Woods used in 10th Century Trans Himalayan Tabo Buddhist Monastery of India

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Abstract

Tabo Monastery was established in 996 CE at an altitude of 3280 meters in Trans Himalayan terrain of Spiti Valley in Himachal Pradesh. The monastery with its nine temples and twenty three chortens is a protected monument under the aegis of Archaeological Survey of India (ASI). Being the oldest and continuously functioning Tibetan Buddhist monastery in the world, it has played an important role in transmission and preservation of Buddhist culture, traditions and heritage. The present study sheds light on the usage of the wood species such as *Populus* sp., *Pinus wallichiana*, *Cedrus deodara* and *Juniperus* sp. etc. which are native of Himalayan dry temperate forests and are used in construction and renovation of the wooden architecture of Tabo monastery. The wood samples collected from the various parts of the monastery, keeping its integrity and sanctity in mind were processed for species identification in the wood anatomy laboratory of Forest Research Institute, Dehradun. The study would help to understand the usage of wood by humans in the past and to facilitate accurate replacement of damaged structures during future renovation and maintenance.

Key words: gTsug-Lha-khang, Tabo monastery, Trans Himalaya, Wooden architecture, Wood identification.

1 Introduction

The present study focuses on the identification of wood species used in wooden architecture of Tabo monastery situated in Spiti valley of Himachal Pradesh at an altitude of 3280 meters. The word 'spiti' refers to 'the middle land', i.e. the land between Tibet and India. Tabo Monastery is known as the 'Ajanta of the Himalayas' owing to its stunning iconographic illustrations, whose substantial parts are still survived in its original state. Tabo is known as the oldest continuously operating Buddhist monastery in India and the Himalayas that continues to preserve culture, tradition and glorious heritage of Buddhism since the time of its foundation (Klimburg-Salter 1996).

The monastery was built by Buddhist king of Purang-Guge kingdom and royal lama Yeshe-ö with the assistance of the lotsawa (translator) Rin-chen-bzang-po, around 996 CE (Klimburg-Salter 1996). It was later reformed by the member of same royal house, Byang-Chub-'od. During the period of second diffusion of Buddhism in western Himalayan region around 10th and 11th century, monasteries were established along the major trade routes of the Himalayan kingdom. It was an impressive tool to integrate and expand the political, religious and economic

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institutions at that time (Verma 2016). Tabo monastery was proved to be one of the important establishments in the exchange and transmission of Indian Mahāyaāna Buddhism. It has served as a meeting place of Indian *pandits* and *lāmās* to learn, translate and share their respective religious scriptures and practices (Klimberg-Salter 1996; Wandl 1999). The major work was done by several Tibetan scholars and the great translators like Rin-chen-bzang-po who translated many Sanskrit texts and scriptures in Tibetan, bringing the Buddhist renaissance in Tibet (Verma 2016).

The monastery compound contains nine temples/chapels with numerous *stūpās* and shrines. The whole monastery was built between 10th and c. 17th century (Klimburg-Salter 1996). The nine temples are: the temple of the enlightened Gods (gTsug-Lha-khang); the golden temple (gSer-khang); the mystic mandala temple (dKyil-hKhor-khang), the Bodhisattva Maitreya temple (Byams-Pa Chen-poLha-khang); the temple of Dromton (Brom-ston Lha khang); the picture treasure (Z'al-ma); the large temple of Dromton (Brom-ston Lha-khang C'enpo); the Mahākāla Vajra Bhairava temple (Gon-khang) and the temple of Goddess (dKar-abyun Lha-Khang). The route to Spiti valley is difficult with rocky terrain throughout. Major road networks leading to monastery are still under construction by Border Roads Organization (BRO).

