Journal of Mechanical, Civil and Industrial Engineering
ISSN: 2709-0809
DOI: 10.32996/jmcie
Journal Homepage: www.al-kindipublisher.com/index.php/jmcie

JMCIE
AL-KINDI CENTER FOR RESEARCH AND DEVELOPMENT

| RESEARCH ARTICLE

Sustainable Building Materials in the Traditional Architecture of Nuristan Province, Afghanistan: A Case Study of Wood, Stone, and Indigenous Materials in Parun and Wama Districts

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| ABSTRACT
In many developing countries, construction methods differ significantly from those in developed regions, often relying on readily available but low-quality materials. Afghanistan, as a developing country, displays a wide range of traditional construction practices, particularly in remote provinces. This study focuses on the traditional residential construction techniques of Nuristan Province, with an emphasis on the use of wood, stone, and other indigenous materials in the Parun and Wama districts. The research investigates how these materials are applied in local building practices and evaluates their performance in terms of sustainability, structural resilience, and climatic suitability. Data were collected through field observations, interviews, questionnaires, and physical measurements conducted during site visits in 2025. The findings reveal that the indigenous materials used in Nuristan are not only practical and cost-effective but also environmentally sustainable and culturally significant.

| KEYWORDS
Nuristan Province, Traditional Architecture, Indigenous Building Materials, Wood and Stone Construction, Sustainability, Seismic Adaptation, Vernacular Techniques

| ARTICLE INFORMATION
ACCEPTED: 10 July 2025 **PUBLISHED:** 12 August 2025 **DOI:** 10.32996/jmcie.2025.6.3.8

1. Introduction and Aims of Study

Nuristan is located in the eastern region of Afghanistan and is characterized by rugged mountainous terrain. This province is renowned for its rich culture and unique history. The provincial capital, Parun, lies approximately 280 kilometers from Kabul city. The unpaved and difficult routes to Nuristan contribute to its relative underdevelopment and poverty compared to other provinces of Afghanistan. The population of Nuristan is predominantly poor, relying mainly on subsistence agriculture and forestry. Additionally, many residents depend on wage labor outside the province.

According to a 2006 provincial survey by the Swedish Committee for Afghanistan, government sources, local strongmen, and insurgent groups exploit the province's cedar, oak, and pine forests, as well as its marble deposits in Waigal and precious stone mines in Kantiwa and Wama districts. Much of these natural resources are smuggled into neighboring Pakistan. Opium poppy cultivation has also been present historically; although Nuristan was considered opium-free between 2006 and 2016, the UNODC recorded minor cultivation of about 120 hectares in Mandol and Nurgram districts in 2017 (Thomas Ruttig and Jelena Bjelica, 2025).

Buildings in Nuristan are predominantly constructed using local materials, with modern materials rarely employed. This contrasts with the urban development seen in Kabul, where many new constructions follow modernist architectural styles that often lack the regional character and charm found in traditional Afghan architecture (Kazimee and Najimi, 2017). The use of locally available materials such as wood and stone in traditional Nuristani architecture is not only practical but also holds deep symbolic and cultural significance. As the last part of Afghanistan to be converted to Islam (in 1896), Nuristan retains a distinct material and intangible cultural heritage (Rider and Varoutsikos, 2023).

This paper aims to explore the types, applications, and significance of the primary building materials used in traditional Nuristani construction. Additionally, it examines contemporary apartment housing in Kabul, focusing on construction technologies and methods. The specific objectives of this study are:

- To illustrate the prevalent construction technologies and housing methods in Nuristan Province, Afghanistan.
- To analyze construction materials from the perspective of sustainability.

For this purpose, Nuristan, located in eastern Afghanistan, has been selected as the focus of this research.

2. Methodology

Nuristan presents a special case in virtually all relevant respects, as its ethic, linguistic and cultural features are highly particular (Max Klimburg, 2010). Nuristan is a remote province with difficult access from Kabul, which influenced the choice of methods applied in this study. The following approaches were used to gather data and analyze traditional and contemporary building practices in Nuristan:

- Archival Research: A comprehensive literature review was conducted, covering previous studies on Nuristani architecture, local construction methods, and regional materials.
- Site Visits: Field visits were carried out to observe buildings during their construction phase in 2025, enabling direct insight into construction methods and the use of local materials.
- Physical Measurements: Precise measurements of apartment building plots and structures were taken to document dimensions and construction layouts.
- Photography: Detailed photographs were taken of Nuristani buildings to visually capture the types of materials used, construction techniques, and architectural details.

