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Wood Identification of Ancient Temple Structures in Ladakh, Located in the Western Himalayas

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Abstract

Microscopic wood identifications were performed on five Buddhist temple structures, three vernacular houses, two stupas, and two holy trees located in Ladakh, a region in the Indian state of Jammu and Kashmir in the Western Himalayas. Leh is Ladakh's capital and is located along the Indus River, the backbone of Ladakh. The vernacular buildings, stupa, and holy trees are located in Leh. Ladakh is a high-altitude desert with extremely scarce vegetation. Natural vegetation occurs mostly along the watercourses. The temples are located in villages along the upper Indus river valley, or along confluent rivers. From the 110 wood samples, 4 wood species were identified: poplar, willow, juniper, and pine. Building type, local availability, specific physical and mechanical properties of the wood species, and religious considerations were apparently the leading criteria for timber selection.

Keywords

wood identification – *Pinus wallichiana* – *Populus* sp. – *Salix* sp. – *Juniper* sp. – Ladakh – western Himalayas – buddhist temples – vernacular buildings

1 Introduction

During a stay from 16 September to 6 October 2014 in the cold desert area of Ladakh (Western Himalayas, India), wood samples were collected from five Buddhist temple structures, three vernacular houses, two stupas, and two trees

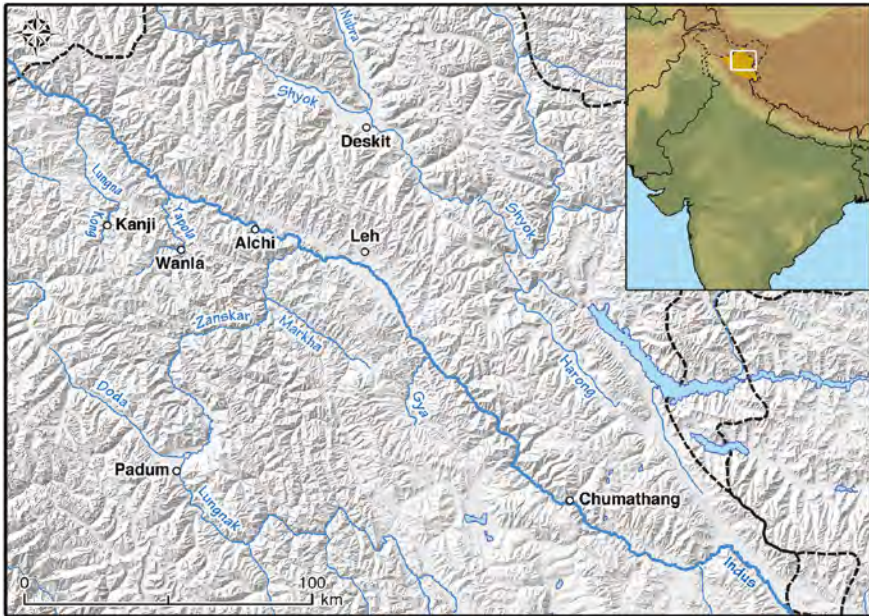


FIGURE 1 Map showing sampling sites: Leh, capital of Ladakh (3505 m asl); Kanji village (3850 m asl), Wanla village (3200 m asl); Alchi village (3060 m asl); Chumathang village (4050 m asl).

MAP BY QUENTIN DEVERS, CRCAO

in cooperation with the Tibet Heritage Fund (THF). Samples were also collected from two archaeological sites in cooperation with Quentin Devers of the Centre de recherche sur les civilisations de l'Asie orientale (CRCAO). Sampling was carried out in buildings at five locations: Kanji village, Wanla village, Alchi village, the capital Leh, and Chumatang village. All building sites are situated along the Indus river valley or in the valleys of its confluent streams, the Yapola and Kong Tokpo (see map in Fig. 1). Identifying the wood species of the temple structures and secular houses in Ladakh will help, firstly, to prepare further restoration works to be undertaken with state-of-the-art techniques, and secondly, to understand the criteria of timber selection in ancient times. Most of the temples have already been restored, except for Chumatang temple, of which the restoration just started.

Therefore, the goal was to understand the criteria for timber selection in the Western Himalayas. Past research has shown that various criteria determine timber selection. The criteria depend mainly on availability, physical and mechanical properties, and cultural and religious aspects. This study is part of a greater project that comprises the study of the human-wood relationship in the whole Himalayan area.

