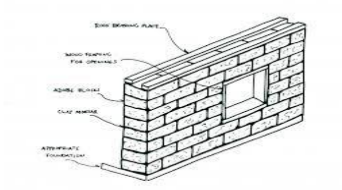



***Hilly Nepal:*** *Timber Laced Masonry*

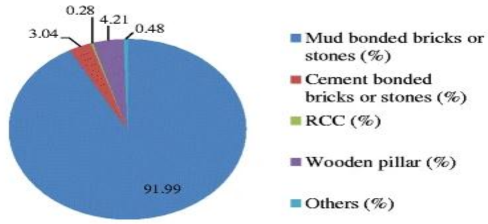
- Adobe (Mud Bricks): Adobe bricks are made from a mixture of earth, straw, and water, dried in the sun. This method is eco-friendly and provides excellent thermal mass.

- **Types of Structure**

From the survey data, it is found that most of the houses of Jumla are constructed with mud bonded bricks or stones. The cement bonded bricks and stones are however being used as a replacement of mud mortar for the better stability.



*Hilly Nepal: Mud bricks*




***Hilly Nepal:*** *Types of structure*

## 2. A Case of Hilly Nepal: Typical House in Jumla

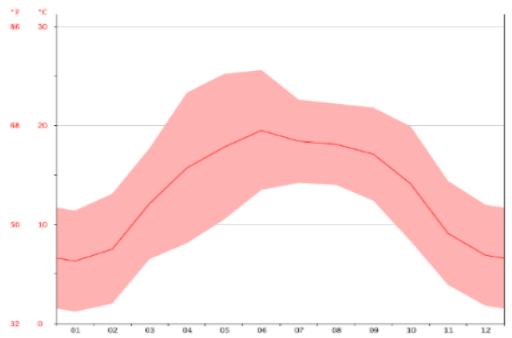
Jumla is one out of the ten district of Karnali, 6 no's province, with as its district headquarters in the MId-Western Development Region of Nepal. Its cover an area 2,531 km$^2$ and had a population 108,921 in 2011 Nepal census. It elevation varies from 915 m to 4,679 m. Jumla is an entirely mountainous region with no flat land except for narrow stripe alongside the beds of the various tributaries of the Karnali River which drain the region. The major rivers in Jumla are Hima, Tila and Jawa. (Jumla (town), 2018)

***Hilly Nepal****: Jumla*

The primary purpose of this dissertation is to understand Jumla religion within the context of Jumla culture. As Jumla religion can be distinguished into two separate tradition, which I have labeled -Jumla Brahmanism (Dharmic) and oracular religion (non- Dharmic), the bulk of this study is devoted to exploring the roles and meaning of these two traditions and their relationship to each other.

**Climate**

The climate of Jumla is found warm and temperate. The summers are much rainier than the winters in Jumla. The average annual temperature is 13.5 °C in Jumla. In a year, the average rainfall is 766 mm. In Jumla, the wet season is comfortable and partly cloudy and the dry season is cool and mostly clear. Over the course of the year, the temperature typically varies from *25°F* to *74°F* and is rarely below *17°F* or above *79°F*.



*Jumla: Climatic Data*

**Socio Cultural Aspects of Jumla**

Vernacular Architecture of Jumla is highly influenced by the social and the cultural aspects also merged with topography. In the figure below we can see the condition and cultural aspects of Jumla.

*Jumla: Activity Mapping*

**Jumli Architecture**

There are significant differences in the way the Jumli people settle and construct housing units as compared to other caste groups in Nepal. The rich may have their own spacious homesteads but this is not the case with most of the Jumlis who occupy what is known as extended family house which is a unit comprising two or more families living under one roof or within one compound, thereby forming a closely packed settlement. The long shape seen in these communal dwellings is referred to by locals as a "BADO" & contains several compartments called GHAR each having its entrance meant for a separate conjugal group. This term may also refer to several contiguous BADOs or PAGRIs of similar caste taken for granted belonging to one extended family. For instance, there are thirty-three DHEVALGAUN in seven different BADO at Dangibada hamlet of Suni-gaon village in Jarmi-tatopani-chayat. (Dinesh, 2020)