For this study, 30 buildings were selected based on specific criteria including the building's age, number of stories, and the use of local materials. Of these, 18 buildings are located in Parun and 12 in Wama District. Approximately 88% of these buildings have more than one story, reflecting the prevalent architectural style in the region.

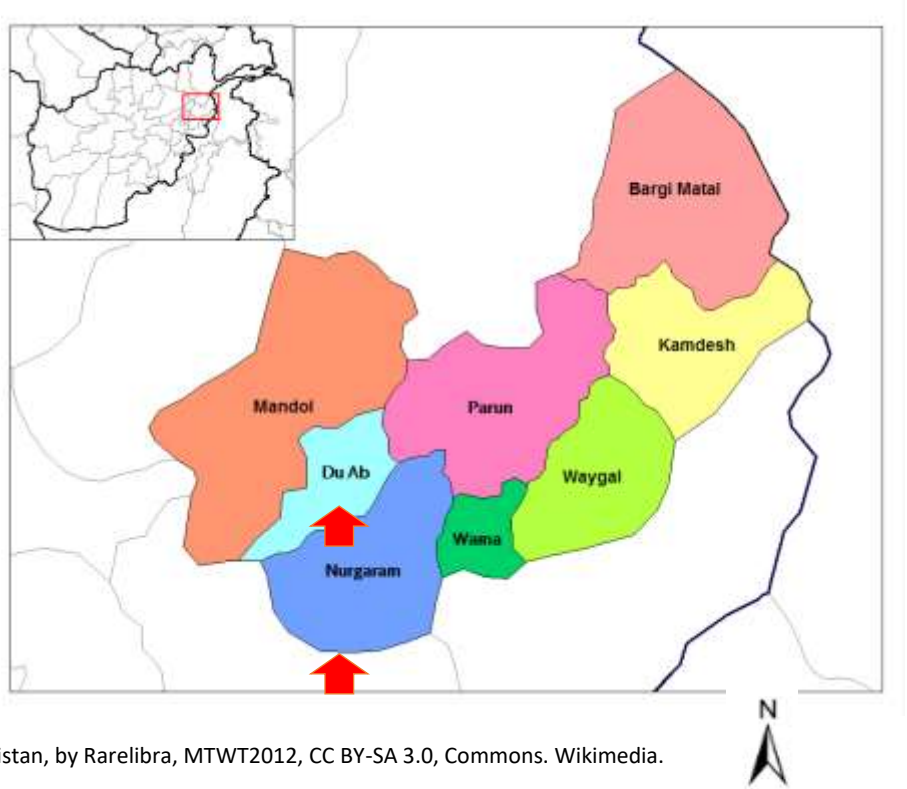


Fig.1. Districts of Nuristan, by Rarelibra, MTWT2012, CC BY-SA 3.0, Commons. Wikimedia.

The study area districts.