An initial study was undertaken in 2012–2013 in Sikkim, located in the Eastern Himalayas (Mertz *et al.* 2014). Since the climate and vegetation differ significantly between the Eastern and Western Himalayas, it is interesting to compare the timber tree species used for buildings in both areas.

2 Investigation Sites of Secular Buildings and Temples

The wood identifications were carried out in cooperation with the THF, a non-governmental organization registered in Berlin, Germany, committed to the preservation and restoration of historical buildings in the Tibetan realm. Since 1996, the THF has initiated the restoration of historic sites in Lhasa and the Tibetan cultural sphere extending over China, Mongolia, and India by funding and organizing the rehabilitation of numerous sites in collaboration with local communities. Since 2003, the THF has worked in Ladakh, mainly on the Leh Old Town Conservation Project (Fig. 2).

A total of 110 samples were taken from several of the traditional secular buildings in Leh previously restored by the THF, from one temple of which restoration just started, and from temples that had formerly been restored by the Indian-Swiss Achi Association.

The collected wood samples were prepared and identified at the Research Institute for Sustainable Humanosphere (RISH) at Kyoto University. The



FIGURE 2 Old Town of Leh, capital of Ladakh (3505 m asl).

samples were soaked in water for two days for softening. For the preparation of the microscopic slides, thin hand sections were taken in transverse, radial, and tangential directions (15–25 μm thick) by means of a double-edged razor blade. *Gum-chloral* was used as a slide-mounting medium. The slides were studied under an optical microscope (Olympus model BX51, Japan) with a magnification of 40–400 \times and photos were taken with a digital camera, (Olympus model DP73, Japan) (see also Mertz *et al.* 2014). The results are listed in the Appendix at the end of the paper. The various traditional buildings and temples are described below, along with an idea of how people live in and cherish traditional buildings.

2.1 *Roke Bano House (Figs 3 and 4) – Early 1900s*

This house, restored by the THF, belongs to the Bano family, a Muslim family. They moved to a larger house in a village near Choglamsar, a Tibetan settlement 7 km from Leh. The family, including five children and a 75-year-old mother, still cherish their old family house. They appreciate the old beams that are common in all of the traditional houses. This kind of social connection and cooperation is hardly felt in newly constructed houses. Over the last five years, more and more concrete houses have appeared in Leh Old Town. The mother, Roquia Bano, after whom the house was named, said that “In the past, Muslims



FIGURE 3 Roke Bano House dating from the early nineteenth century. The house belongs to a Muslim family but is rented to the THF staff.



FIGURE 4 Main pillar (poplar wood) and a bracket made of willow. The purlin is made of poplar. The rafters and ceiling-covering sticks (called “*talu*”) are made of willow. The sticks are cut from poles of pollarded willows. Continuous lopping of the top of a tree encourages fresh growth into new shoots producing poles (Corkhill 1979).

and Buddhists had good relationships in the Old Town, living together in peace and harmony.”

The Roke Bano House itself shares a common wall with the White Maitreya temple. On the ground floor, the family used to store wood and cattle dung in the winter; in the old days, they kept camels. At present, the THF rents the flat roof floor for its staff members (Chan 2010).

2.2 *Sofi House – Early 1900s (Fig. 5)*

The Sofi House is located next to the Stagopilog Stupa Gate.

The wooden doors and benches at the main entrance porch, as well as the hanging wooden balconies, are signatures of Kashmir-style houses. It is home to four families, all related. The house is warm in winter and cool in summer. The Sofi family, originally from Srinagar in Kashmir, came to trade in Ladakh (Chan 2010).



FIGURE 5 The Sofi House, dating from the early nineteenth century, shows the beautifully carved wooden doors and balconies typical of a Kashmir-style house. The rafters, beams, and pillars are made of poplar.

2.3 *Stagopilog Stupa Gate (Fig. 6)*

This is a small gate in the form of a stupa, or *chorten* in Tibetan, above a small street next to the Sofi House. A stupa, or *chorten*, is a mound-like hemispherical structure containing relics, typically the remains of Buddhist monks and nuns, that is used as a place of meditation.



FIGURE 6 Stagopilag Stupa Gate, located next to the Sofi House (left). One beam of the ceiling is made of willow.



FIGURE 7 Interior of the Lakruk House dating from the early 1700s. It belongs to a Buddhist family. The whole inner structure appears to be made from poplar, with the exception of the ceiling sticks (“*talu*”) made from willow.