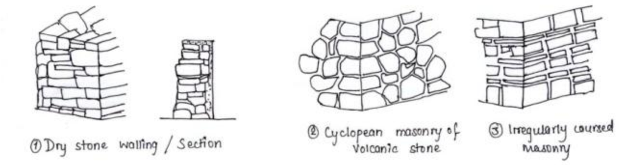
Even though they resemble some Bhotia homes, the architecture of a typical Jumli home remains quite distinct among other Pahari ethnic groups dwelling in the region. These houses are made using wood beams, stones and mud-mortar; they also have flat roofs made out of pressed earth known locally as "THIRO" which are used to dry cereal crops and vegetables that have been stored or will be prepared for food. In addition, these flat surfaces offer strategic locations from where people can observe what is happening around them. (Dinesh, 2020) Most buildings face towards the sunny side (south) so as to receive maximum sunlight; at times, the roof may be linked down on one side thus creating space above ceiling intended for extra provisions whose access is facilitated through such means as inclined holes or trapdoors on lower levels. A notched log ladder provides access between the top floor and roof. [Raut Balman]

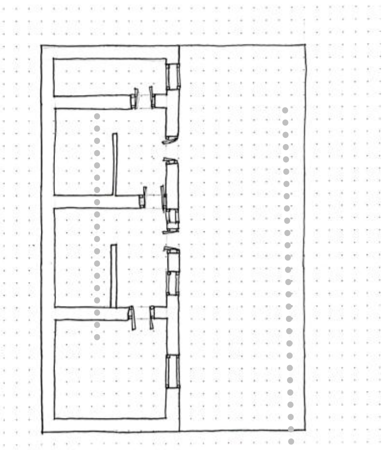
In DHEVALGAUN, most houses have a similar structure on the first floor, which is found immediately above the ground. It comprises of three to four rooms arranged linearly with each other and one acting as a passage way. Normally these are the rooms where close family members sleep so as to get some heat but interestingly they first undress before lying in bed. Some extra spaces may be there to put on clothes while some people may also use them as bedrooms. Such a house has two features only; one is that it is completely dark & the other one is that there can be light inside only when something is burnt there. This is because they burn pine-pitch faggots for illumination & due to lack of chimney smoke fills up in these kinds of houses, turning Jumli people who live there into someone with face and hands covered by soot. [Raut Balman]

The lower storey comprises animal quarters called GOTH for cows, buffaloes, horses, etc. kept in there. These GOTH units also act as venues for special communal and religious functions such as bratabandha, marriage that require a Brahman (priest), etc. & for which guests assemble at home!. Besides they are scenes of some semi-private singing gatherings too. Nearby, a small wooden shed called PIRE is used for drying chilies and as a place for menstruating women to stay during their five-day exclusion from the house. [Raut Balman]

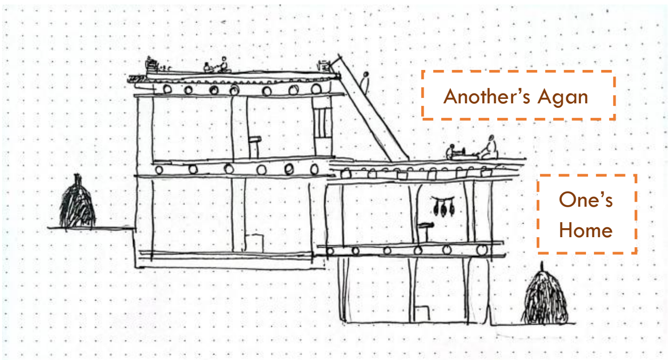
*Jumla: Vernacular Architecture*

This concept of local architecture where one's roof is taken as another's Aagan is the unique feature in Jumla. However, this architecture is diminishing due to misconception created due to material and technology. Below we can see how BADO, a house acting as a roof as well as Aagan. The typical section shows how the architecture is merged into the topography while keeping in mind the social functions.



*Typical Plan of House in Jumla, BADO Ghar*




*Typical Section of BADO Ghar*

**Wall Construction Techniques**

The typical wall section shows how the stones with mud mortar or dry stone rubble are placed in such a way they create the interlocking properties within themselves.

