TIMBER AS A VERNACULAR MATERIAL

SUBMITTED TO:

AR. JYOTHI KUMARI
AR. PRIYANKA REWATKAR

LOKMANYA TILAK INSTITUTE OF ARCHITECTURE AND DESIGN STUDIES, NAVI MIMBAI

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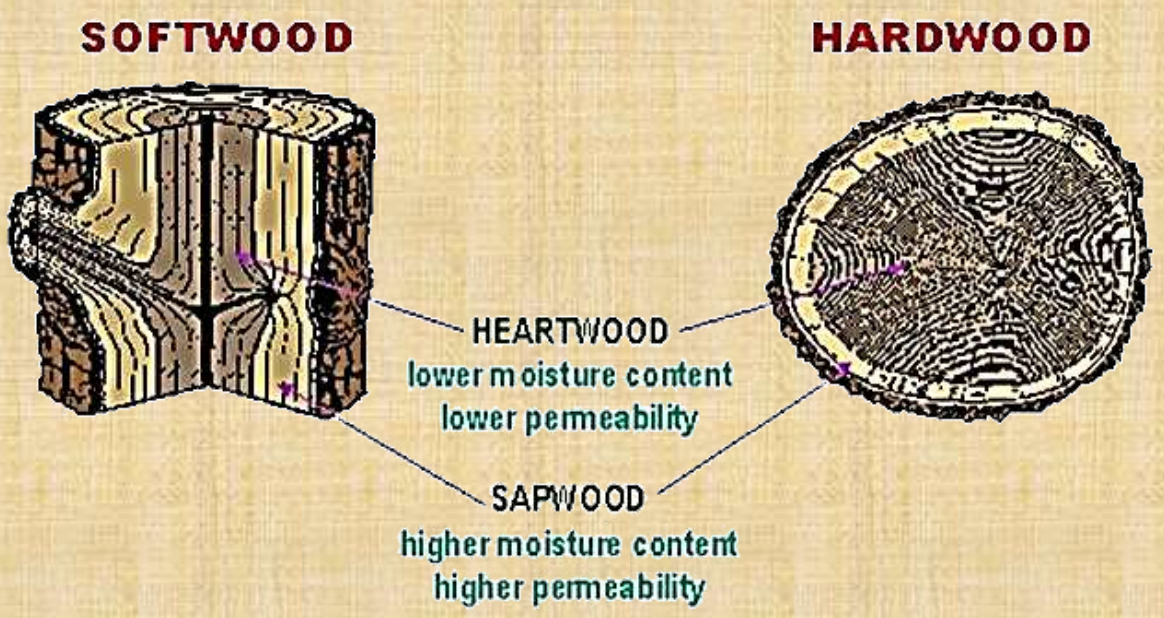
INTRODUCTION

Derived from an old english word “timbrian” which means to build.

The timber thus denotes wood which is suitable for building or carpentry of various other engineering purposes

Applied to the trees measuring not less than 600mm in circumference of the trunk.



Softwood

- Conifers
- Needle like leaves
- Evergreen
- Wide sapwood band
- Usually softer
- Usually lighter when dried

Hardwood

- Deciduous
- Broad leaves
- Shed leaves each season
- Narrower sapwood band
- Usually harder
- Usually stronger

PROPERTIES

Strength	• Strong enough to with stand the loads • Enough strength in direct compression and transverse direction.
Durability	• Resisting the various actions due to fungi, insects, chemicals, physical and mechanical agencies.
Weather	• Alternate dry and wetting • Alternate heating and cooling ,variations, wind effects.
Elasticity	• Capable to regain its original shape when load causing deformation is removed.
Workability	• Should not clog the teeth of saw.
Toughness & abrasion	• Resistance to shocks due to vibration
Sufficient weight	• Uniform, hard and compact.
Hardness	• Free from defects, sweet smell, good sound when struck, etc.

ADVANTAGES

- Natural material
- Readily available.
- Low production energy.
- Quicker and economical construction.
- No thermal expansion.
- Sound absorption.
- High strength.
- Easy workability.
- Easy maintenance and replacement.
- Good in insulation.
- Availability of various varieties of woods.

DISADVANTAGES

- Cannot be used in construction of longer spans.
- Shrinkage and swelling of wood.
- Biotic and abiotic deterioration of wood.
- Irregular properties and grain varieties
- Stronger in some places than others.
- Highly combustible.

SEASONIN G

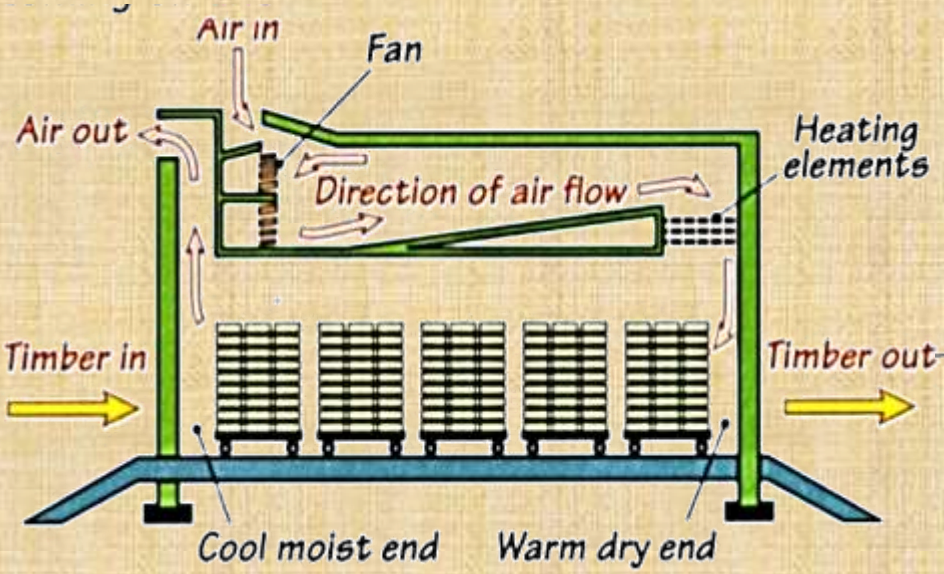
Seasoning is the controlled process of reducing the moisture content (MC) of the timber so that it is suitable for the environment and intended use.

We need to reduce the of timber for the following reasons:

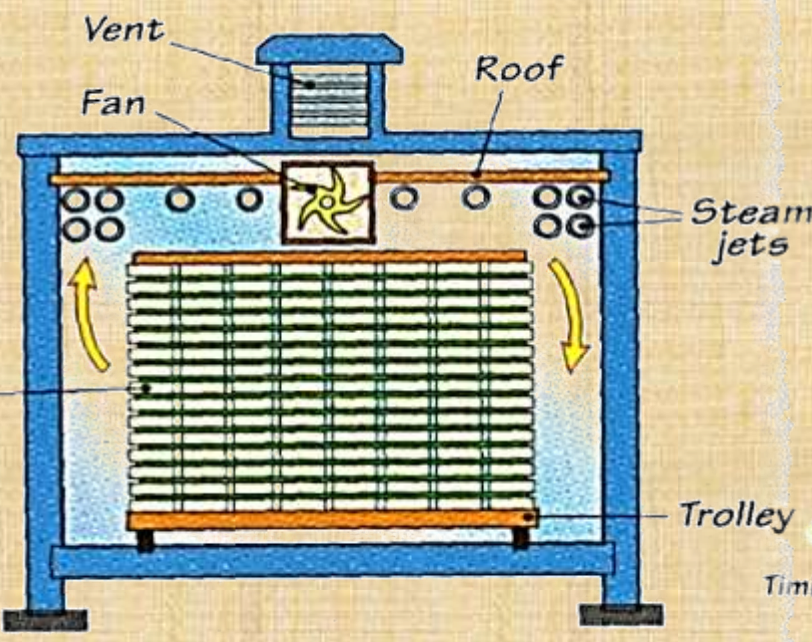
- Stronger and momcre reliable.
- The sap in timber is a food for fungi and wood parasites.
- For construction grade timber the timber must be below 20% mc
- Dry and well seasoned timber is stronger, is easier to work with and consequently safer especially for machine working.
- Timber with higher moisture content is difficult to finish i.E. Paint, varnish, etc

SEASONING

KILN SEASONING

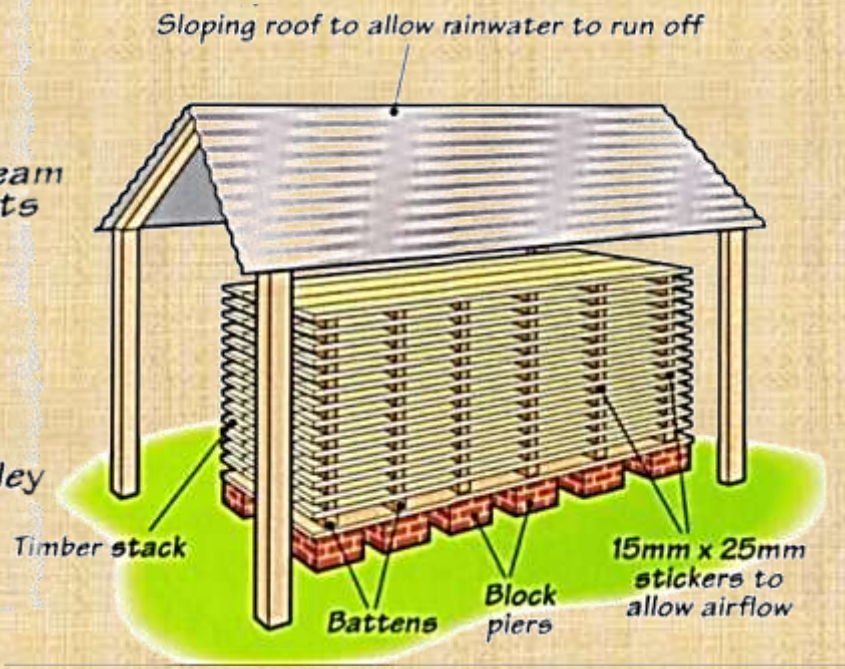


Progressive.



Compartmental,

AIR SEASONING



PRESERVATION

It is the process of protecting or preserving the timber structures from the attack of destroying agencies such as moisture, dry-rot, internal decay, fungi, insests, etc. preservation also ensures increased life of timber and better durability.

TYPES OF PRESERVATIVES

Oil preservatives:

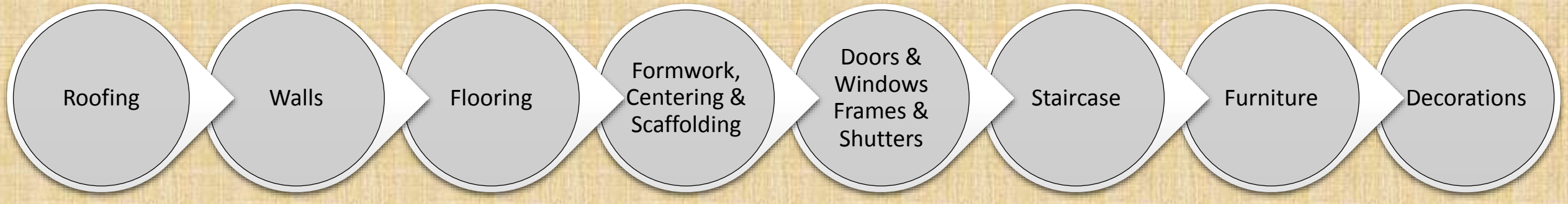
- Employed for outdoor & wet exposure conditions.
- Posses high toxicity & non-corrosive quality
- But they offer painting difficulties.
- Adopted for posts, poles, piles, etc.

Water soluble preservatives:

- Commonly done in interior wood work since they are washed away by rain water.
- Colorless, odorless, and involve very little fire hazard.

METHODS OF PRESERVATION

USES OF TIMBER IN CONSTRUCTION



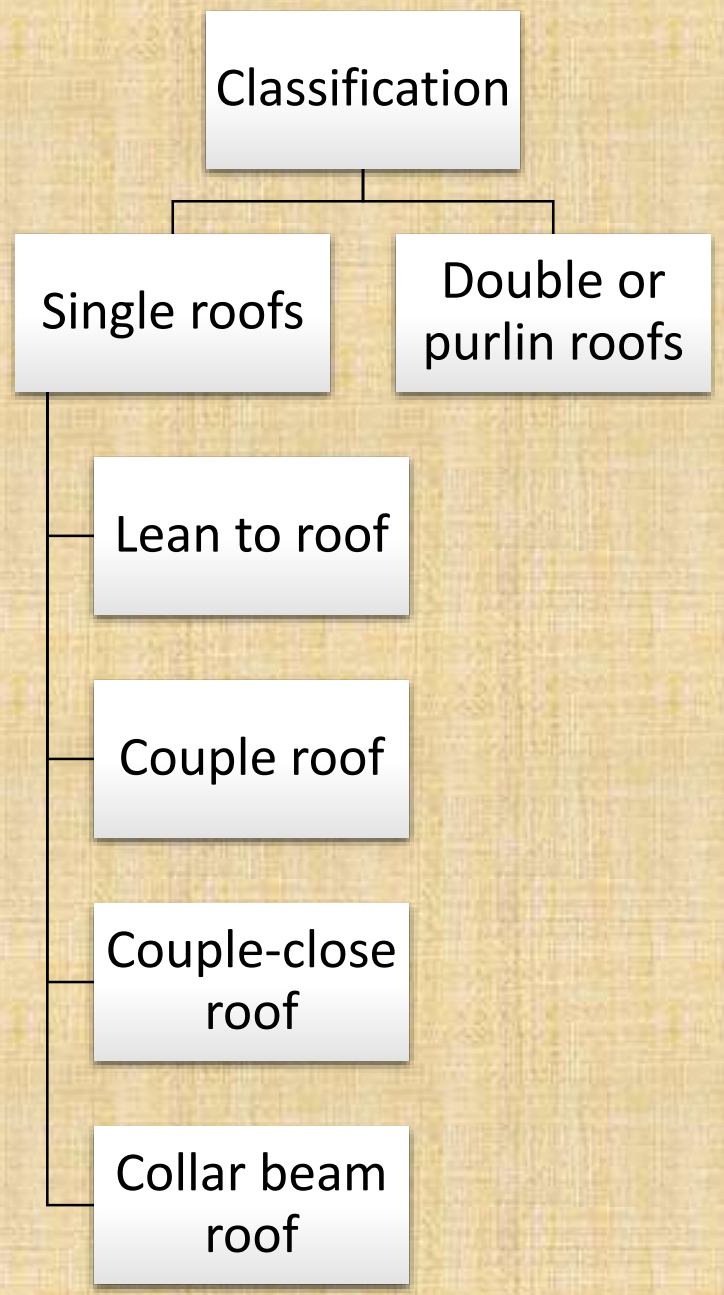
ROOFING

Timber is used in Making Pitched roofs or Sloping roofs.