2 Vegetation of Trans-Himalayan regions

The geological setting of Lahul Spiti dates back to Precambrian to the Cretaceous period with short breaks in Carboniferous and Jurassic periods (Chaurasia et al. 2007). The unique climatic conditions and physiography of the trans-Himalayan zone such as scarce and erratic rainfall, heavy winds and snowfall, low moisture retaining capacity of the soil and high lopping and grazing are responsible for the characteristic flora of the Indian trans-Himalaya. The vegetation is dominated by annual and perennial herbs, along with few stunted shrubs and bushes (Aswal and Mehrotra 1994). Lahul-Spiti valley has high humidity in comparison to the other parts of Indian trans-himalayan zone and thus classified under temperate, Alpine mesophytes, Oasitic and desert vegetation (Chaurasia et al. 2007). The predominant tree species are *Pinus wallichiana* (Blue pine), *Picea smithiana* (Spruce), *Cedrus deodara* (Deodar), *Betula utilis* (Birch), *Juniperus macropoda* (Juniper), *Juniperus recurva* (Juniper), *Juglans regia* (Walnut), *Prunus armeniaca* (Apricot) and different species of *Salix*, *Populus*, *Malus*, *Sorbus* etc (Chaurasia et al. 2007). It is imperative to explore the choice of wood species used in archaic architectures to understand the wood usage by humans in the past. Furthermore, identification and documentation of the wood species used have proved to be beneficial during the renovations, as the information helps in accurate replacement of damaged structures.

3 Materials and Methods

The nine temples of monastery were surveyed for wood collection. The samples were collected from the old wooden pillars and beams that were kept at back side of the 4th temple Brom-ston Lha-khang Cénpo (the large temple of Dromton) and from the Assembly hall. Samples were cut using knife, only from flawed and broken parts of the wooden structures, to maintain the integrity and sanctity of the monastery. The collected and labeled samples were then brought to Wood Anatomy Laboratory, FRI for identification in plastic bags.

All the samples were boiled for 1–2 hours in water until they were soft enough to be cut and then 20–30 μm thick sections were cut using Reichert microtome. Some of the samples which were collected as a scantling were very fragile, and therefore, a hand blade was used to cut the transverse, radial and tangential sections instead of Reichert microtome. The samples were trimmed to remove any irregular edges and cleaned with a solution of iron alum to remove any impurities. The sections were stained with safranin, mounted in glycerin: water (1:1) and microstructure was examined using light microscope. For identification through microstructure, the terminology given by International Association of Wood Anatomists (IAWA 1989) was followed for hardwoods and (IAWA 2004) for softwoods. Photomicrographs depicting the diagnostic microscopic features of each sample were taken using Zeiss microscope equipped with AxioVision, image analyzer software. The identification was done on the basis of data from literature and examination of known wood samples housed in the repositories of Xylarium, FRI.

Various limitations and challenges were faced during on the spot identification as there was no electricity or source of natural light inside the monastery. Torch light or mobile light were used to examine the samples. Transverse or cross sections of wood samples were not exposed for examination, since they were obliterated at the joints and base. Wood surfaces were mostly painted which hindered identification through macrostructure (non-invasive technique).

4 Results

The main temple gTsug Lha-khang (the temple of enlightened Gods) consists of old entrance hall (sgo-khang), the main hall or Assembly hall (du khang), the cella (dri-gtsang-khang) and the ambulatory (skor-lam) (Klimburg-Salter 1996). The assembly hall has thirty two life sized coloured stucco figures which are supported by wooden pegs (Figure 1) embedded on the side walls from their bodies. In addition to this, some of these figures have additional wooden supports at the base (Figure 1). The central sculpture, a group of four figures (main deity) in the assembly hall is supported by the wooden framework (Figure 2) (Handa 2004). At the base of the figures, wooden framework is covered by mud plaster and then painted (Figure 4). At some places, the plaster was wearing off and the wooden support was clearly visible (Figure 4). These supports are joined by the wooden nails (Figure 5). The old wooden pillar of the main hall is carved on top, also beams on the ceiling has flower shaped carving attached on them. A few pillars are not cut out of a single piece but are held together through finger wood joints at places (Figure 6). The renovation of the main temple has been done by ASI (Archeological Survey of India), in which beams and pillars were replaced. Most of the wood samples collected for the present study belonged to the main temple.

Figure 1 Timber studs supporting stucco figure (arrow).

Figure 2 Wooden framework of sculptural group of four figures (Main deity) (arrow).

4.1 Old pillar and flower shaped wood-carving

The wood scantling was taken out from the cracked samples of wooden old pillars (Figure 7) lying at the back of the fourth temple Brom-ston Lha-khang Cénpo (the large temple of Dromton) said to be of the main assembly hall. The wood scantling was also taken out from the flower shaped wood-carving (Figure 8) lying at the back of the fourth Temple. The species identified was *Populus* sp. The diagnostic features of the species revealed diffuse-porous wood, distinct growth ring, delimited by denser latewood fibres (Figure 9). Small to very small, numerous and unevenly distributed vessel, mostly in radial multiples of 2-4 were found (Figure 9). Alternate, polygonal inter-vessel rounded or angular pits with much reduced borders were observed. Marginal, not conspicuous parenchyma was noticed. Very fine numerous, closely spaced, distinct and homogenous rays were observed (Figure 10, 11).