*Typical Wall of BADO Ghar*

**Building Techniques**

**Typical Wall Construction Methods of BADO Ghar**

The vernacular architecture in Jumla is a product of the application of passed down construction know-how over extended periods, and which takes into consideration the environment, resources, and way of life. (Dinesh, 2020) Below is an analysis of some primary construction techniques within the local architectural setting of Jumla

1. **Stone Masonry**

   Techniques: The technique involves careful selection of stones which are arranged one on top the other without using cement just the way it was done since ages!. For binding agents most people prefer mud mortars because they like it that way; nevertheless through this type of practice they end up with thick walls that can keep off heat loss from occurring within the house or any other building.

Construction: These types of stones may be placed in an interlocking pattern so as to increase their strength & make them last longer.

2. **Timber Framing**

Techniques: It makes use of wooden beams obtained locally from forests to offer support for the overall structure load path analysis. These beams experience little resistance to movement because they join poorly without being subjected any mechanical fastening device like nails also known as traditional joinery methods. Construction: This kind of wooden framework enhances strength but still keeps the house flexible enough to survive earthquakes that are common in this area. (Association, 2014)

3. **Pounded Earth Roofs**

Techniques: The roofs comprise level surfaces made by tamping down earth. A method where layers of soil are compressed tightly until it forms impermeable and long serving cover constitutes what roofing experts refer to as pounded earth roofs.

Construction: Such roofs rest upon timber joists and serve several purposes which include sun drying of farm produce & keeping harvested food in safe place while also being used socially.

4. **Layered Construction**

Houses often consist of many floors, where the ones at the top are built with materials that are not heavy so as to reduce the pressure on the lower sections.
Access to Upper Rooms: A set up where one could move straight up & also it does not effect on the strength of the house has been employed; for example the first floor is accessed by a wooden ladder whose notched logs are made of wood. (Dinesh, 2020)

5. **Orientation and Layout**

In what ways do the two parts differ? The south facing direction is normally chosen while building houses so that they may receive maximum amount of sunlight which is very helpful in warming up the house especially during winter at Jumla where there are low temperatures.
Construction: It comprises of a courtyard located at the center & shared among several families thus enhancing unity while saving on space.

6. **Earthen Floors**

Expound on how this can be achieved: These kinds of floors may be made from hard-packed dirt or sticky natural soil with or without mixing some little amount of cow's waste to make it stronger and prevent heat loss.

Construction: To have a solid clean surface, it requires regular smoothing & general upkeep procedures are done on such kind of floors including washing them.

**Building Materials**

In Jumla, the building materials used for constructing houses are primarily local and traditional, reflecting the region's resources and environmental conditions. [Raut Balman] Here's a detailed explanation of materials:

1. **Wooden Beams**:
   - Source: Local forests provide the wood.
   - Usage: Used as structural supports for the houses.

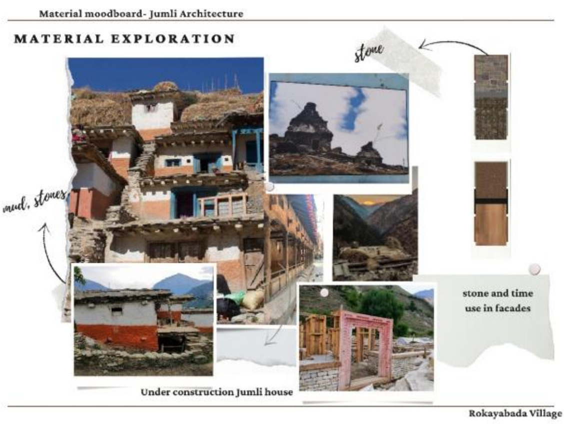
2. **Stone**:
   - Source: Collected from the surrounding areas.
   - Usage: Stones are used for the main walls of the houses, providing durability and insulation.

3. **Mud Mortar**:
   - Source: Derived from the local soil.
   - Usage: Acts as a binding material to hold the stones together in the walls.

4. **Pounded Earth**:
   - Source: Local earth is compacted.
   - Usage: Utilized for the flat roofs (thiro), which are a distinctive feature of Jumli houses. These roofs are multifunctional, used for drying, storing, and preparing grains and vegetables.

*Jumla: Vernacular Architecture*

Here's the material mood board showing how and where the local materials are used within the village and their community.