2.4 *Lakruk House – Early 1700s (Fig. 7)*

This house belongs to a Buddhist family. A 70-year-old Ladakhi nun, Ani-le Thupstan Choedon, lives alone in the family’s Lakruk house, which overlooks the old town. The house was named after one of the great-grandfathers of the family. A prominent Buddhist family, they have hosted many *rimpoches* (spiritual leaders).

The Leh Old Town Initiative and THF are renting the top floor of the Lakruk House for their office and residential use. During the day, Ani-le sometimes climbs the narrow stairs up to the terrace, where she can be with the staff and volunteers (Chan 2010).

2.5 *West Stupa Gate (Fig. 8)*

This is a small gate above a small pathway next to the Central Asian Museum.

2.6 *Two Holy Trees (Sikh Trees) Next to the Central Asian Museum (Fig. 9)*

These two impressive trees are landmarks of Leh Old Town. Many myths are told about them. One signboard says the following about the dead tree:



FIGURE 8 West Stupa Gate squeezed between two houses.



FIGURE 9 These two holy trees are impressive landmarks of Leh Old Town. The one on the right is dead and the one on the left is living; both are poplar trees.

The ‘Sacred Tree’ is revered by the local people of the Ladakh region, as the great prophet Rimpoche Lama visited this place in the year 1517. Master, or Guru, Ji put down his walking stick at this place. With the passage of time, a huge tree grew from the stick in the desert area of Ladakh, where there were no trees at that time. For five hundred years, this sacred tree has been well known among all the people, including our Buddhist and Muslim brethren, both for its sacredness and Guru Ji’s most memorable journey to spread the message of truth, peace and love there.

2.6.1 Living Tree

“The real aim of Guru Ji was to establish greenery in an arid climate, and this tree also is there to remind us to take care of the environment.”

2.7 *Kanji Village: Tsuglag-khang Temple – 3850 m (Fig. 10)*

The Tsuglag-khang Temple is approximately 700 years old and roughly contemporary with the temple of Wanla village (next entry). It dates from a period when Kanji was part of a local kingdom ruled from Wanla.

The temple is a one-room structure built of river stones, earth, and wooden beams. The interior is decorated with three larger-than-life-sized clay sculptures. In the middle is the four-armed Shadakshari Lokeshvara, a popular form of the Bodhisattva Avalokiteshvara, flanked by the Medicine Buddha



FIGURE 10 The Tsuglag-khang Temple dating from 1300 is located in Kanji Village on the Kong Tokpo River, a confluent of the Indus River. It is made of juniper.

(Bhaisajyaguru) and the green form of the goddess Tara. Its walls are covered with paintings, including six mandalas. Although the exact identification of these is not yet possible, the mandalas on the left-side wall are dedicated to the main Bodhisattva Vajrasattva and the Buddha of long life Amitayus, and those on the right-side wall to the Buddha Shakyamuni and Vairochana. On the entrance wall, the left mandala is damaged to the extent that it must be considered unidentifiable. The one to the right is dedicated to the fierce deity Vajrapani. Due to the quality of the interior decoration and its fragile state of preservation, this temple was selected by the Achi Association in 1999 as its first monument conservation project. The conservation problems mainly resulted from an overload of the structure accumulated over centuries of casual repairs. The heavy load caused instability and cracks in the walls and resulted in an outward drift and partial detachment of the east wall; in consequence, water penetration through the roof soiled and partly destroyed the precious paintings.

2.7.1 Conservation and Restoration Measures

After more detailed survey work on the building structure and the interior paintings in 2000, the stabilization and restoration of the temple structure were executed in the following years. The underpinning of the foundation and reconstruction of the damaged roof and tie beams was stabilizing the building

and preventing further damage to the interior decoration. Parallel to this, the Achi Association carried out conservation of the paintings, consisting of their cleaning and stabilization and the filling of cracks. The work was completed in 2008. Currently, the sculptures are undergoing conservation work and the missing areas of the paintings are being reconstructed.

The final aim is to do equal justice to both, the religious utilization of the temple, and to the art-historical importance of the paintings and sculptures. Their cautiousness in the painting and reconstruction arose from the desire to restore the former unity of the interior decoration, and to render its religious meaning clear. All of the repainted and reconstructed sections are easily distinguishable from the originals, when closely observed.