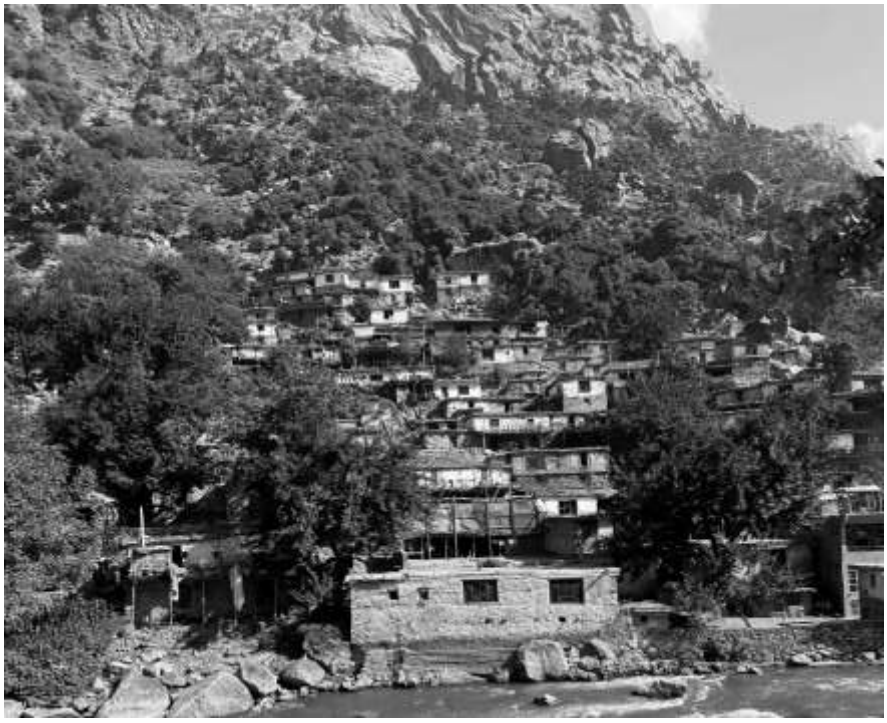


Fig.2. The Nuristan Architecture, a mountain view (photo by Author 2025).

3. The Construction Materials of Nuristani House

Most of the house are built with local materils which are available in this province. As the Nuristan is rich of jungles with tall trees and also it is surrounded by Hindukush mountains. As result most of the materils are wood and stone. Although generally the wood is expensive in all over the country but in Nuristan they used it widely.

3.1 Wood

The Nuristan province's cedar, oak and pine forests, as well as marble (in Waigal) and precious stone mines (in Kantiwa and Wama districts) are the main natural resource. The wood widely use in house walls, roof, stairs, windows and doors. Wood from local species such as walnut, oak, and plane trees is widely used in structural components — including beams, joists, floors, doors, and window frames. Timber is also essential in roofing systems, often laid in interlocking patterns for strength.

3.2 Stone

The most dominant material in Nuristani construction. Local stone is used for building thick, load-bearing walls. In many cases, the stones are dry-fitted without mortar or bound together with mud mortar, showcasing advanced indigenous masonry skills.

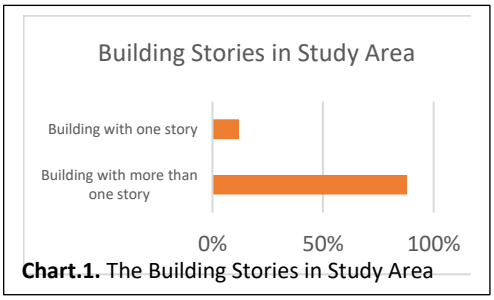


Chart.1. The Building Stories in Study Area

3.3 Mud and Clay

These are used primarily for plastering walls and insulating roofs. A mixture of clay, straw, and water is applied as a sealant and weather-resistant coating.

3.4 Natural Fibers

In some households, reeds, bark, or tree leaves are added to roofing or wall insulation to provide added thermal regulation.

4. Environmental and Structural Considerations

4.1 Seismic Adaptability:

The use of flexible wooden joints and compact structural design provides a degree of resistance to minor earthquakes.

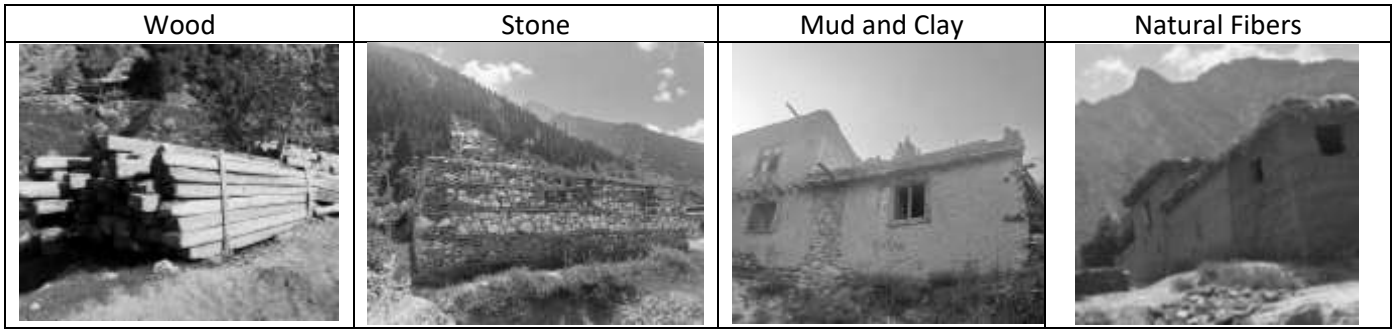


Fig.3. The local construction material (photo by Author 2025).