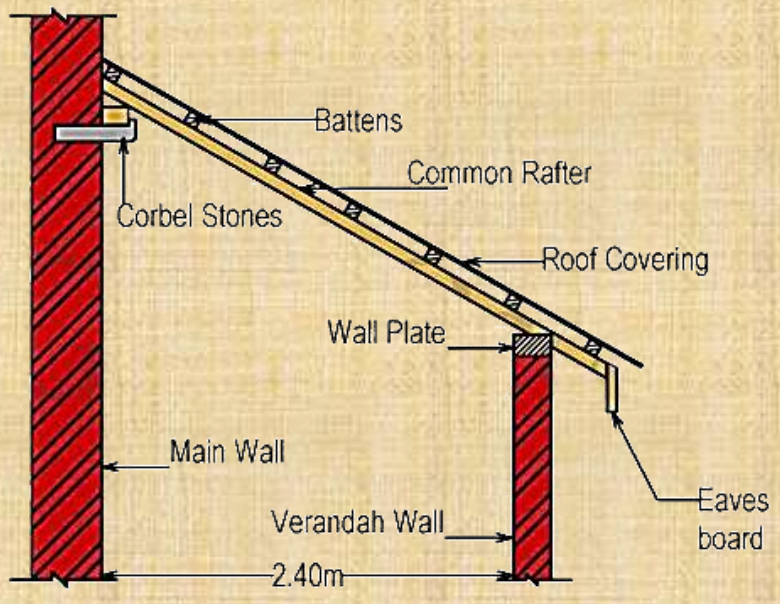
Decks or surfaces with considerable slope for covering the building structure.

Lighter then flat roofs and constructed either in wood and steel.

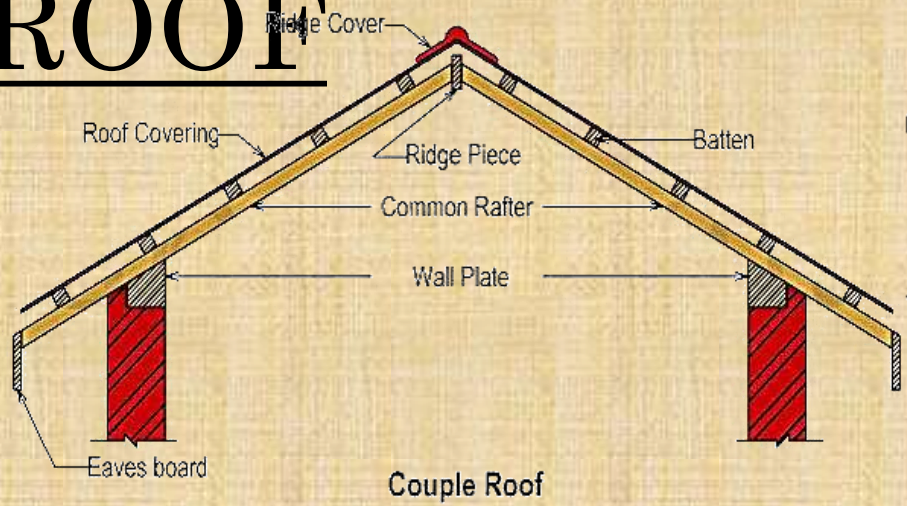
Suited in regions of heavy rainfall and snowfall.

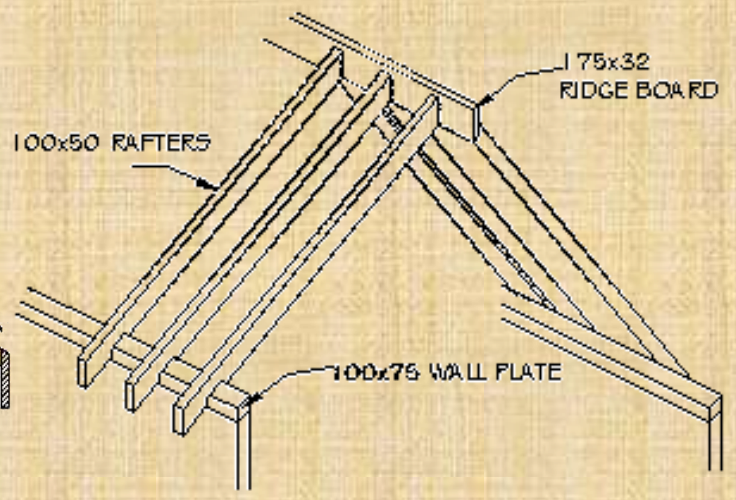


SINGLE ROOF

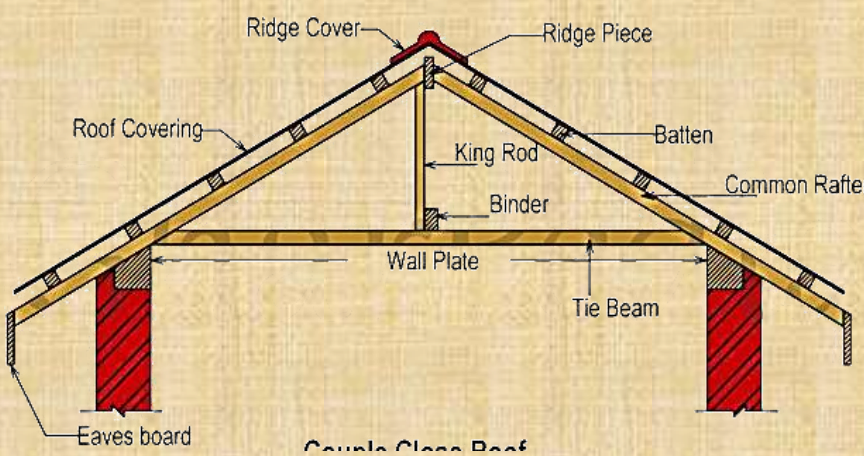


LEAN-TO-ROOF

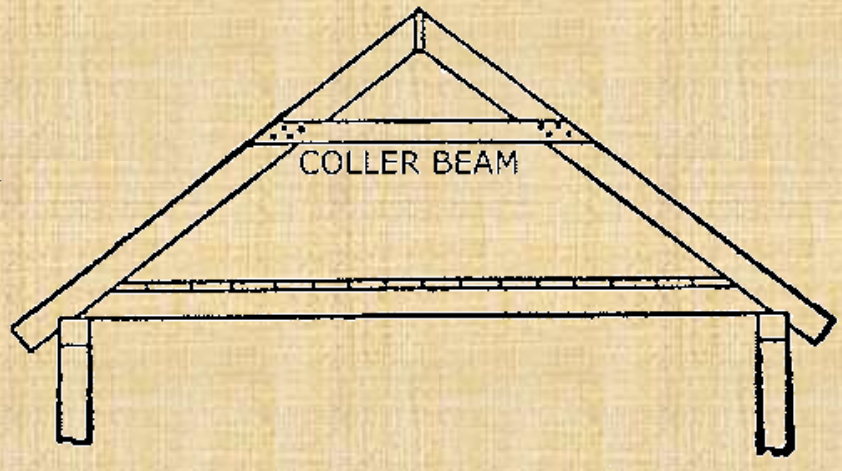




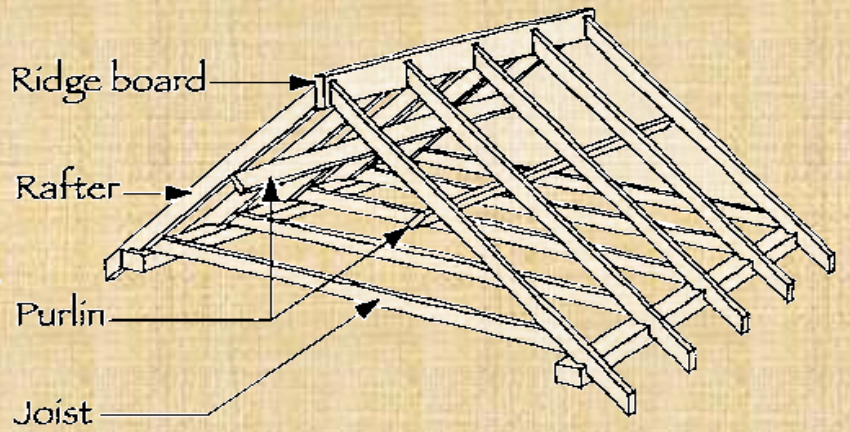
COUPLE ROOF



COUPLE-CLOSE ROOF

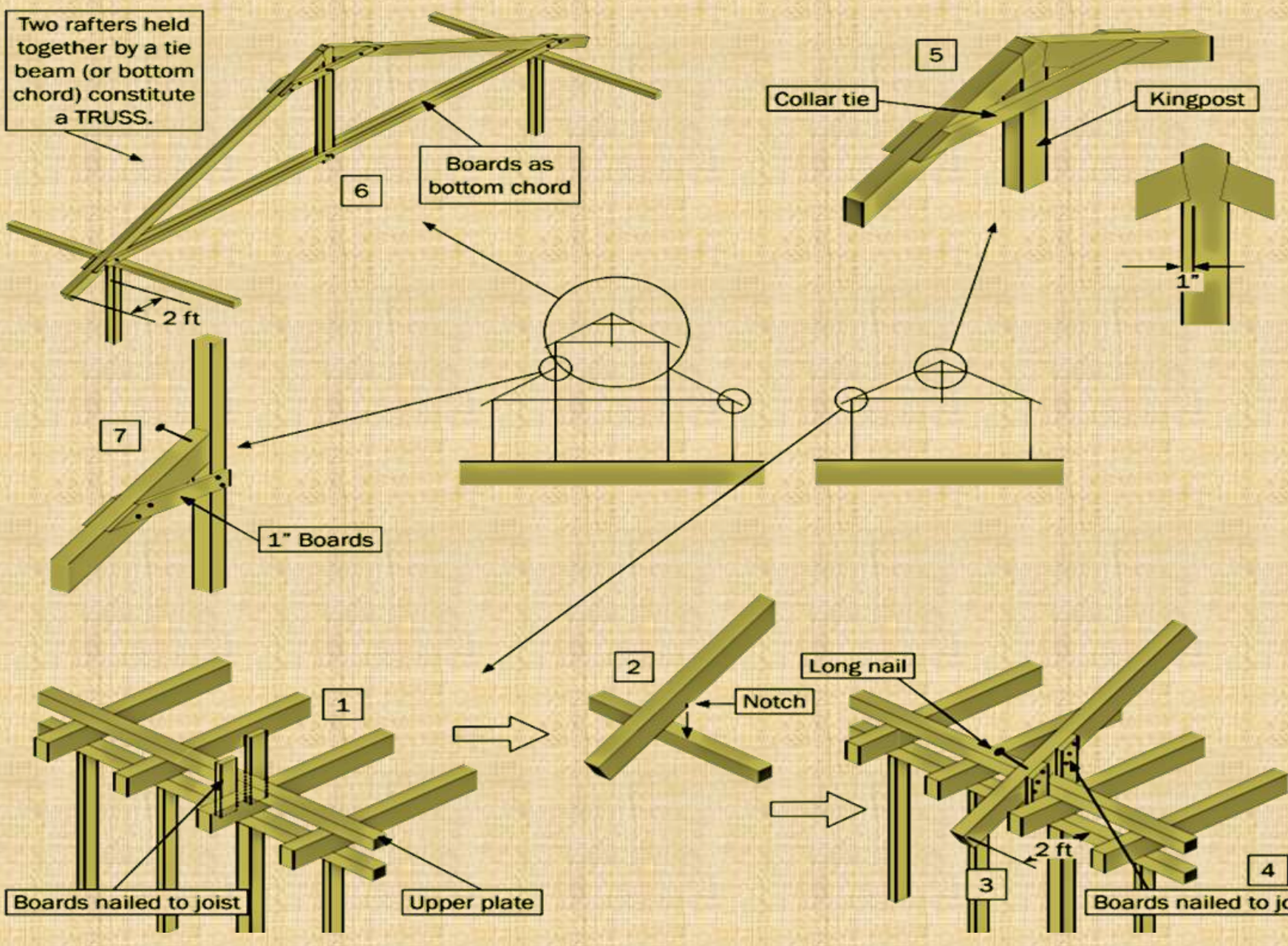


COLLAR BEAM ROOF



DOUBLE PURLIN ROOF

DHAJJI CONSTRUCTION- ROOF

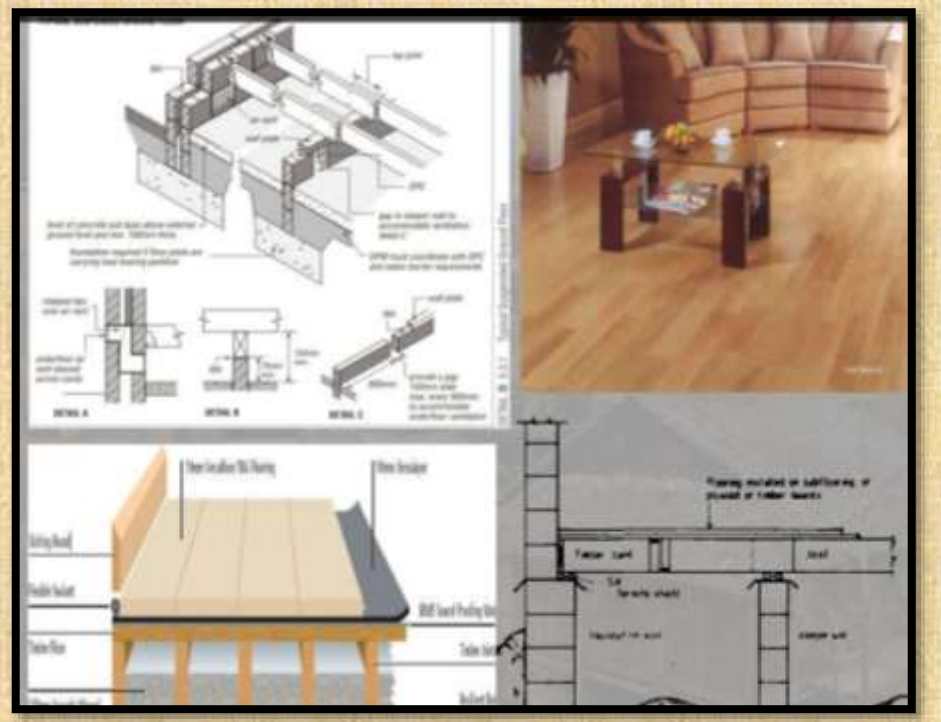


1. Where rafters are to be fixed on the upper plate, start with nailing short vertical boards against the joists on both sides of the upper plate.
2. Place the rafter (with a notch) and nail it down with a long nail (length = thickness of rafter plus 3 to 4 inches).
3. Let the rafters protrude 2 ft from the wall. In high wind areas, this distance may be reduced to 18".
4. Then nail the vertical boards against the rafter. These vertical boards ensure a stiff connection between the rafter and the joist.
5. Assemble the rafters at the top by using a kingpost and collar ties (1-2" boards).
6. Trusses can also be made by nailing long boards to both sides of the rafters and the kingpost.
7. To fix rafters agains posts, use a long nail and secure the connection with boards nailed on both sides.
8. Never nail rafters against the head of joists. Such a connection is very weak.