Figure 3 Wooden base of the cella sculpture in Assembly hall (arrow).

Figure 4 Wooden framework of main deity covered by mud plaster (arrow).

Figure 5 Wooden nail used in the wooden framework of main deity (arrow).

Figure 6 Finger joints in the pillar (arrow).

Figure 7 Old pillar of assembly hall.

Figure 8 Flower shape wood-carving of assembly hall.

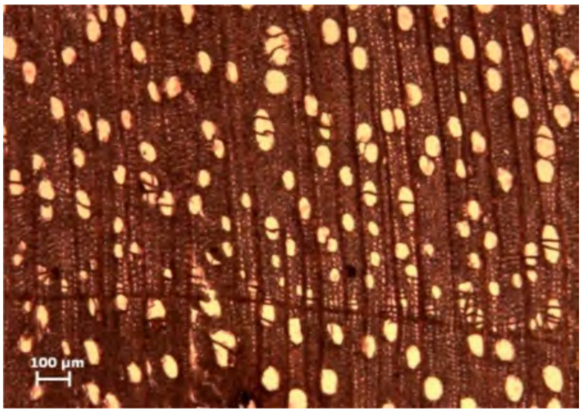

Figure 9 T.S. of *Populus* sp. showing growth ring and porosity at 50x.

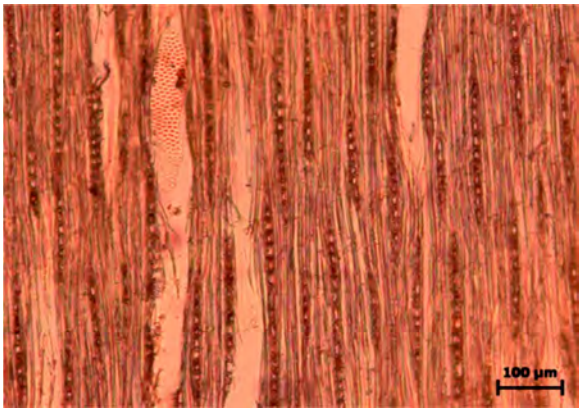

Figure 10 T.L.S. of *Populus* sp. showing rays at 100x.

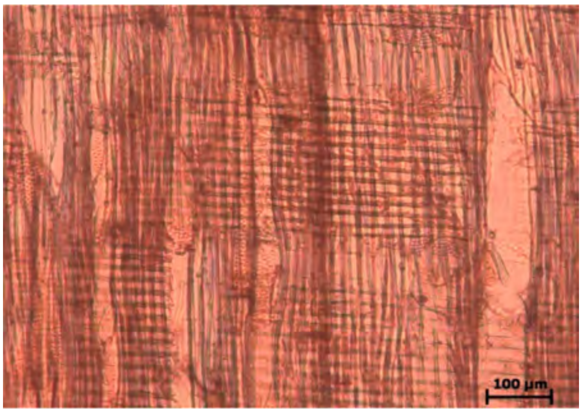

Figure 11 R.L.S. of *Populus* sp. showing homogenous rays at 100x.

4.2 Beams and part of window

The wood scantling was taken out from the cracked wooden beams (Figure 12) lying at the back of the fourth temple Brom-ston Lha-khang Cénpo (The large temple of Dromton) said to be of the main assembly hall. A part of window of the main assembly hall was exhibited in the Monastery Museum, from which wooden scantling was collected (Figure 13). Species identified was *Juniperus* sp. Diagnostic features of the species included non-porous, distinct growth ring delimited by a line of thick walled tracheids (Figure 14). Tracheids were arranged in definite radial rows with bordered pits uniseriate mostly on radial walls and tangential walls pits were few and smaller (Figure 15). Parenchyma was present, abundant, irregular in distribution, mostly toward late wood zone. Rays were uniseriate, ray tracheids absent, cross field pits cupressoid, 2-3 per crossing (Figures 15, 16). Resin canal and mineral

Figure 12 Beam of assembly hall.

inclusions were absent.