The practical conservation efforts on the temple go together with the commitment to assisting the village community in maintenance strategies and capacity building in preventive conservation. In cooperation with the Achi Association, the University of Udine (Italy) is preparing a conservation manual on the historic Kanji village (ACHI Association).

2.8 Wanla Village: Chuchig-zhal Temple – 3200 m asl (Fig. 11)

The temple of the Eleven-headed Avalokiteshvara (Chuchig-zhal) was built about 700 years ago within the hilltop fortress of a local ruler, Bhag-dar-skyab.



FIGURE 11 The Chuchig-zhal Temple of Wanla Village dates from ca. 1300, and is located on the Yapola River, a confluent of the Indus River. The pillars are made of *Pinus wallichiana* and the beams of willow.

It is said to be a copy of the Sumtsek (“three-storied building”) at Alchi, the only other temple of this type in Ladakh. Commonly referred to by the name of the main deity in its southwestern niche, in the inscription on its southeastern wall it is called Tashi Sumtsek (“The Auspicious Three-storied”). The temple was built on a mandala plan, with an eastern entrance porch and three niches containing colossal standing statues of Maitreya, Avalokiteshvara, and Shakyamuni. The central space rises through two stories into the rooftop lantern. The internal walls on all levels are completely covered with wall-paintings. Carved and painted wooden pillars, capitals, and beams complete the décor of the porch and interior.

2.8.1 The Need to Intervene

Structural investigations of the temple revealed that the roof system had a thickness of up to 110 cm and that the layer-wise increase of the roof structure was the result of maintenance work over the centuries. These excessive roof loads affected the stability of the temple and caused cracks and detachment of the decorated wall plaster in the interior. According to witnesses, some of these cracks developed only over the last 20 years. The main beam at the gallery level is broken on one side, and is propped up from below by a temporary post. Further damage to the plaster and paintings was caused by a defective rainwater spout, which led to water penetrating the wall. All of the paintings were covered with the greasy lampblack of the countless butter-lamps that were burned in the temple during the centuries. The paintings on the ground floor became nearly invisible.

2.8.2 Conservation Measures

Temporary supports were erected in the left-hand-side apse in 1999, followed by an investigation of the wall foundations down to the rock base, and consolidation of the masonry below ground level. Before the works on the roof structure started, the detached and finely painted plaster on the wall above the broken main beam had to be secured in those places that were in immediate danger. In 2006, measures to diminish the roof load were begun, and in 2008 the structural reinforcement was carried out. Since 2003, working hand in hand with the architects, the conservators have investigated, consolidated, and cleaned the interior wall paintings.

2.8.3 Renovation of the Roof

Over the centuries, several attempts were made to seal the roof against water with the aid of new, additional layers of loam. This led to massive overloading of the structure that is evidenced by the wide cracks in the masonry.

In 2005, the thickness of the roof at the front was reduced by 43 cm and at the same time a drain was installed on two sides.

The relief offered by the works performed since 2005 led to a relief of more than 28 tons on an area of 32 m². The latest roof layer, with a thickness of 10–18 cm, was installed in two layers, using an improved, traditional technique: *markalak*, loam soil, fluvial sand, horse dung, and straw. In the particularly critical zone of the transition to the top ceiling (parapet zone), a fiberglass-reinforced strip of plastic was installed to protect the painted areas by preventing “rivulets” on the inside. In 2008, the roof surface above the main recess was refurbished. The existing roof of 1 m thickness was removed, and a new lightweight aluminum construction was installed. These beams are supporting the new external roof independent from the inner roof. The original inner ceiling was suspended from spring-born bars (ACHI Association).

2.9 *Alchi Village: Alchi Monastery – 3060 m asl*

2.9.1 Lotsawa Lhakhang – 11–12th Century

On the central wall of the temple, there is a presentation of Shakyamuni, surrounded by the translator Rinchen Sangpo at his left and the four-armed bodhisattva Avalokiteshvara on his right. On the left wall, next to the Buddha Amitabha, there is a mandala of Avalokiteshvara on his left and a mandala of Amitayus on his right. A painting of Mahakala is situated above the entrance door. On the right wall, one can find in the center a representation of Akshobhya; on its right, there is a mandala of himself, and on its left, a heavily deteriorated mandala (Gnoud *et al.* 2011).

The temple’s timber structure is made of poplar, except for one carved Lion-bracket that is made from a conifer, probably juniper.