TIMBER FLOORING

Types

- Single joist timber beam.
- Double joist timber beam.
- Frame triple joist timber beam.



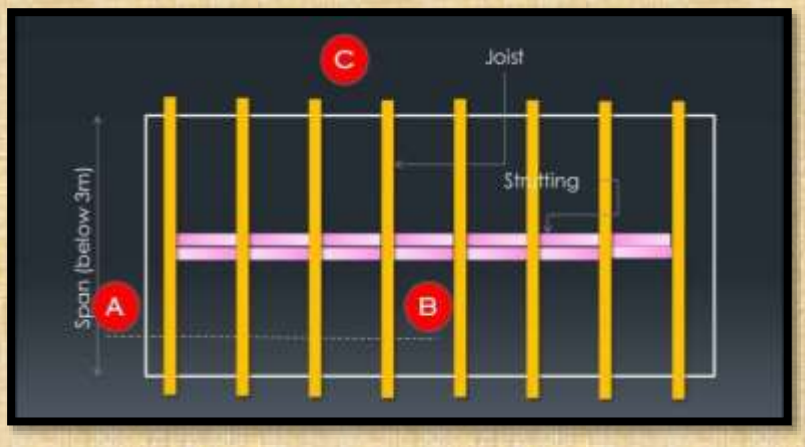
Floors are used to give lateral restraint to walls, and where the joists run parallel to the wall.

Normally straps need to be positioned every 2m along the wall, but up to 3m is acceptable where this is to allow the formation of a stairwell or similar opening in the floor.

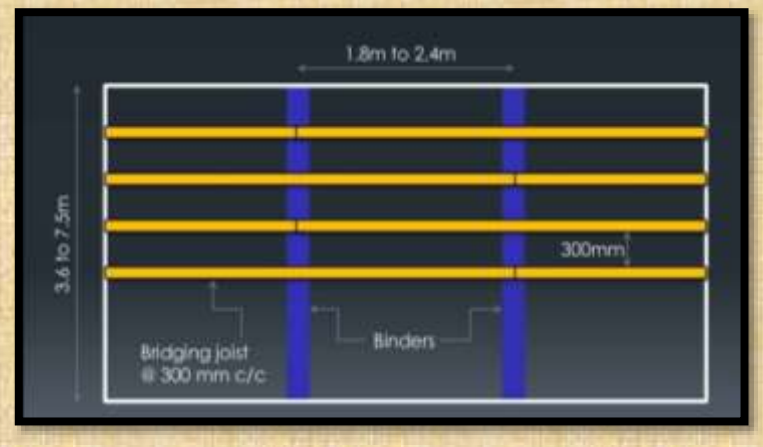
Around stairwells and similar openings it is often necessary to use trimmer beams to support the ends of joists.

Where joists support a partition wall or under baths they usually need to be 'doubled up' to support the increased localized loading.

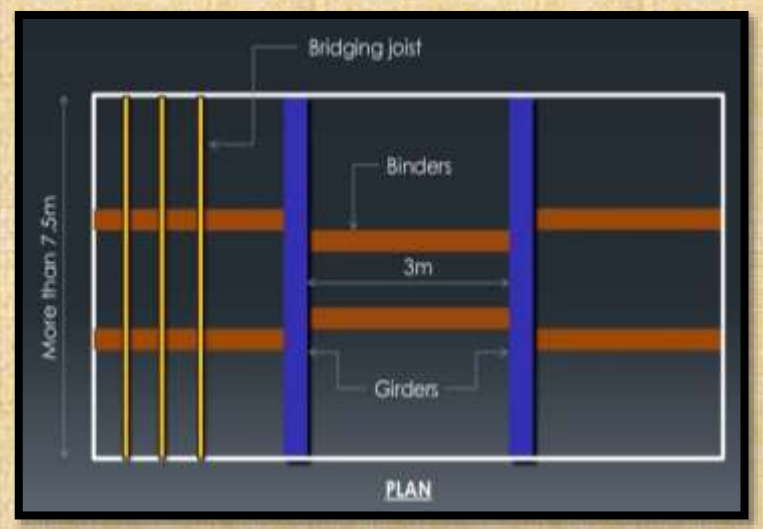
Single joist timber beam



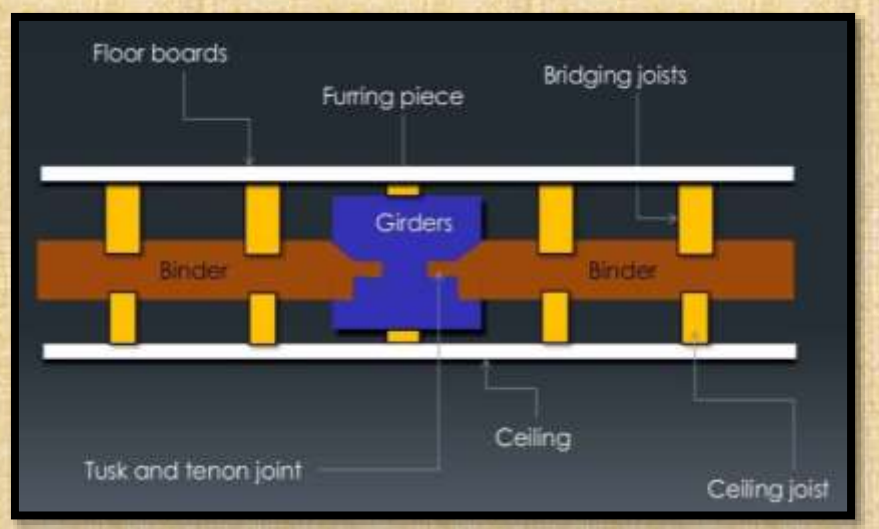
Double joist timber beam.



Frame triple joist timber beam.



Plan



Section

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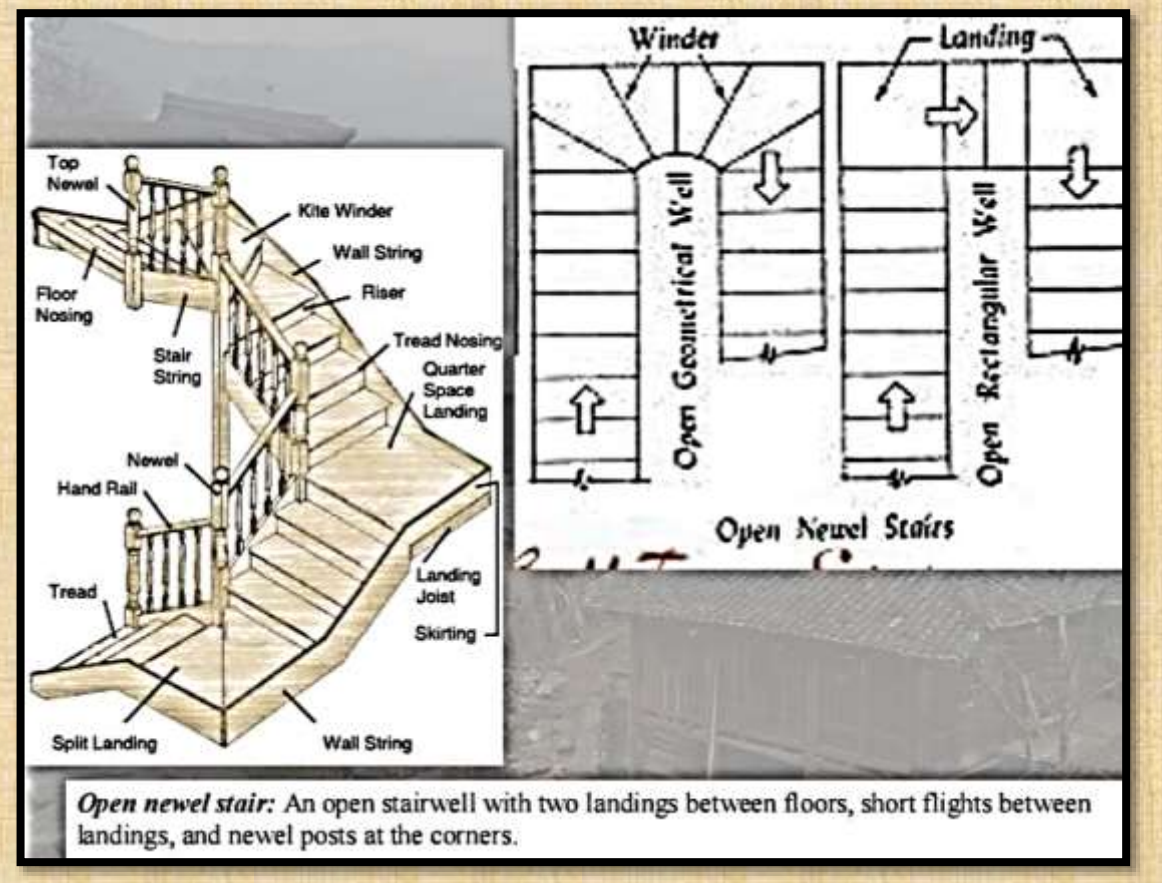
TIMBER FRAMING

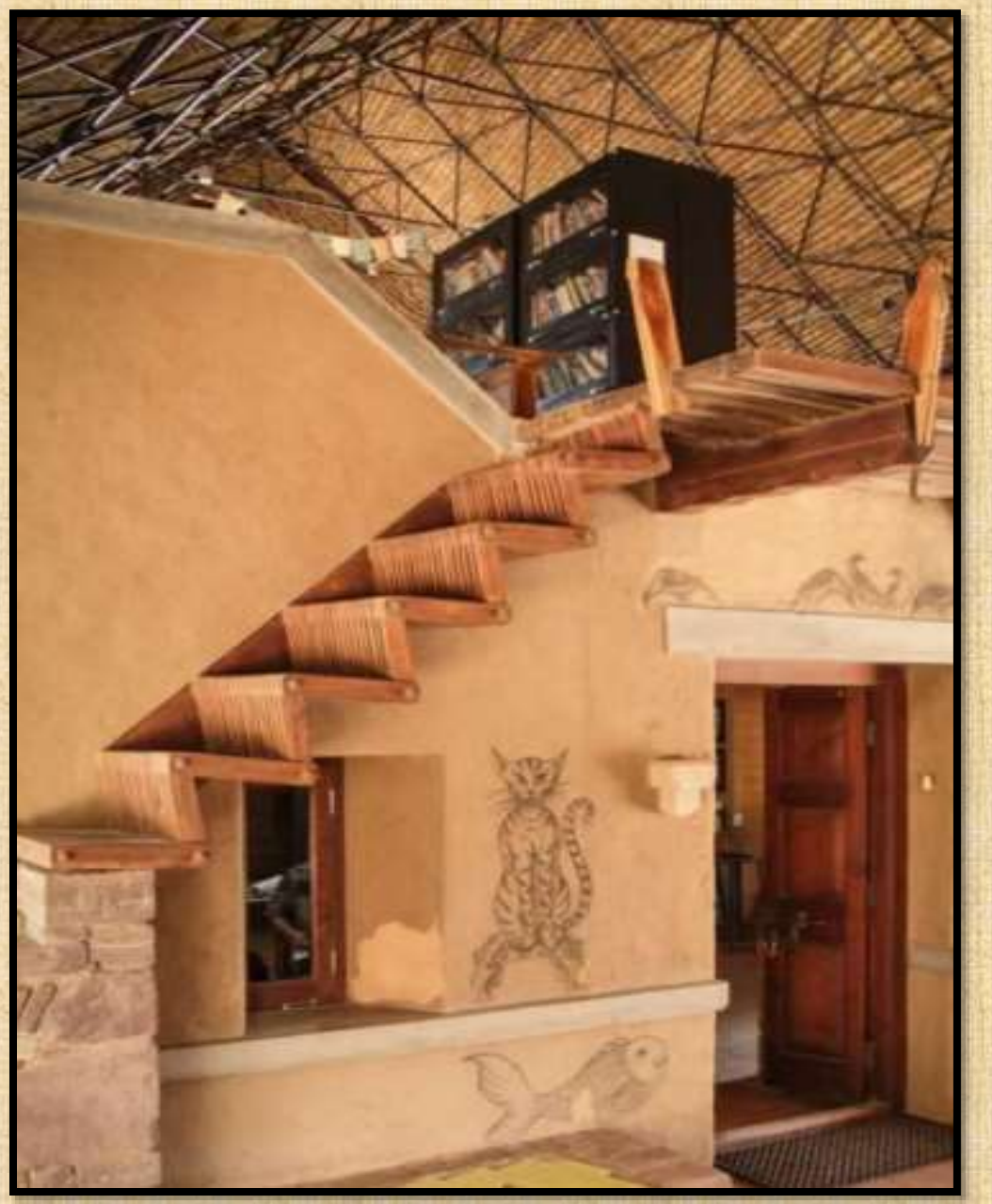
- Simplest, most economical, adaptable and environmentally friendly methods of building available.
- Method of creating framed structures of heavy timber jointed together with various joints
- Most commonly originally via lap jointing, and then later pegged mortise and tenon joints.
- Framing construction is a building technique based around structural members, usually called studs
- Provide a stable frame to which interior and exterior wall.
- Coverings are attached, and covered by a roof comprising horizontal ceiling joists and sloping rafters (together forming a truss structure)
- All of which are covered by various sheathing materials - to give weather resistance.