4.3 New pillar and base of the sculptural group of four figures (main deity)

The wood scantling was taken out from the base of the cracked part of wooden pillar in the main assembly hall (Figure 17). The wood sample was collected from the assembly hall (main deity) (Figure 18). Species identified was *Pinus wallichiana* with non-porous. Distinct growth ring showed gradual transition from early wood to latewood (Figure 19). Tracheids were arranged in radial rows, bordered pits uniseriate mostly on radial walls, tangential walls pits were few and smaller. Parenchyma was absent. Uniseriate and multiseriate rays were found. Both, vertical and horizontal resin canals were observed (Figure 20). Ray tracheids present, marginal and interspersed, cross-field pits 1-2 per ray crossing, large window like, horizontal walls not thin, not well pitted (Figure 21).

4.4 Pillar top

A part of carved pillar top of the main assembly hall was exhibited in the monastery museum, from which wooden scantling was collected (Figure 22). Species identified was *Cedrus deodara*. Diagnostic features of the species included non-porous wood having growth rings distinct on all the three surfaces (Figure 23). Tracheids were arranged in radial rows, bordered pits uniseriate with scalloped tori mostly on radial walls (Figure 25), pits on tangential wall few and smaller, spiral thickening absent. Parenchyma was scanty restricted to few cells on the outer face of latewood, end walls nodular. Rays were uniseriate (Figure 24), rarely biseriate or paired, ray tracheids present with smooth (non- dentate) walls, cross field pits

Figure 13 Part of window from assembly hall.

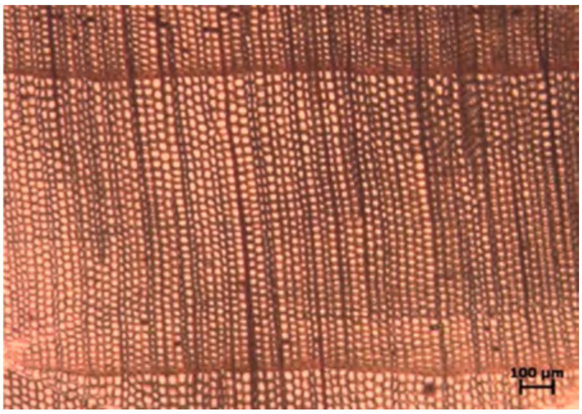

Figure 14 T.S of *Juniperus* sp. showing growth ring at 50x.

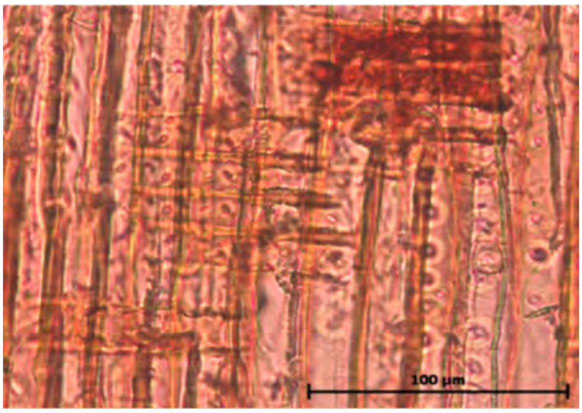

Figure 15 R.L.S. of *Juniperus* sp. showing cupressoid cross field pits at 400x.

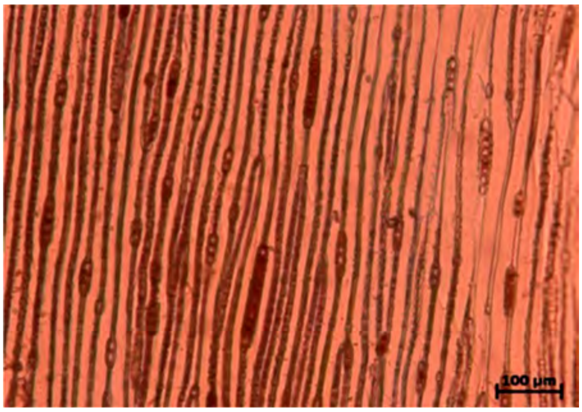

Figure 16 T.L.S. *Juniperus* sp. showing ray seriation at 100x.

Figure 17 New pillar of Assembly hall.

Figure 18 Wood sample from the base of wooden framework of main deity (arrow).