*Jumla: Material moodboard*

## 3. CONCLUSION

Here's the comparison on the various aspects of vernacular architecture of Uttarakand and Nepal on the various criteria:

| | Nepal | India |
|---|---|---|
| Materials | • Wood, Stone, Mud | • Timber, Stone, Tiles |
| Construction Technology | • Sill bands<br>• Lintel Bands<br>• Foundation | • Sill bands<br>• Lintel Bands<br>• Foundation |
| Vernacular Architecture | • Kath kuni Architecture | • Bado House |
| Wall Details | • Alternate layers of wood and stone | • Stone Binded with mud mortar |
| Connection and Joints | • Beams connected with wall plate | • Mortise and Tenon joints in corner points |
| Roof | • Mud roofing above joists followed by timber planks | • Tiles |

**Analysis of the construction techniques of Jumla and Uttarakand**

The vernacular architecture of Jumla, when compared to that of India, exhibits lower seismic resistance despite the use of similar materials. This disparity can be attributed to several factors:

1. **Lagging Bands at Different Levels**

- The structural integrity of the buildings in Jumla is greatly compromised due to lack of appropriate lagging bands, as well as sill and lintel bands. On the other hand, Indian Kathkuni architecture strengthens the stonework by using every second course in joining together blocks with wood or stone thereby making it more resistant to earthquakes.

2. **Roof Load**

- The vernacular architecture of Jumla features roofs that often serve as additional living spaces (agan) for another house, resulting in substantial live loads on the structures. This heavy load adversely impacts the seismic resistivity of the buildings.

3. **Structural Design**

- The use of wooden beams and stone in Kathkuni architecture not only binds the materials more effectively but also allows for a more flexible and robust structure. The wooden layers provide elasticity, which is crucial for withstanding seismic forces.

Overall, the architectural techniques and structural designs in Jumla contribute to its lower seismic resistance. Addressing these factors through the incorporation of proper lagging bands and reducing excessive live loads on roofs could enhance the earthquake resilience of buildings in the region.

### Findings

To enhance the seismic resistivity of vernacular architecture in Jumla while preserving its traditional essence, the following recommendations can be implemented:

1. **Incorporation of Lagging Bands**

Sill and Lintel Bands: Introduce horizontal sill and lintel bands at critical levels within the stone masonry. These bands will provide additional support and bind the stonework effectively.

2. **Alternate Layering Technique**:

Wood and Stone Layers: Adopt the Kathkuni technique of alternating layers of wood and stone. This method enhances the binding of stones, increases the flexibility of the structure, and improves overall seismic performance.

3. **Reduction of Roof Live Load**:

Lightweight Materials: Use lighter materials for the construction of roofs and upper stories to minimize the live load. This can significantly reduce the stress on the structural components during an earthquake.

Separate Living Spaces: Design roofs that do not serve as additional living spaces to prevent excessive live loads. Separate agan spaces can be constructed adjacent to the main structure to distribute the load more evenly.

4. **Improved Structural Design**:

Flexible Connections: Implement flexible connections between wooden beams and stone masonry to allow for controlled movement during seismic events. This can be achieved through the use of traditional joinery techniques combined with modern reinforcement methods.

Foundation Reinforcement: Strengthen the foundation with reinforced concrete or stone bands to provide a stable base for the entire structure.

## Recommendations

With the incorporation of all the recommendations here's a conclusion taken out with the design of community center focusing on the better stability to earthquake forces.


Legends

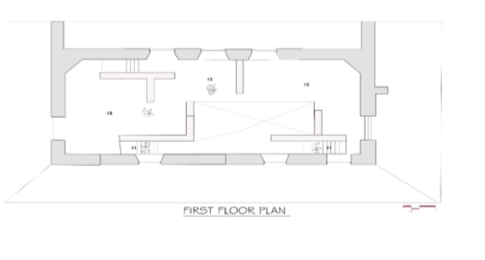
1. Main Entrance
2. Entry to Museum
3. Main Gate
4. Major Display Zone
5. Seating Space
6. Exhibition Zone
7. Cultural exhibition zone
8. Working Zone
9. Maintenance zone
10. Exit

*Jumla: Masterplan*

The southern facade of community center has small openings and the spaces of entry focuses on the gallery space for the display of community art. The wall that gets bulked are then treated with bitumen asphalt for the better damp proofing. Also the damp proofing layers are installed on flooring levels for the better water resistance.