TIMBER STAIRCASE

- Constructed using solid timber stringers as support for the treads and risers.
- The treads are housed in rebates in the stringer and held in place by wedges and glue blocks.
- A stringer that closes off the ends of the treads and risers is a closed stringer.
- If the stair is built between walls the stringer may be called a wall stringer.
- In this case the stringer is attached to the wall and transfers the stair load directly to the wall.
- Stringers may be sized for the horizontal span using the joist
- The stringers are routed out to a minimum rebate depth of 13 mm.



Open newel stair: An open stairwell with two landings between floors, short flights between landings, and newel posts at the corners.



Timber staircase in Thannal hand sculpted cottage in Bangalore.

Wooden members are stuck together to form risers and treads.

They are interlocked with holes on both ends.

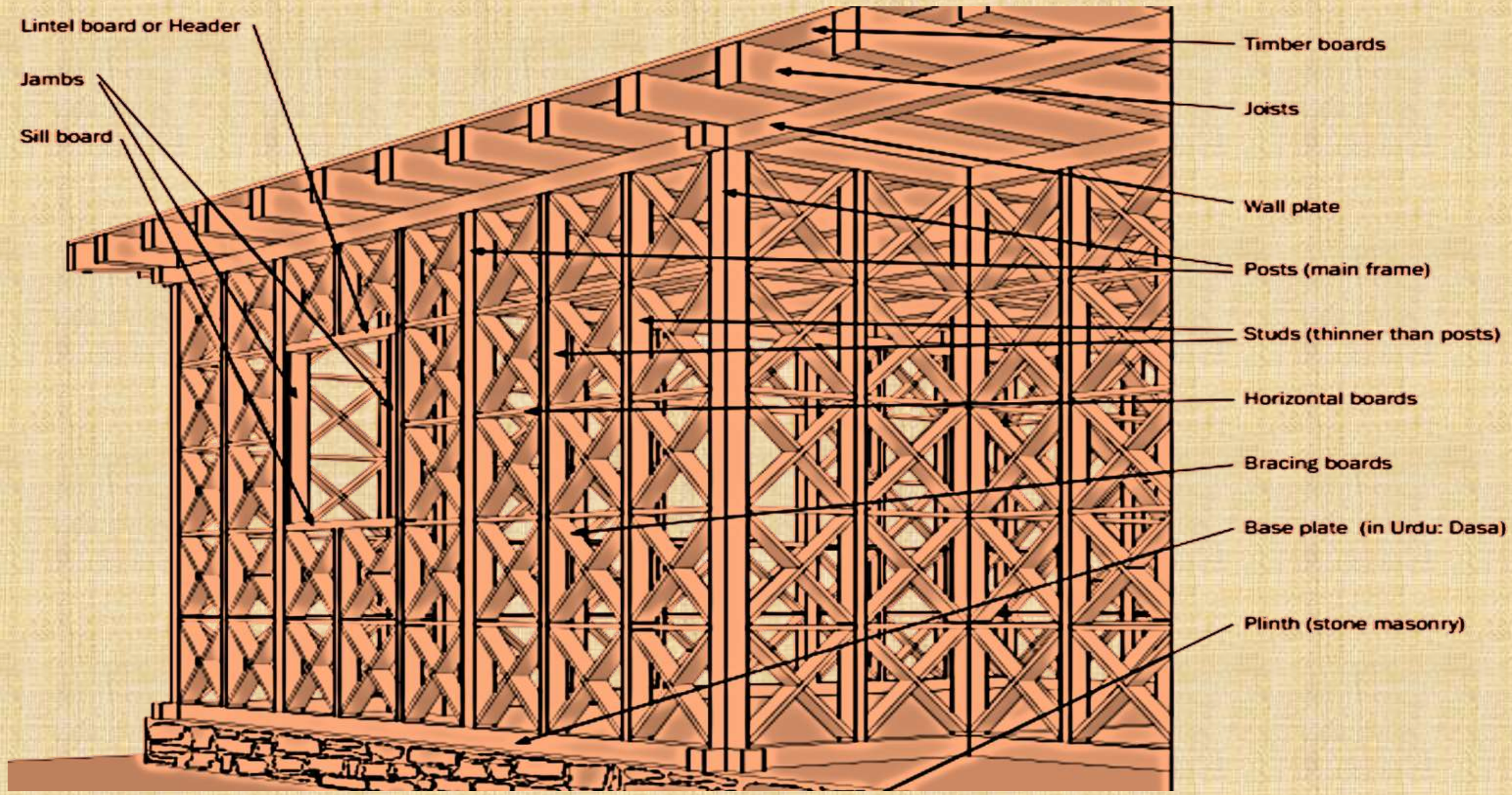
TIMBER WALLS

DHAJJI WALL CONSTRUCTION

In certain regions the construction system constitutes the erection of a timber frame work of uprights, beams and braces with dressed stone blocks as an in-fill material without any cementing material.

- Main posts should be 4 to 6 feet apart.
- With this spacing ,the main posts must be 4”x 4”
- With no main posts (except the corners), the vertical boards can be 2”x 4”.
- But they must be maximum 2 ft Apart.

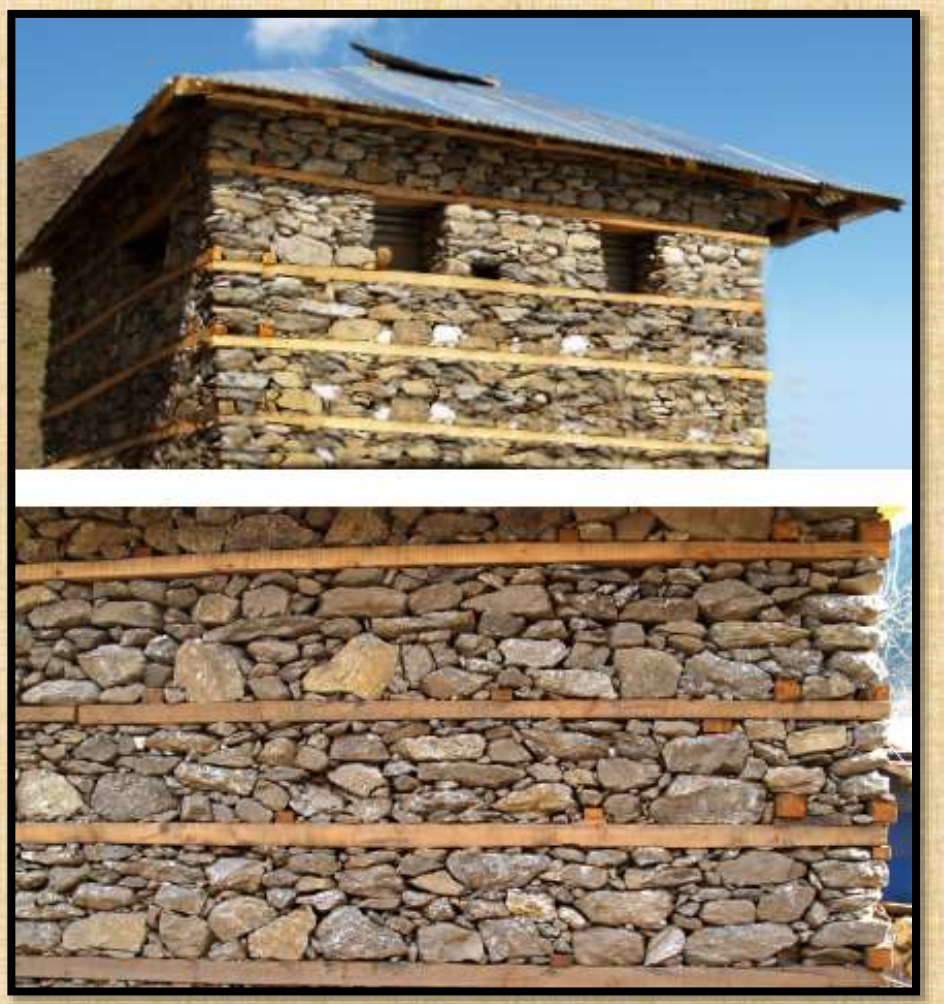
DHAJJI WALL CONSTRUCTION DETAILS AND ELEMENTS

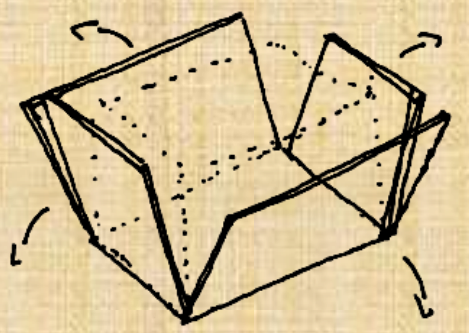


TIMBER WALLS

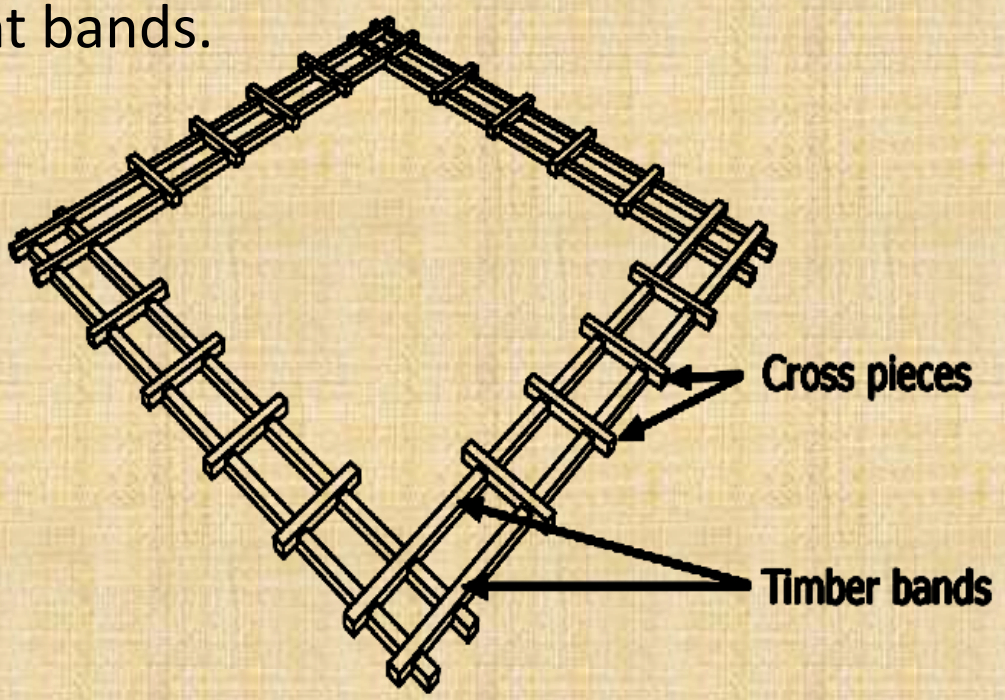
BHATAR WALL

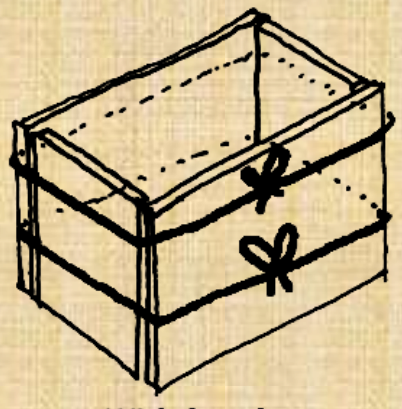
Bhatar is a dry stone masonry structure reinforced with horizontal timber reinforcement bands.





Without bands:
Wall falls appart





With bands:
Wall is held tightly

Timber bands (with cross pieces) act as seismic bands which prevent the walls from falling apart in an earthquake.

Contemporary Bhatar construction Tarand – NWFP Pakistan

Timber Bands **every 2 feet**.

Wall thickness 18 inches.

Foundation 2 & 1/2 feet.

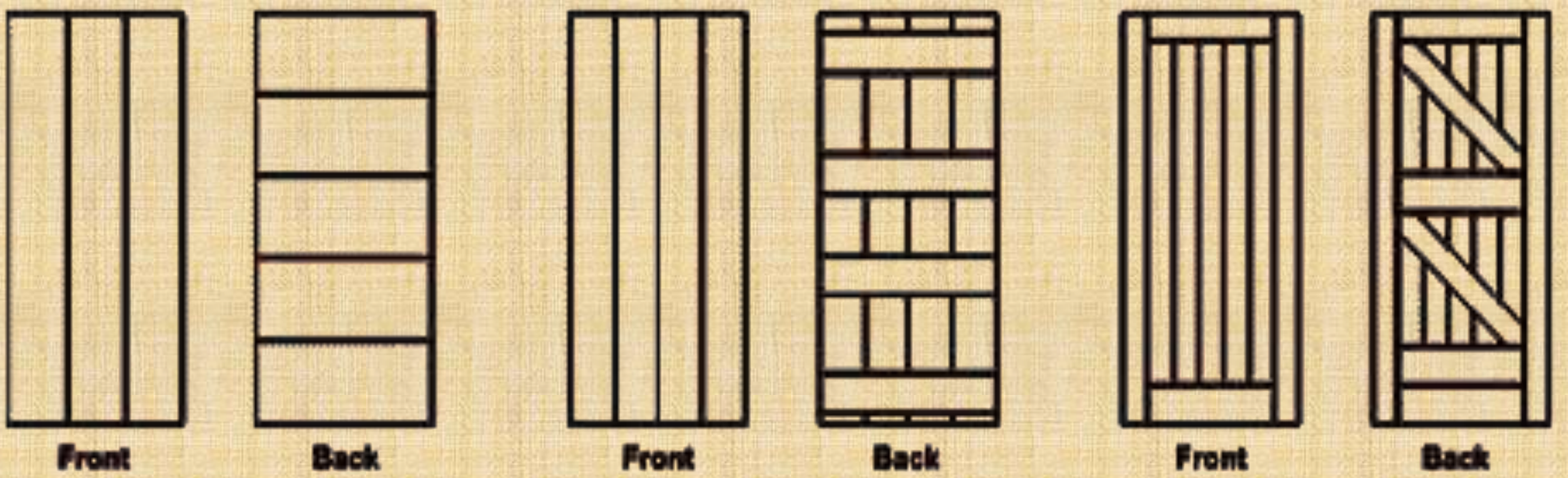
Room size is maximum **12 x 12 feet**.