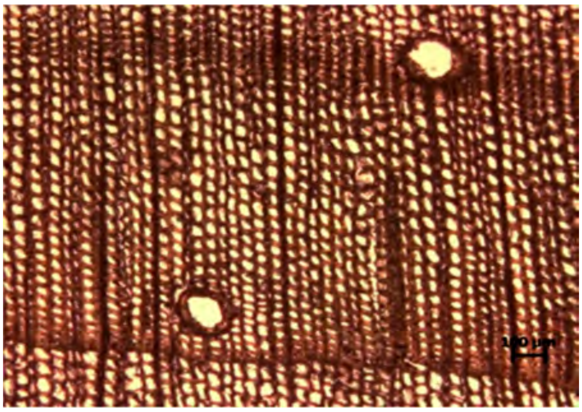

Figure 19 T.S. of *Pinus wallichiana* showing growth ring and canal at 50x.

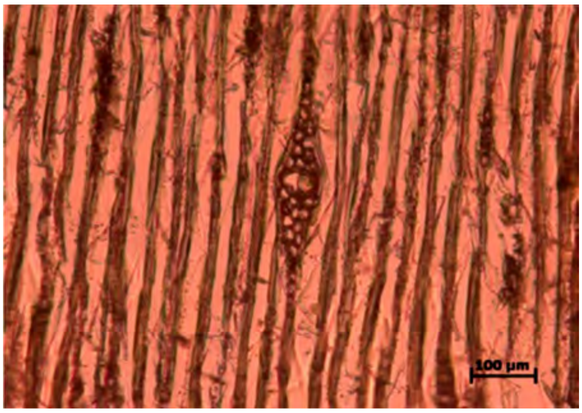

Figure 20 T.L.S. of *Pinus wallichiana* showing canal at 100x.

2-4 per ray crossing, taxodioid also piceoid to cupressoid, horizontal wall thick, well pitted, end walls nodular, indentures present. Resin canals were present in long tangential rows, epithelial cells thick walled (Figure 23). Minute to small, variable crystals present in ray cells and tracheids.

5 Discussion

It was observed that both softwood and hardwood species were used in construction of the monastery. The main temple of the monastery, gTsug Lha-khang (the temple of enlightened Gods) is the oldest part build around 996 CE. Samples were taken from two different pillars; one was apparently older than the other. Species identified for the new pillar was *Pinus wallichiana*, while the old pil-

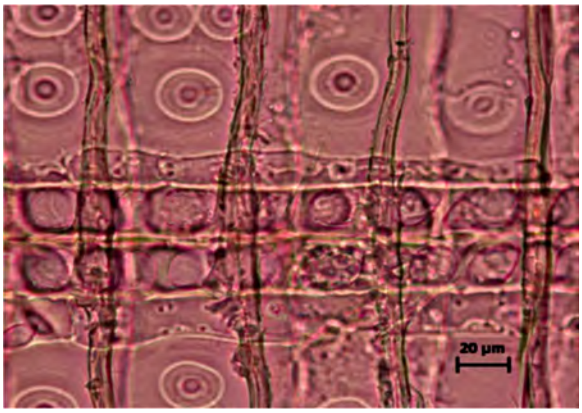

Figure 21 R.L.S. of *Pinus wallichiana* showing window-like cross field pits at 400x.

Figure 22 Pillar top carving of Assembly hall.

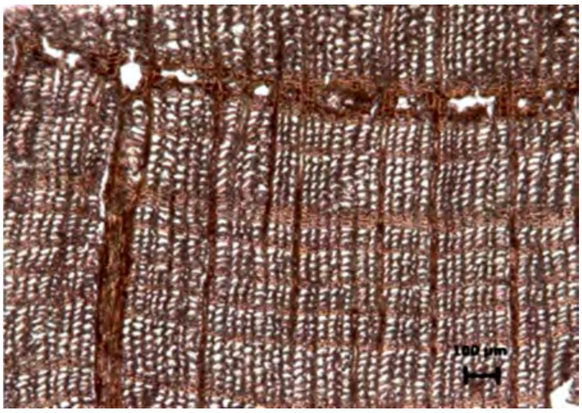

Figure 23 T.S. of *Cedrus deodara* showing growth ring and canals in long tangential row at 50x.

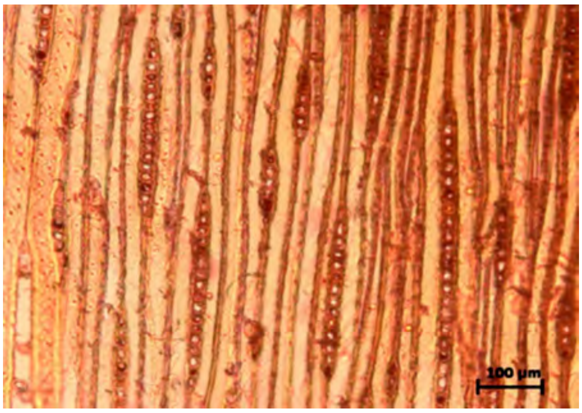

Figure 24 T.L.S. of *Cedrus deodara* showing rays at 100x.