4.2 Climate Adaptation :

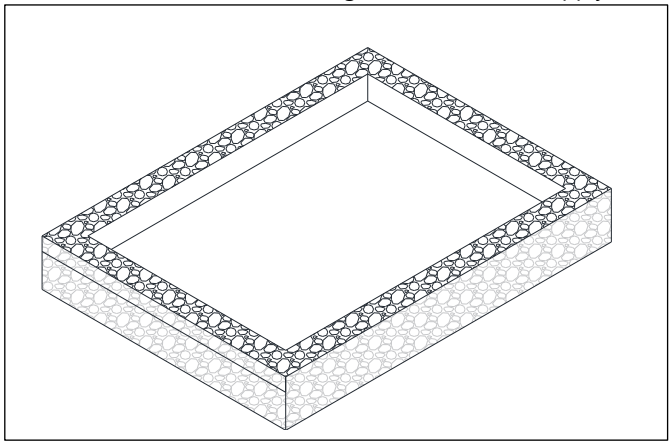
The thick stone walls offer excellent insulation against extreme cold, while open spaces and wooden ventilation systems on upper floors ensure airflow during warmer months.

4.3 Eco-Sustainability:

The use of entirely local, natural, and biodegradable materials contributes to a low carbon footprint and aligns with principles of sustainable architecture.

4. Construction Technology and Methods

In Nuristan Province of Afghanistan, the construction of residential buildings significantly differs from methods used in other parts of the country. One of the most distinctive features is the prominent use of wood, which is clearly visible both inside and outside the structures. This reflects the region's rich natural supply of timber, which plays a central role in local architecture. Located in the Hindu Kush mountain range, Nuristan is a seismically active region. In response to this risk, local builders have developed construction techniques that incorporate wooden structural elements within the walls. These timber components are used specifically to resist horizontal forces caused by earthquakes, improving the flexibility and seismic resilience of the buildings. In general, the construction of a traditional residential building in Nuristan follows several sequential steps, as outlined below::



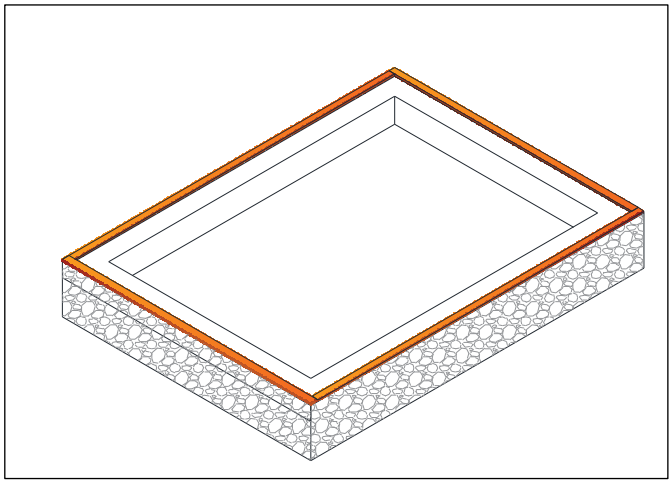


Figure.5. Step 2: Wooden Seismic Buffer Layer (First)

On top of the stone foundation, a horizontal wooden board layer is added. This layer, typically composed of thick planks measuring 10 to 20 centimeters in thickness, is integrated as a seismic buffer. It serves to distribute lateral loads during earthquakes, reducing the stress on stone walls and improving the house's flexibility under seismic movement. This technique demonstrates an indigenous understanding of earthquake-resistant construction long before modern engineering introduced similar strategies.