TAQ CONSTRUCTION

- In this system of construction 2-3 ft. thick brick masonry piers supporting wooden floor beams formed the basic structural system of the building.
- The distance between two brick piers used to be normally around 3-4 ft and was known as a taq.
- The gap in between each taq would be filled in with either a window opening or brick masonry.
- The roof comprised a layer of earth covering over birch bark and wooden planks resting on wooden rafters.

An historic house of Taq construction still extant in Srinagar, Kashmir, India.

TIMBER DOORS AND WINDOWS



DOUBLE PLANK

BATTEN AND PLANK

LEDGED AND BRACED

DOORS

Timber compound gate in Punjab
Made of wooden planks

Heavily intricated door in bangalore

Wooden door with iron battens in tamilNadu. Built with monolithic timber member

WINDOWS

OPENINGS COVERED WITH TIMBER PANELS

Windows in dhajji wall construction in Himachal Pradesh

Fixed timber window in Ahmedabad made by interlocking wooden members and inlaying with coloured tiles

BASIC JOINTS FOR TIMBER

BASIC JOINTS

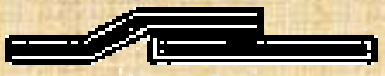
Timber joints are designed to allow lengths of timber to be connected in a variety of shapes and forms using the simplest, strongest most efficient means.

When choosing a joint for a particular job, the following must be considered:

- Performance
- Economy
- Practicability.

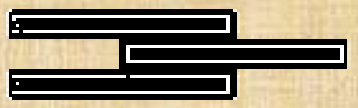
Basic Construction Joints

Bevelled lap



Joggle lap

Single lap



Double lap

Double butt lap

Overlap Joints

Joints are strong and simple and can be used for general purpose jobs.

The joints may be nailed, screwed or bolted

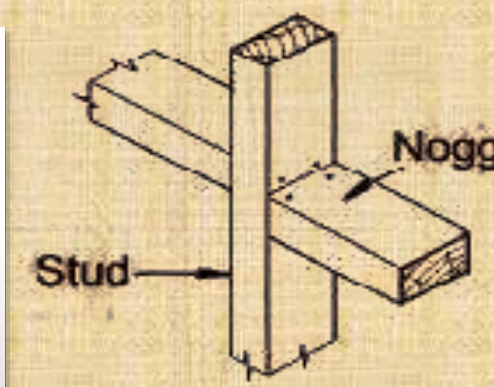
Mainly designed for use where appearance is not critical.

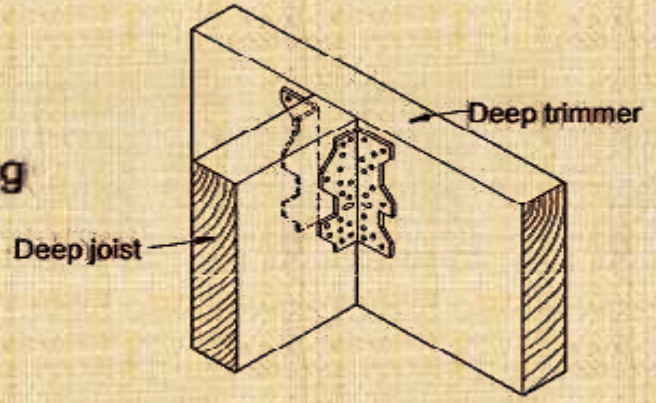
Once the joint is chosen it must be marked, accurately cut and assembled using a suitable fastening system

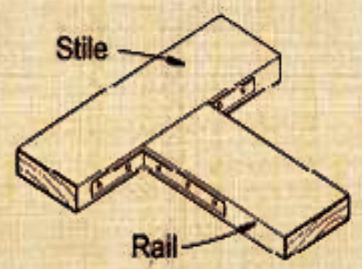
BUTT JOINT

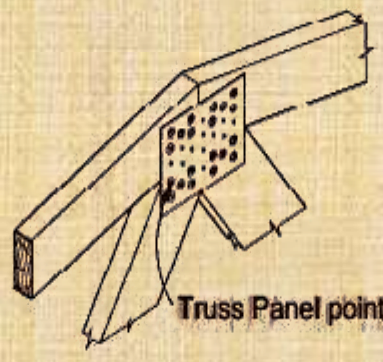
This is the simplest joint

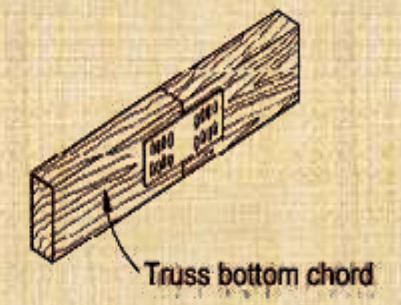
Held together with nails, screws, wriggle nails, nail plates, 'Gang nail' plates, angle brackets or patent type connectors.

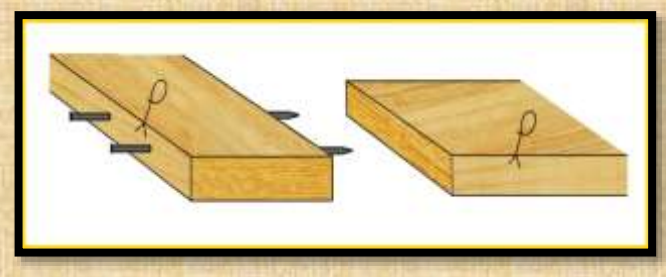


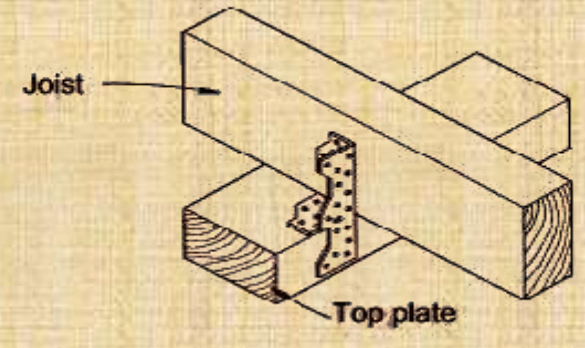


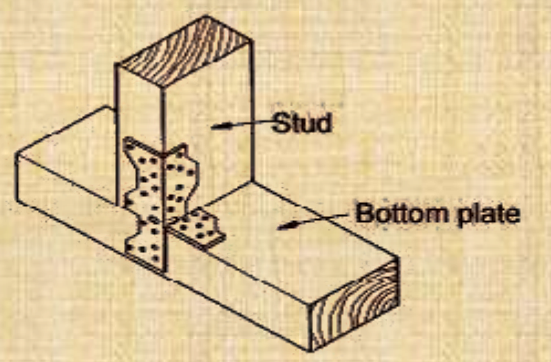


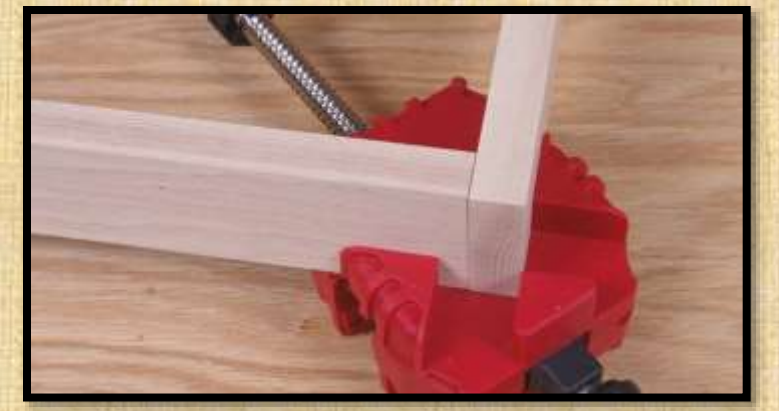












HALVING JOINTS

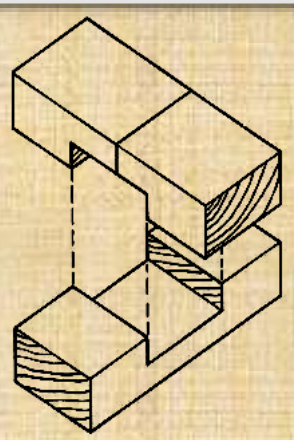
Comonly used in wall frame construction

Cross halving's may be used where internal walls intersect at a common position,

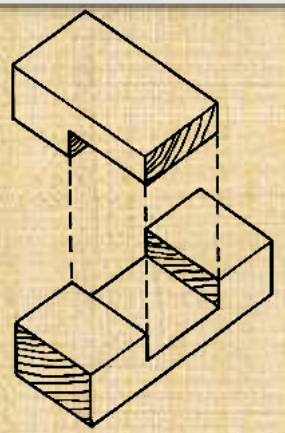
Tee halving's may be used where an internal wall connects to an external wall,

Corner halving's may be used where internal or external walls connect at an internal or external corner

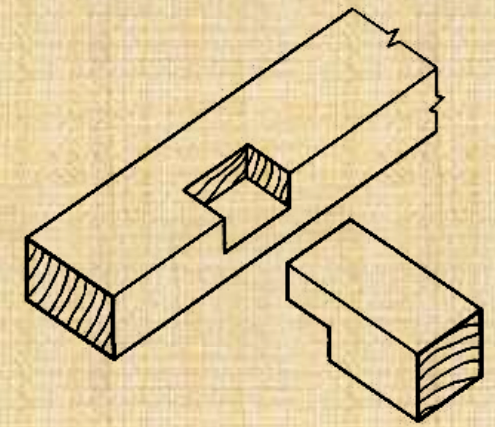
Stopped housings may also be used to connect wall plates at ‘T’ intersection