**First floor plan**

The first floor plan has the space for community meeting.




Legends

11. Staircase
12. Community Meeting
13. Space for Communal Activity

*Jumla: First floor plan*

**Second floor plan**

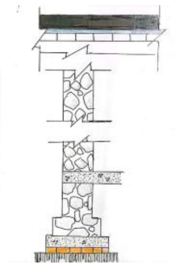
The second floor plan has the space for community activity.

Legends
14. Storage
15. Community Celebration

*Second Floor Plan*

**Wall Section**

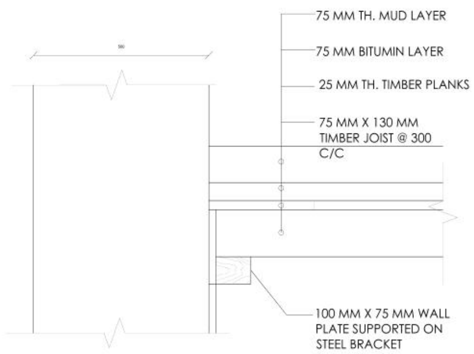
Below wall section shows how the modern interventions is adopted in the building design solving the existing problem of vernacular architecture of Jumla for the better stability and resistance against seismic forces.



*Wall Section*

**Flooring Details**

The flooring details of the typical section shows the different laying layers of the mud, timber planks and also timber joists. These flooring are supported by wall plate supported on steel bracket in order to maintain stability. A layer of bitumen is also added for maintaining safety.




*Jumla: Flooring Details*

***3D* views**

This design of community center shows an improvement on the vernacular architectural styles, making it more resistant to earthquakes and at the same time not losing the originality. With some necessary changes, this project has created a blend in both the vernacular architectural design with a modern intervention.

*Jumla: 3D Views*

This image reflects a community center designed in the vernacular architecture of Jumla, characterized by the following features:

1. **Use of Local Materials**: The building uses stone and wood i.e. traditional materials of Jumla, ensuring sustainability.

2. **Flat Roof Design**: The structure has a flat roof, known as "thiro", a mud for roofing which is used for communal activities and performance.

3. **Multiple Stories**: The building has multiple stories, which is blend into contour and land topography of Jumla.

4. **South-Facing Orientation**: The design maximizes sunlight exposure for warmth and energy efficiency.

5. **Seismic Resistance**: Enhanced seismic resistance is achieved through horizontal and vertical reinforcement bands and the Kath-kuni technique of alternating wood and stone layers.

So, this community center preserves the traditional architectural essence of Jumla while incorporating new safety features and interventions.

## ACKNOWLEDGEMENT

I am immensely grateful to my tutors Ar. Sadichchha Shrestha, Ar. Swasti Bhattarai for their guidance during the research and studies. I am thankful to Mr. Dipendra Rokaya for his valuable guidance during the site visit at Jumla, as well as Saraswoti Rokaya and Raj Bahadur Kami for their help in the measured drawing process. Their support and hard work have

contributed significantly to establish the depth and accuracy in the project.

## REFERENCES


1. Association, G. D. (2014). Jumla Community Development Project - Govinda EV.

2. Camilla, G. (2020). What is vernacular architecture?

3. Chawha Vrushali, Kamal Mohammad. (2024). A study of planning, design and construction of buildings in hilly regions of India. *American Journal of Civil Engineering and Architecture*.

4. Contributors, W. (2024).

5. Dinesh, C. (2020). umlis(khas) socio-cultural centre. *Issuu*.

6. *Jumla (town)*. (2018, September 04). Retrieved January 11, 2019, from Wikipedia: https://en.wikipedia.org/wiki/Jumla_(town)

7. NHDP - Welcome. (2017).

8. Rautela Piyoosh, Joshi Chandra Girish. (2008). Earthquake-safe Koti Banal architecture of Uttarakhand, India. *Academia*.

9. Sinja Valley: Historical legacy and challenges. (2024). *GorakhaPatra*.

10. Smriti, S. (2017). Koti Banal Architecture of Uttarakhand: Indigenous Realities and Community Involvement.

11. Sryahwapublications. (2024).

12. Uttarakhand summary. (2022).

13. Vernacular architecture of nepal. (2022).