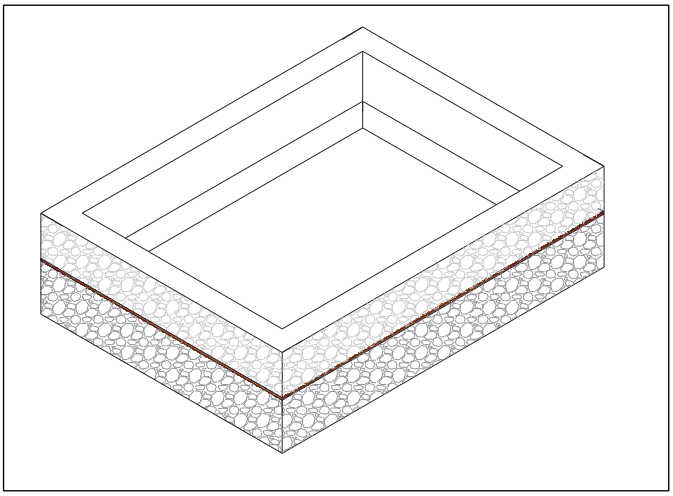


Figure.6. Step 3: Base Wall Layer – Stone or Earth-Based Option

The third step involves building the first vertical wall layer above the wooden platform, and it comes in two traditional material options:

Stone Option: In many villages, especially where stone is abundant, a stone wall layer of approximately 70 centimeters in height is added. This stone course serves as the plinth, forming the solid base for the walls and raising the structure above ground moisture and snow. Earth-Based (Mud) Option: In regions where stone is less available or where traditional practice favors it, builders instead apply a thick mud or earth-based layer as the initial wall. This earthen wall, sometimes mixed with straw or other binding materials, is shaped and compacted by hand to form a strong, insulating barrier.

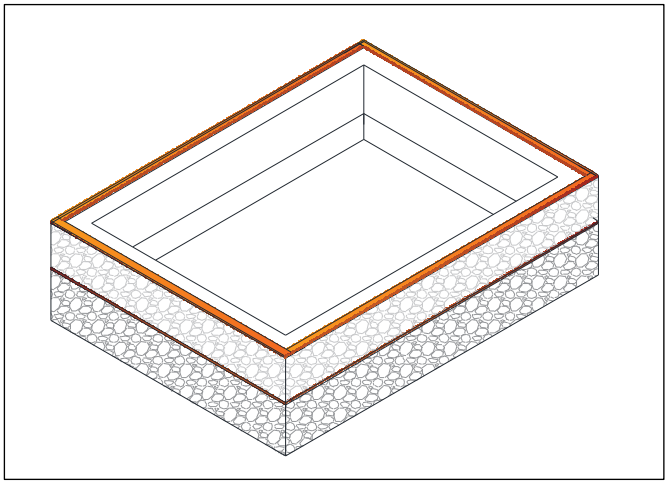


Figure.7. Step 4: Wooden Seismic Buffer Layer (Second)
Following the stone or mud wall layer, a second horizontal wooden board layer is added. Like the first, this layer typically consists of 10–20 cm thick planks and serves the same seismic function — resisting horizontal forces caused by potential earthquakes. By alternating between rigid (stone/mud) and flexible (wood) materials, the structure gains enhanced stability and seismic resilience.