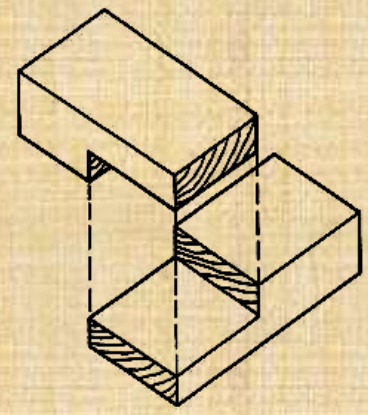
CROSS HALVING JOINT



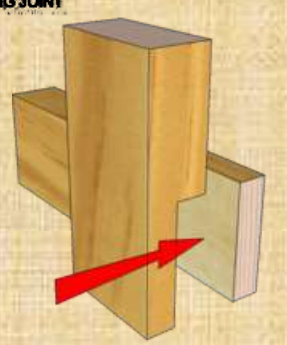
TEE HALVING JOINT

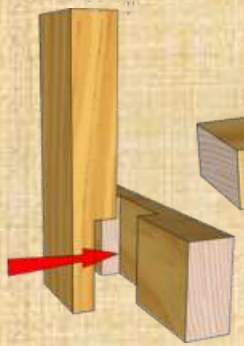


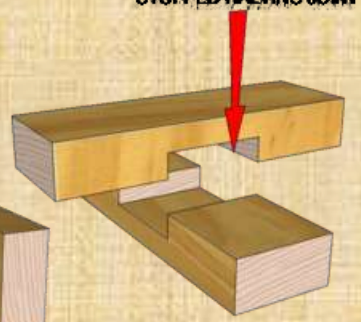
STOPPED HALVING JOINT

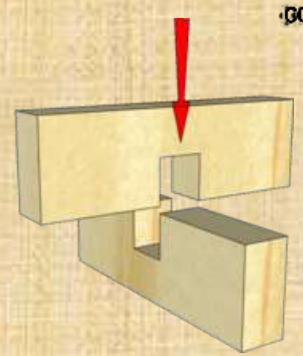


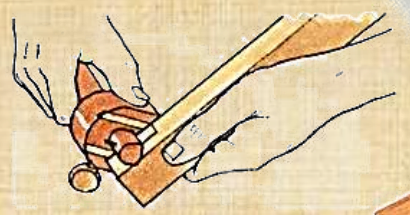
CORNER HALVING JOINT

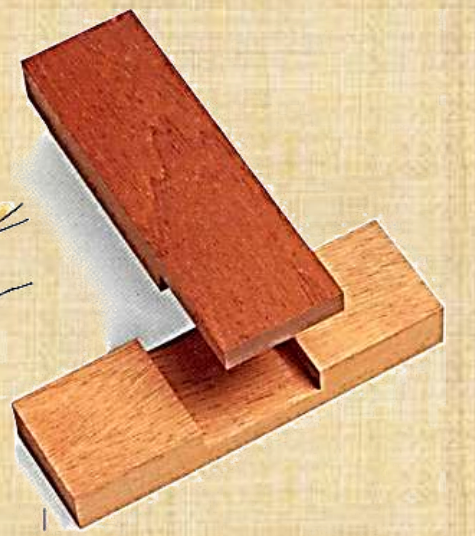


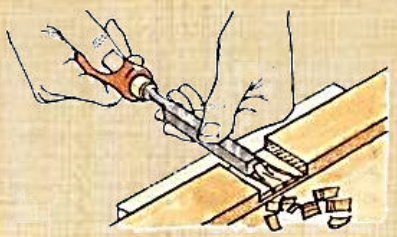












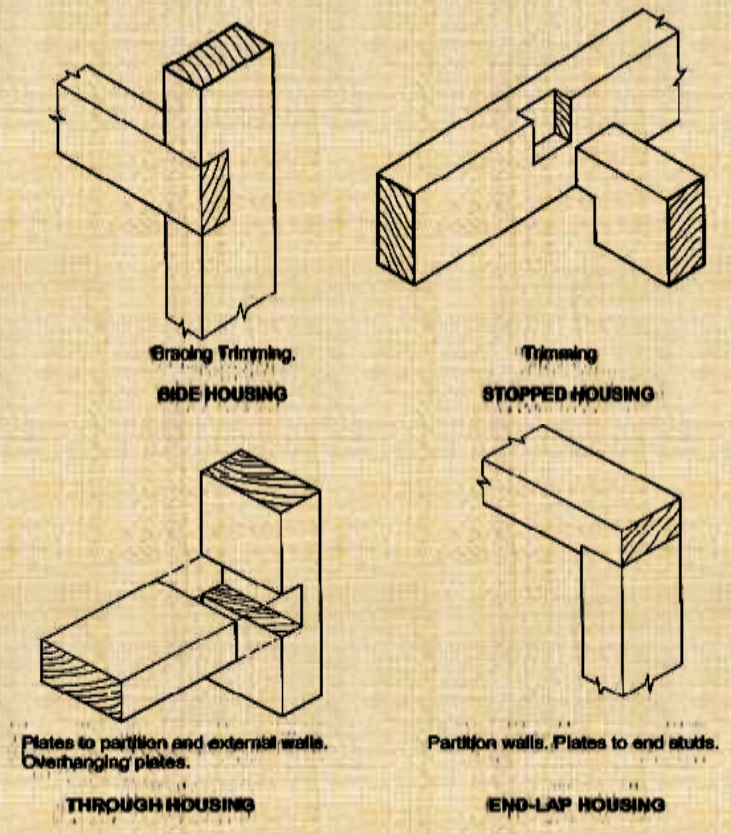
HOUSING JOINTS

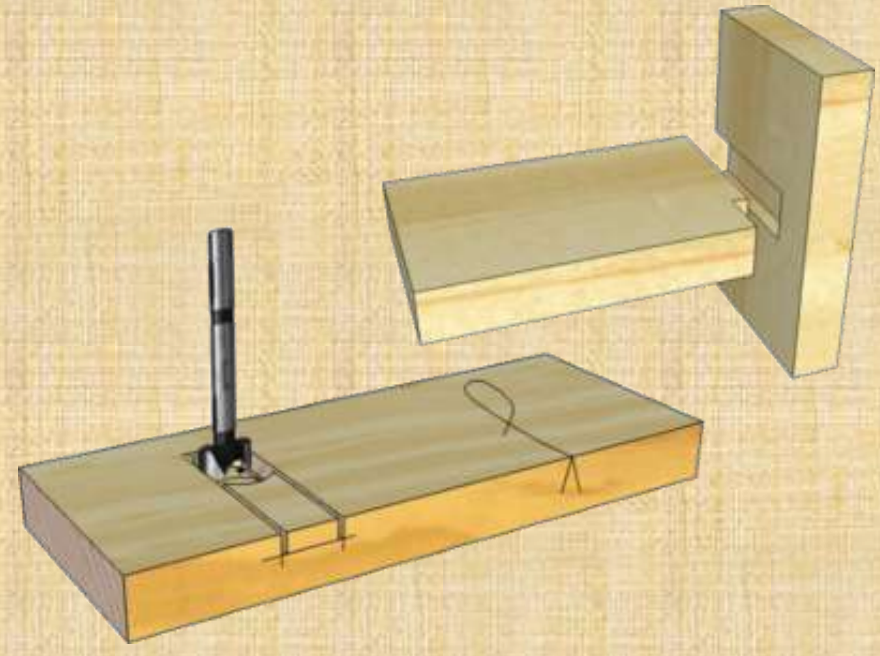
Mainly to connect studs to wall plates or sill and head trimmers to door or window studs,

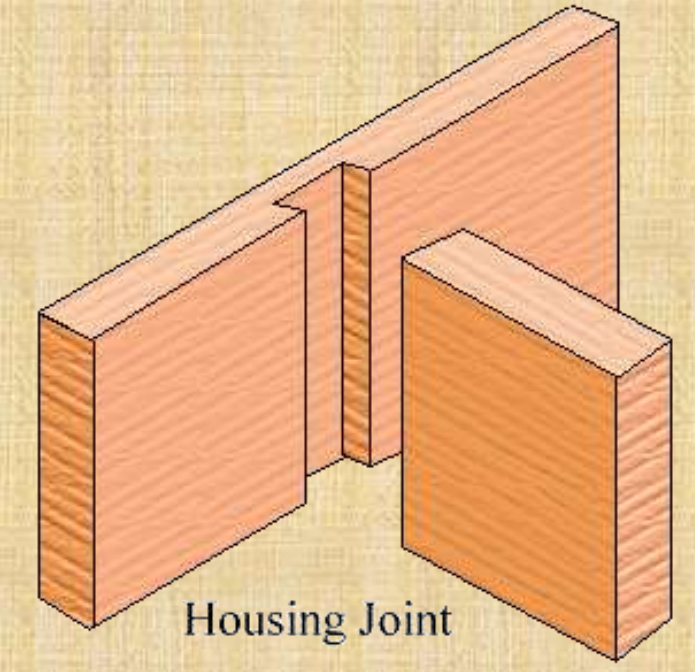
End lap housing used to connect a stud to wall plates at the end of a wall,

Side housing used to connect trimming or braces to the face of a wall frame.

The stopped housing used to connect floor trimmers to the sides of joists around an opening, fireplace, etc.



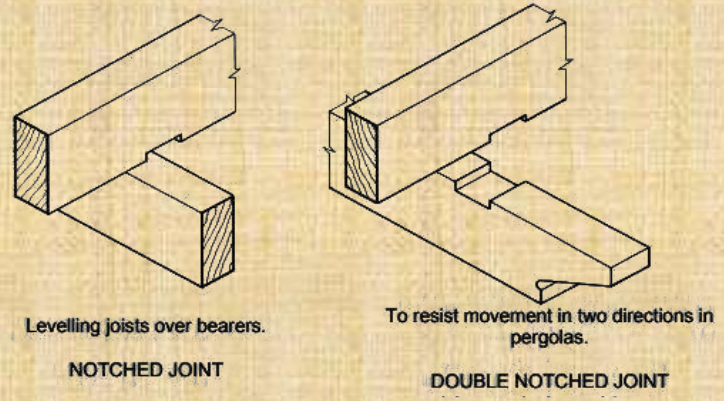


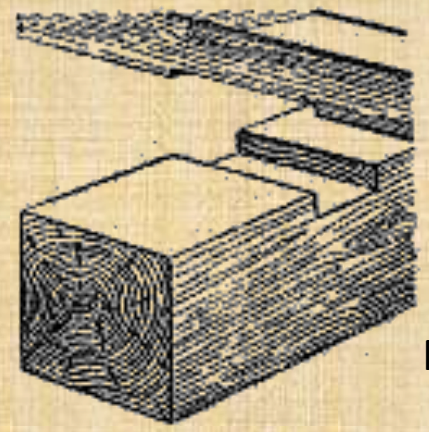


NOTCHED, COGGED AND CHECKED JOINTS

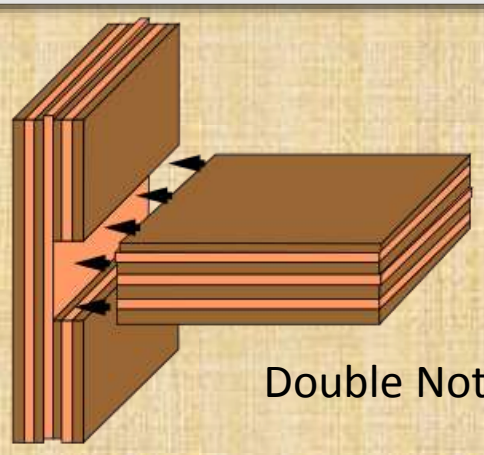
Notched joint may be used to create a level top surface to a floor by checking out the bottom edge of rough sawn joists to fit over bearers, double notched joint

The cogged joint may be used to connect rafters to beams of pergolas or open frame structures to prevent the members twisting, and the checked joint may be used where wall framing jack or soldier studs are to be checked around the lintel of a window or door opening.

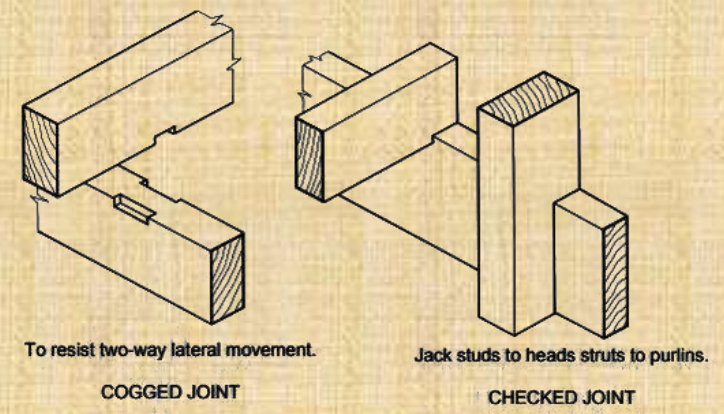




Notched Joint



Double Notched Joint



Cogged Joint

Checked Joint

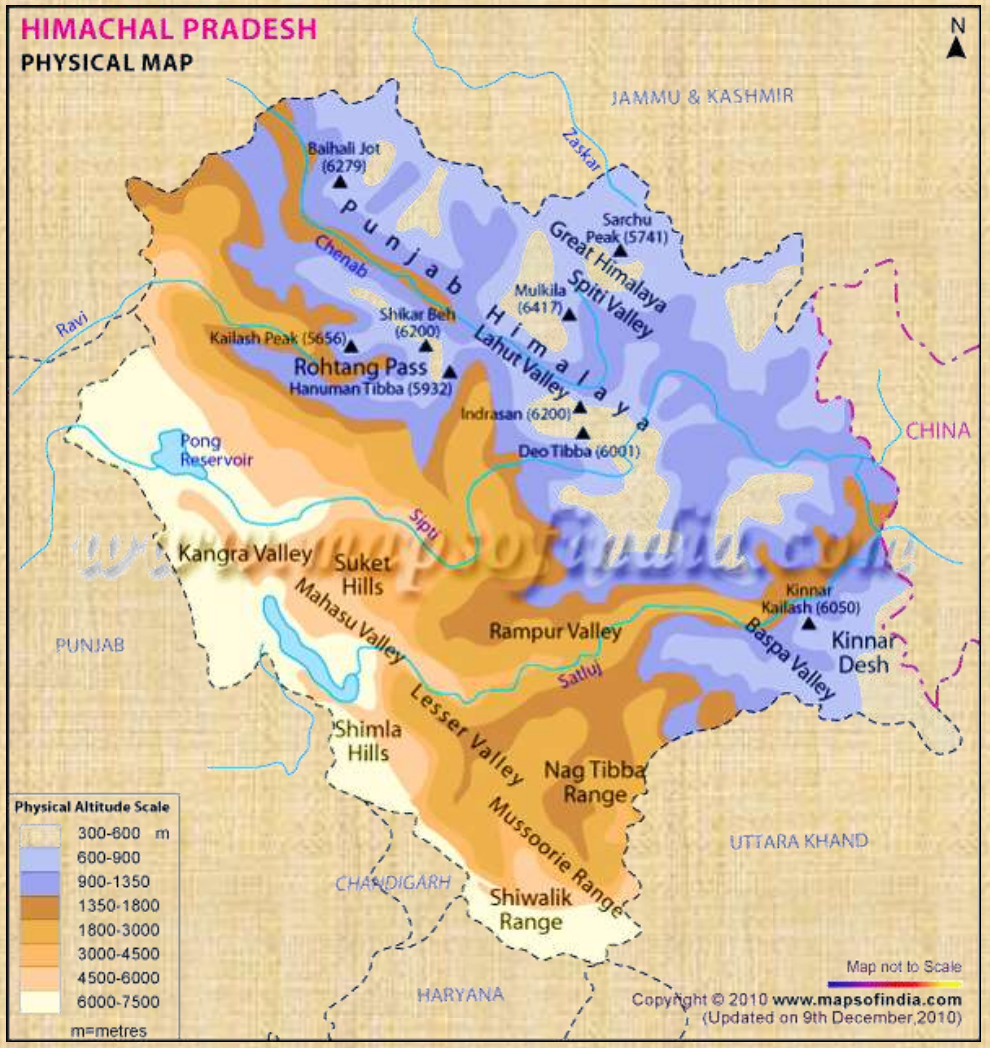
THE HIMALAYAN VERNACULAR: KATH-KHUNI ARCHITECTURE

The state of Himachal Pradesh varies in elevation from 450 meters to 6500 meters above mean sea level.

The region extends from the Shivalik range to the Great Himalayas.

Despite its varying topography, the stretch displays a relative consistency and homogeneity of traditional construction and material with slight variations.

In the mid and central Himalayas, a particular architecture has extensively developed locally known as kath-khuni construction.



PHYSICAL LANDSCAPE OF H.P

MATERIALS

The primary materials of construction are wood and stone for wall and plinth, topped by slate shingles.

Wood is predominantly from of cedrus deodara (deodar/devidar) an endemic species to western Himalayas and one of the strongest of Indian conifers.

It has straight veins and grows up to 50 meters.

A typical house in Himachal is usually two or three-storey high while a temple may rise much higher from a single storey to a tower with seven storeys.

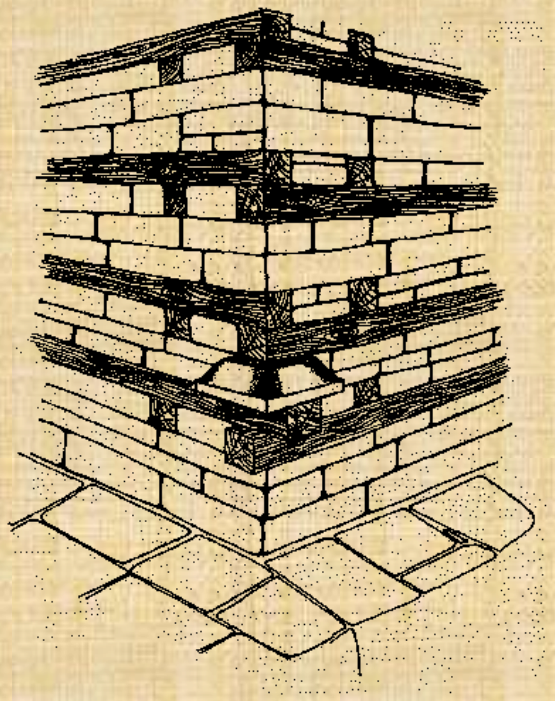
However, the method of construction and elements remain similar in most cases.