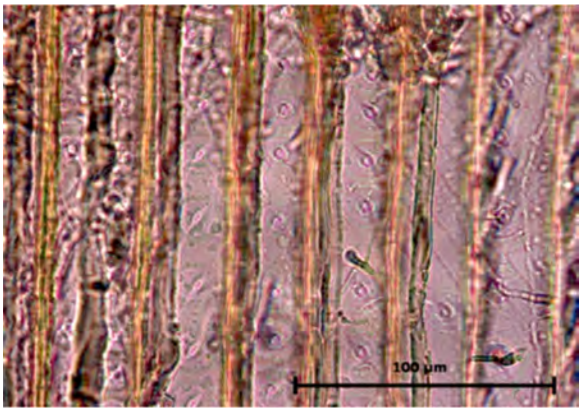

Figure 25 R.L.S. of *Cedrus deodara* showing scalloped tori at 400x.

lar was found to be of *Populus* sp. The top portion of the pillar (capital) was carved and the species identified was *Cedrus deodara* (deodar). The finding suggests that wood of *Cedrus deodara* might have been used to construct the pillars originally. But, in the course of time during renovations, the upper carved portion of pillars was left intact and lower parts were replaced by woods of *Populus* and *Pinus wallichiana*, as per their availability. The possibility of pillars in other temples of monastery being made up of the deodar wood stands strong. *Cedrus deodara* is a strong timber usually used as pillars as they are considered durable even when in contact with soil. It is preferably used in temples as it is fragrant and also considered sacred.

The Tribune September 8, 2002 (online edition) reported that deodar beam above the main deity of the monastery was replaced by *Shorea robusta* (Sal), instead of deodar as it was not available in that size. However, in the present study we found that the beams in the assembly hall were made up of *Juniperus*, while the decorative flower shaped wood-carvings attached to them were made of *Populus*. It is possible that Juniper must have been used originally and was later replaced by Deodar and subsequently by Sal suggesting that the deteriorated beams were replaced by different species available at the time of renovation. However, it is assumed that the beams lying in the fourth temple must have been original and the same were studied. The wood of Sal was not identified for beams or any other structures in the present study.

There was a window on the ceiling of the assembly hall for proper aeration and sunlight. The wood sample of the window was collected from the museum of Tabo monastery, and was found to be made of *Juniperus* sp. This window was strategically built in such a way that sun beam would directly fall on the main deity and the middle cella sculpture at different time of the day. The wood of *Juniperus* sp. is fragrant and it is believed that window provides circulation of the fresh air which mixes with the sweet fragrance of wood and thus making the holy ambience sacred and pure for the religious ceremonies.

A wooden piece was found lying at the base of the main deity in the assembly hall. It was found out to be of *Pinus wallichiana* (Kail). It is assumed that the sample is the part of wooden framework of main deity. It can also be the broken part of pillar which might have been left at the base mistakenly at the time of renovation.

6 Conclusion

It is evident from the present study that species that are native to Himalayan dry temperate forests such as *Populus* sp., *Pinus wallichiana*, *Cedrus deodara* and *Juniperus* sp. etc. were mainly the choice of timber for use in the Monastery. Surprisingly, *Populus* was found to be used for pillars in the Tabo monastery. The use of *Populus* as pillars has not been reported till now in the wood usage literature. The *lāmās* of the Tabo monastery (pers. comm.) have the popular belief that entire wooden structures of the monastery are made up of *Juniperus*. This is in the contradiction to present findings which shows the use of other woods also for different structures. *Juniperus* sp. wood was used in window and beam and deodar was used for pillar top. Both the woods used are fragrant, which coincides with earlier findings where fragrant woods are considered auspicious, for e.g., use of sandalwood in south Indian temples.

Since, many wooden parts of the monastery were painted or the cross section was not exposed, there was no way to identify them by examining the macrostructure (non-invasive technique). The study could reveal more information on the wood species used in building the monastery if the collection of very small wood scantling (of ~3–4 mm wide) or removal of paint from very small wood surface is allowed so as to expose macrostructure of wood.

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