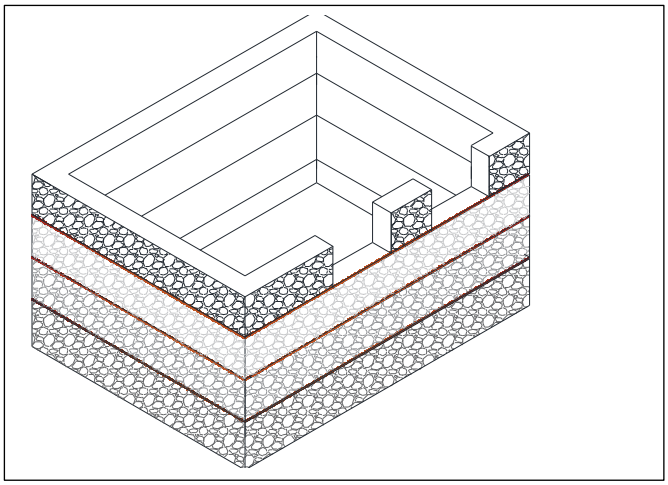


Figure.7. Step 5: Window Construction and Wall Elevation
After the placement of the second wooden seismic layer, construction proceeds with the formation of the wall sections that include window openings. At this stage, vertical stone or mud walls are raised above the wooden platform, carefully leaving openings for windows based on the functional and spatial requirements of the building.
The size and placement of the windows are not standardized but vary according to: The intended use of the room or space (e.g., living areas, storage, sleeping quarters), The orientation of the building, especially with regard to sunlight, wind exposure, and views, Thermal and lighting needs, given the cold winters and natural daylight considerations
Windows are often framed with strong wooden beams or lintels to maintain structural integrity and to support the weight of the materials above. In some houses, decorative wooden elements may be added to the frames, reflecting Nuristani craftsmanship.
This step is crucial for determining interior comfort, natural ventilation, and lighting, and it also contributes to the unique external appearance of Nuristani homes.

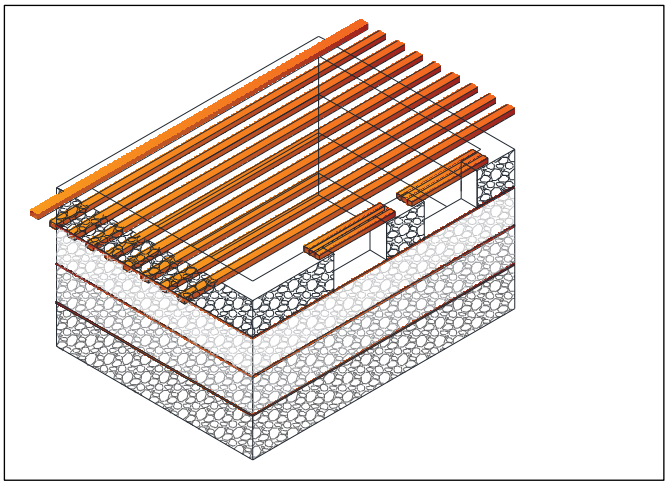


Figure.8. Step 6: Window Construction and Wall Elevation
Roof Construction and Finishing
The final step in the construction of a traditional Nuristani house is the roof structure, which is built once the walls and window openings have been completed.
At this stage, builders install a series of horizontal wooden beams, typically arranged in a square or grid-shaped framework. These structural wooden elements rest directly on the upper wall edges and act as the primary support system for the roof. The use of this wooden grid provides both strength and flexibility — crucial for withstanding seismic activity and heavy snow loads common in the Hindu Kush region. Once the wooden framework is in place:
A layer of thick wooden boards is laid across the beams to form the base of the roof. On top of these boards, a thick mud (earth) layer is applied. This mud acts as a natural insulator, providing protection against cold weather, rain, and sunlight. In some cases, natural insulating materials such as straw, reeds, or tree bark are mixed into the mud to improve its thermal performance and water resistance. The final result is a flat, earth-covered roof that blends seamlessly into the natural environment and supports the energy efficiency and durability of the house.

6. Results and Conclusion

This study clearfiy that, the traditional residential construction methods used in Nuristan Province reflect a highly adaptive and intelligent response to the region's geography, climate, and seismic vulnerability. Through a layered construction system that alternates between stone, wood, and mud, local builders have developed a housing typology that is:

- Structurally resilient — especially against horizontal seismic forces due to the strategic integration of wooden seismic buffer layers.
- Thermally efficient — with thick stone and mud walls and flat earth-covered roofs that offer natural insulation against cold winters.
- Materially sustainable — relying almost entirely on local, natural resources such as wood, stone, and earth, minimizing environmental impact and promoting ecological harmony.
- Culturally distinct — with visible wooden elements, locally sourced craftsmanship, and spatial layouts that reflect social, climatic, and environmental needs.

The step-by-step process, starting with a deep stone foundation and ending with an earthen roof, demonstrates a deep-rooted architectural wisdom passed down over generations. The variation in materials used — such as choosing stone or mud walls based on availability — reflects the flexibility and practicality of this construction tradition.

In conclusion, Nuristani traditional houses serve not only as shelter but also as a living example of vernacular architecture, balancing form, function, and environment. As modern construction continues to spread across Afghanistan, it is essential to document, preserve, and potentially integrate these traditional techniques into contemporary rural development, particularly for regions with similar geographical and seismic conditions.

Funding: This research received no external funding.

Conflicts of Interest: The authors declare no conflict of interest.

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