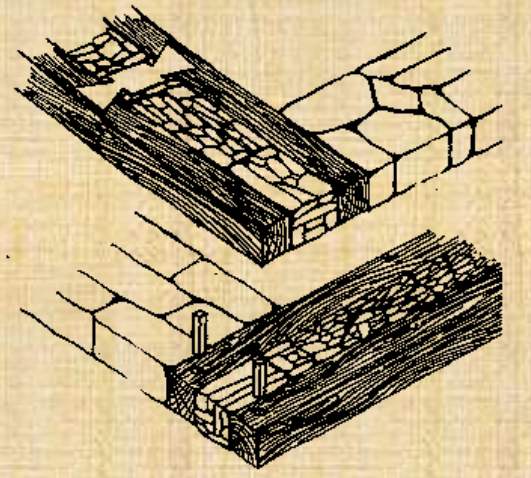
FOUNDATION AND PLINTH

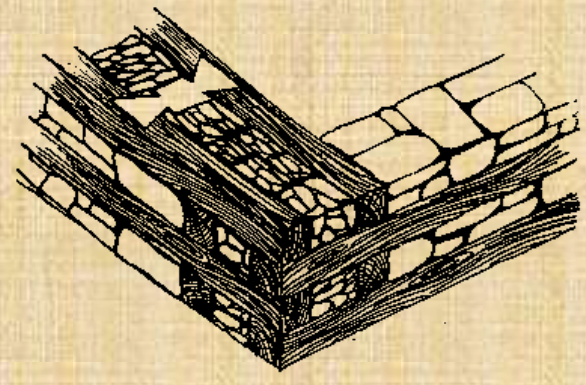
- The trench is dug relative to the height of the structure
- Which is then filled with loose stone blocks
- Provides the stability to the house or tower
- Also protects the building from snow and ground water.

WALLS- WOOD AND STONE

The walls are constructed with alternate courses of dry masonry and wood without any cementing mortar.







WALL CONSTRUCTION

Layering of wood and stone including a truncated pyramid shaped corner stone to protect the wood

Two parallel crossbeams held together by a dove tailed member wall construction dry masonry wood-and-stone wall of a temple construction

WALL PUNCTURES

Wall punctures windows are provided in walls with solid plank shutters on all four sides and are usually very small.

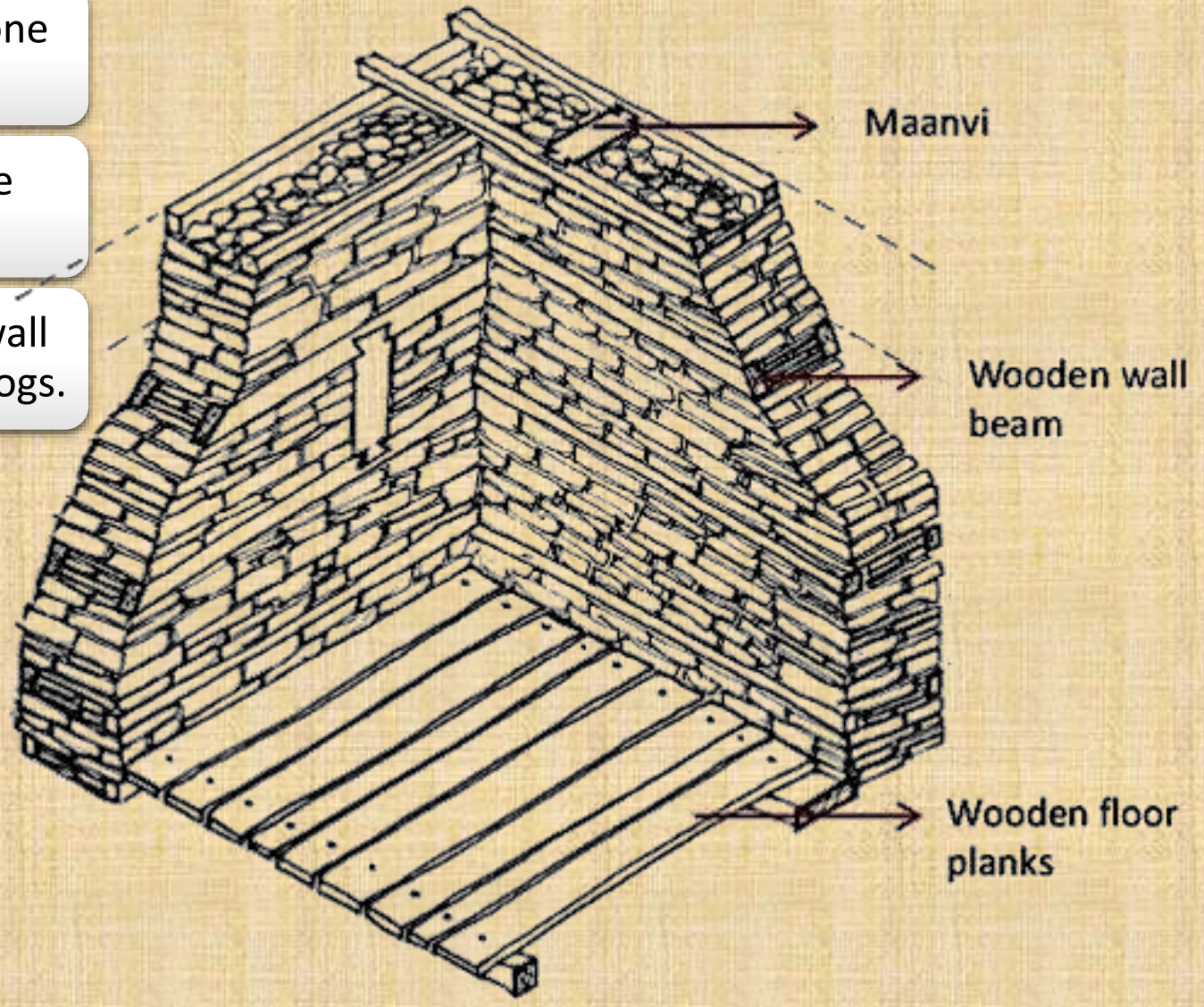
The same window has rhythmic floral carvings on the outer face with a small opening.

WALL AND FLOOR

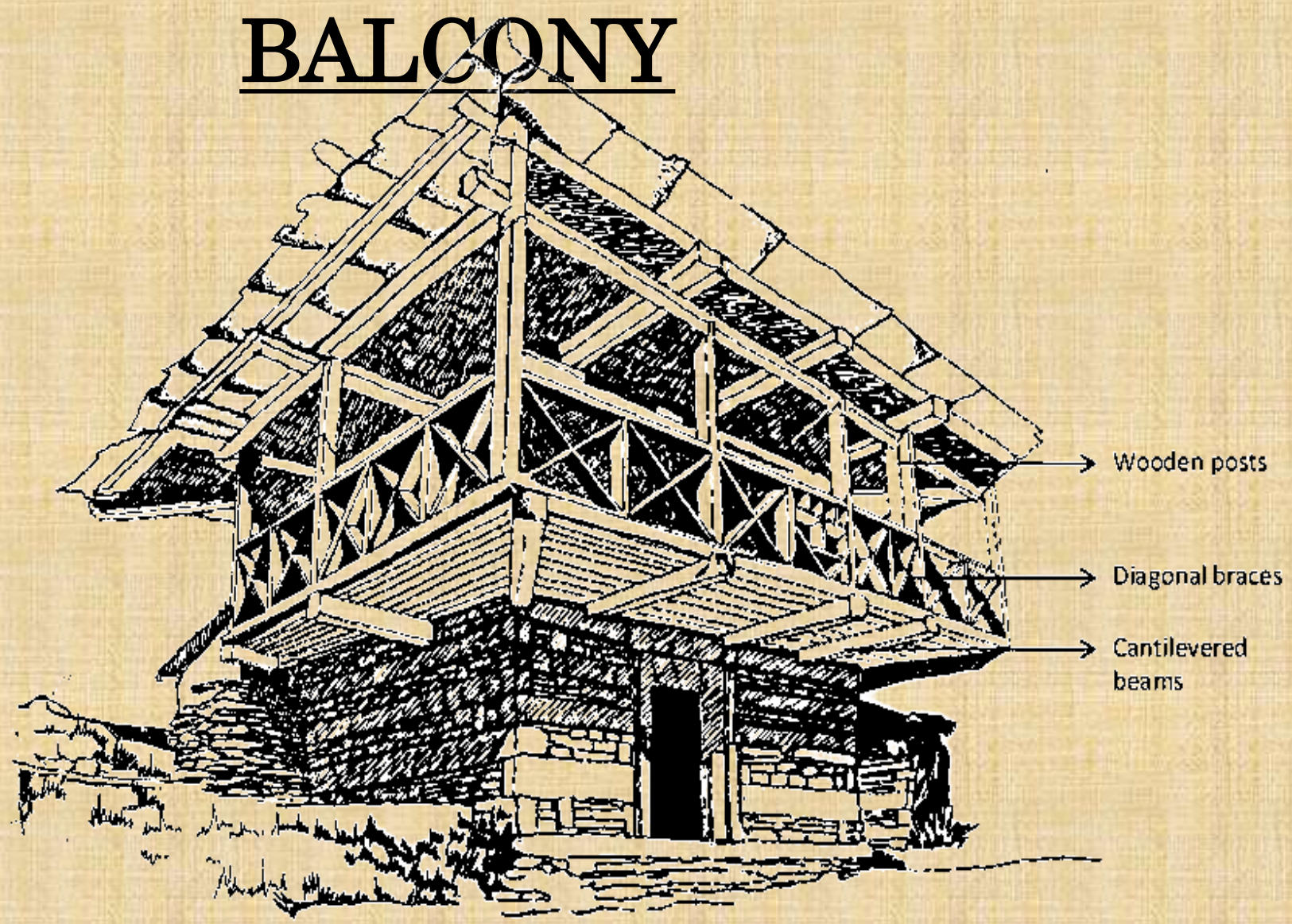
Floor and stairs -the ground floor is raised above the stone plinth and finished with adobe.

It functions as an insulating layer and at the same time remains warmer than stone finished surface.

Wooden wall beam, floor beam, wooden floor planks, wall and floor to floor beams are shear pinned with the wall logs.



CANTILEVERED WOODEN BALCONY



All the vertical posts are connected through a horizontal member on top,

On which sit the perpendicular members (connected with a lap joint) projecting from a wall.

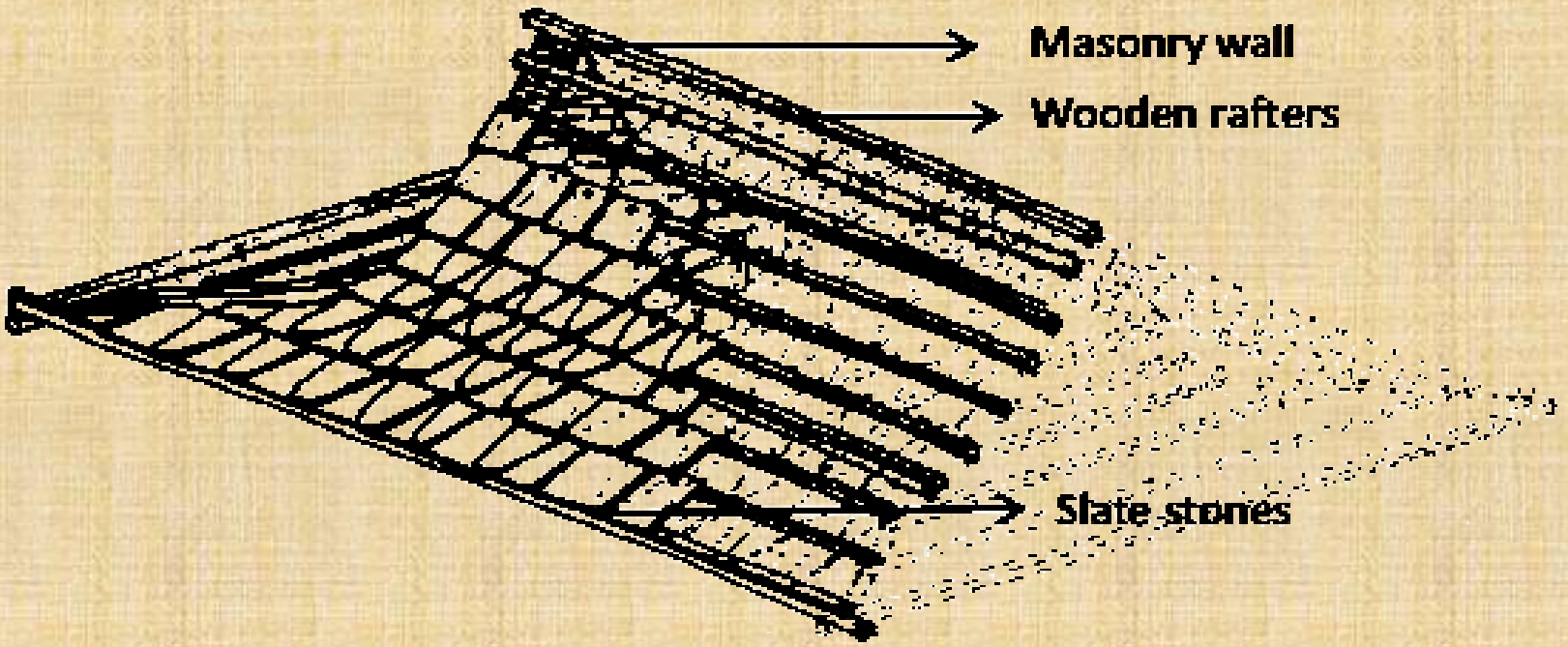
Sometimes the balcony façade is open with a parapet or may be closed

But with a series of openings to catch all the possible warmth of the sun.

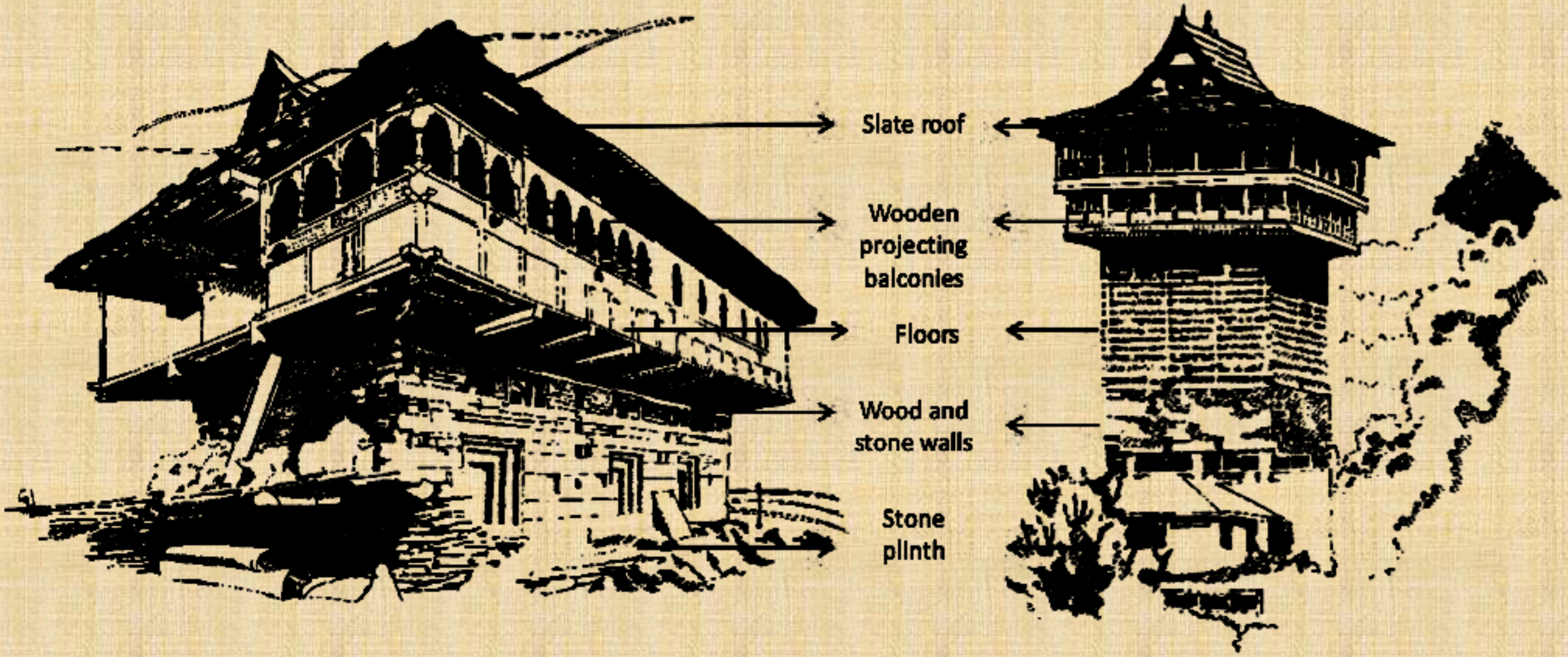
ROOF

The roof structure is constructed out of wooden beams followed by purlins and rafters, topped with slate or wooden shingles.

The slate stones also weighs down the structure against strong winds.



TYPICAL COMPONENTS OF A KATH-KHUNI STRUCTURE



OVERVIEW OF CONSTRUCTION

The construction from foundation to roof uses no mortar in the courses of stone.

The sheer weight of dry masonry and the roof in slate stones holds the structure down in place.

Traditionally no mental nails were used in wood courses instead strategically inserted wooden braces and joists held the structure together.

Nail-less framework without rivets and not rigid construction allows the building to flex with the seismic waves and effectively dissipate the energy of earthquakes.

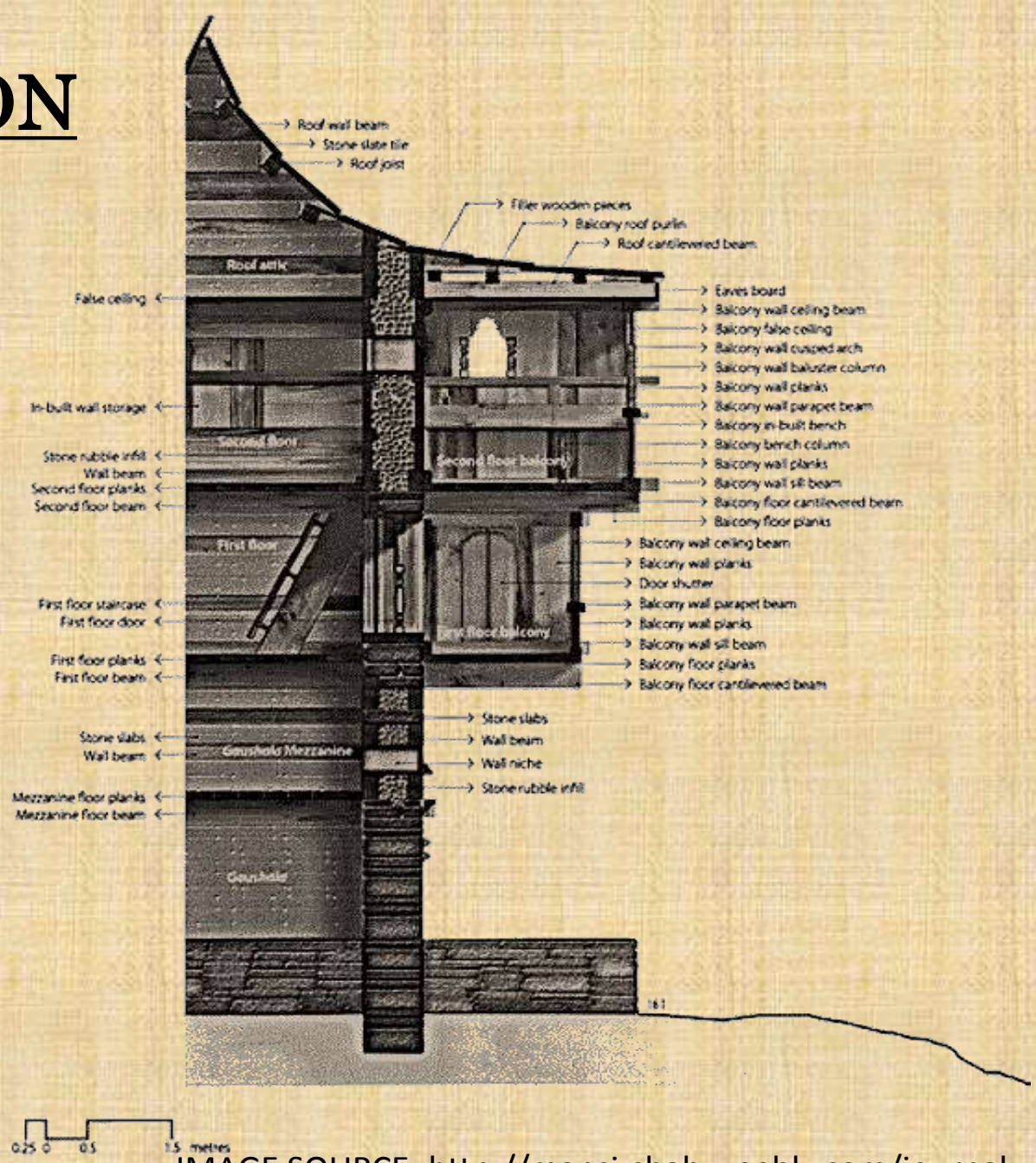


IMAGE SOURCE: http://mansi-shah.weebly.com/journal-articles.html

CARVING

Wood carving is an integral part of kath-khuni built forms

The jhalars (wooden pendants) along the roof edge, motifs on panels and on walls and balconies, door frames and windows all are intricately carved.

The exposed surfaces of wooden beams along the width and cross-section

AESTHETICS OF CRAFTSMANSHIP

Each detail is justified functionally which shows the material sensibility and ingenuity in handling.

They are reflected in the rhythmic pattern of wood and stone on the façade, on doors and windows, and on the overhanging balcony,

That float lightly on the stumpy base, adding another texture and dimension to the otherwise dynamic massing.

CONCLUSION

Most common wood-carving technique involve relief carving (high to low) which is applied to

Friezes, panels, entablature and other planar surfaces.

Sculptural carving is utilized in making columns, studs, doors, frames, hanging pendants and beam edges.

The indigenous buildings of Himachal Pradesh reflect a remarkable understanding about appropriate use of local materials, construction techniques and joinery details that stand strong against the climatic and seismic forces of nature.

The intricate interlocking of joints without nails is the hallmark of indigenous construction ingenuity.

The construction, society, values and building knowledge are continuously transforming, new materials are replacing the old.

With this change, there is also an uncertain future for indigenous practices.

https://www.sahapedia.org/the-himalayan-vernacular-kath-khuni-architecture

TEMPLE: HORYUJI, JAPAN

The five-storey pagoda and the main hall were both originally built around the year 600ad

But after a fire were rebuilt around the year 700ad. 26 other building in the complex were built before 800ad.

All of them together are undisputed as the oldest wooden buildings in the world

The pagoda, being the first built, would take out the title for the absolute oldest.

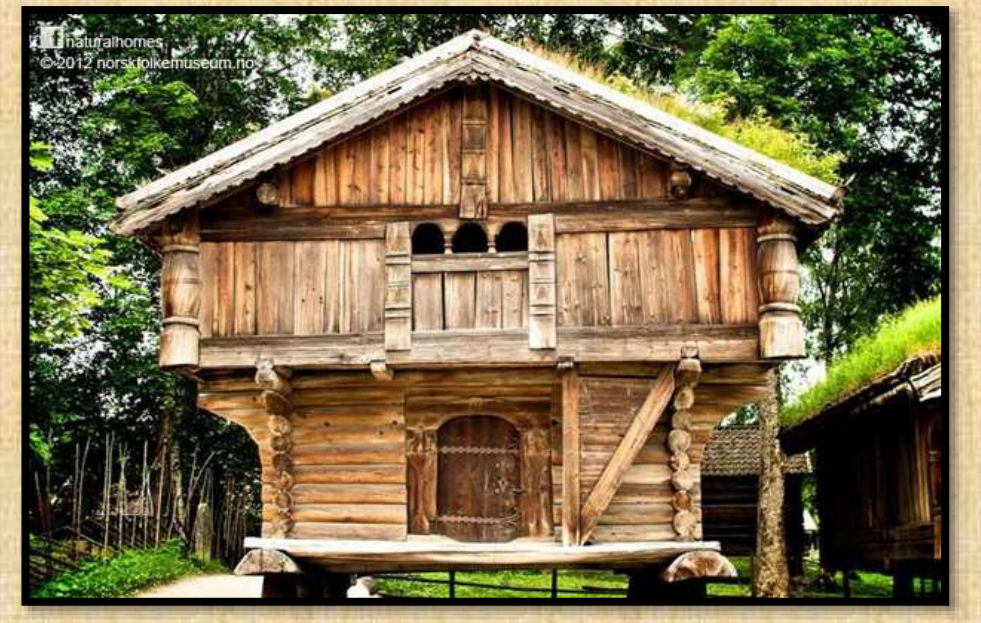
TRADITIONAL HOUSE: Norwegian Folk Museum, Norway

This is the 'lofthus' from Sondre Tveito in Telemark, Norway which now, at 700 years old, stands in the Norwegian Folk Museum in Oslo.

The home was part of a large farm in Norway in the Middle Ages.

The tiny door leads to the ‘bu’, the ground floor room, which was used for storing food.

The upper floor has a gallery on all four sides



PALACE: RUSSIA

The wooden palace of Tsar Alexei Mikhailovich with 270 rooms decorated with paintings and carvings was built in 1667

Without using any fasten materials, nails or hooks.

It consisted of 26 buildings connected with each other by passages and halls.

BARN: GERMAN

The Low German house or Fachhallenhaus is a type of timber-framed farmhouse found in Northern Germany and the Netherlands,

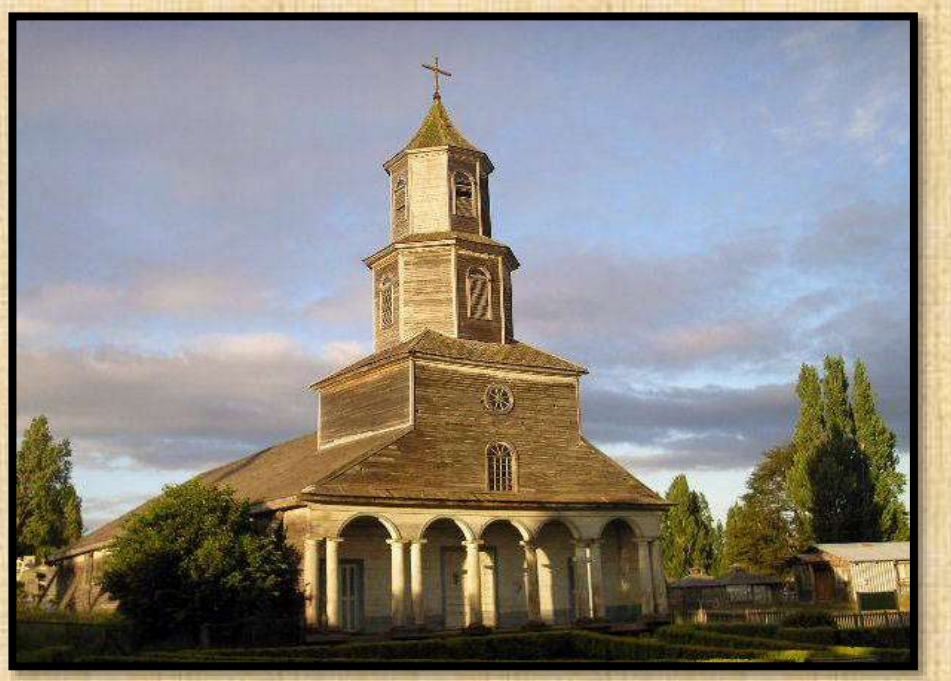
Combines living quarters, byre and barn under one roof.

It is built as a large hall with bays on the sides for livestock and storage and with the living accommodation at one end.

CHURCH: SOUTH AMERICA

The churches of Chiloé are made entirely in native timber with extensive use of wood shingles.

The churches were built from materials to resist Chiloé Archipelago's humid and rainy oceanic climate.



THANK YOU

SEM - V , T.Y

1. PALAK CHHEDA
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4. NIKITA KARANI
5. SUMIT MAITY
6. M.D.EHSAAN
7. SHARDUL SHROTRI

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