2.9.2 Tsa Tsa Puri (Three Separate Rooms, One Two-Storied, the Others One-Storied) – ca. 15th Century (Fig. 12)

On the hill dominating Alchi are two temples that are guarded by the monks of Rizong. These temples called Tsa Tsa Puri, were named by the Lunpo of Alchi by the name of Tugdje Chenpo, “the great compassionate,” which means Avalokiteshvara. The paintings that decorate these buildings are of a very particular style: the only style they can be compared with are those of the principal cave of Saspol. It is supposed that they date from the fifteenth century.

2.10 *Chumathang Village: “Old Temple” – 4050 m asl (Figs 13 and 14)*

Chumathang is a village located about 138 km southeast of Leh. It lies on the banks of the upper Indus river. The restoration of the “Old Temple” started



FIGURE 12 The Tsa Tsa Puri temple, located in Alchi next to the Indus River, probably dates from the fifteenth century. The temple is mostly made from poplar, while the floorboards are made of juniper.



FIGURE 13 The Tibet Heritage Fund team together with the carpenters and masons before starting the restoration of the “Old Temple” of Chumathang village, located on the upper Indus River (4 October 2014).



FIGURE 14 Interior of the “Old Temple” showing the wooden structure and the wall paintings slated for restoration. The wood identifications revealed that most of the structural timber is poplar, while some rafters are made from willow.

with our arrival. First, the responsible priest performed a purification ritual. Then, the THF team started consolidating the wall paintings while the artisans, carpenters, and masons prepared wooden boards for new doors, and soil for plastering. During these activities, the wood sampling was performed.

3 Results

From 111 collected samples, 4 wood species were identified:

Populus sp. (poplar)

Salix sp. (willow)

Juniperus sp. (juniper)

Pinus subgen. *Haploxylon* (five-needle pine/soft pine)

The vernacular buildings in Leh (3505 m asl) are mainly made of poplar (*Populus* sp). This is the timber mostly used in the traditional buildings in Leh; in the temple buildings in Chumathang village, located in the upper Indus river valley (4050 m asl); and in Alchi village, located on the lower Indus river (3060 m asl). However, in room 2 of the Alchi Monastery, the flooring is made

of *Juniperus* sp. Juniper is more durable than poplar and was therefore used for the flooring panels, which are prone to abrasions.

We were very suspenseful about the results on the two sacred trees: The old dead tree that was said to have grown from a walking stick, brought from far away by the holy Rimpoche Lama, a great prophet, in the year 1517, was a poplar.

The living tree was planted after a wish by this holy man to plant “greenery” for a “clean green environment.” This tree was also a poplar tree.

The most probable candidate for the poplar wood is *Populus euphratica*, also called the Indian poplar. The late Gamble of the Indian Forest Department, Dehradun, mentioned the so-called Bahan poplar distributed in the Upper Valley of the Indus: “this being, possibly, the original home” (Gamble 1972, p. 691).

The wood of *Salix* sp. was used for specific purposes, such as the ceiling-covering sticks called “*taru*,” in all of the investigated buildings. In some cases, willow was used instead of poplar, like in the Roke Bano House in Leh, in the Stupa Gates in Leh, and for the front porch of the temple in Wanla village, recently restored by the Swiss ACHI Association.

The temple in Kanji village (3,850 m), located along the Kong Tokpo river (a confluent stream of the Indus river), is made of *Juniperus* sp. As this wood is very hard, it was also used for the flooring boards in room 2 of the Tsa Tsa Puri of Alchi Monastery, while the rest of the temple is made of *Populus* sp.

Finally, a piece of juniper, an incense wood used by locals in Leh, was also identified, so we could confirm its local use as incense for purifying living spaces.

The main wood of the Chuchig-zhal temple of Wanla village (3,200 m) is a *Pinus* species with smooth ray tracheids. Its cell walls are thin, with no ornamentations. It belongs to the group of “soft pines”, scientifically belonging to the subgenus *Haploxyton*. As Pearson and Brown (1932) explain, of the five pine species indigenous to India, only one belongs to the subgenus *Haploxyton*, which is a five-needle pine, while all others belong to the subgenus *Diploxyton*, which are two-needle pines, with thick dentate-shaped ray tracheids. Therefore, it is possible to assume that the timber of that temple is made of *Pinus wallichiana* (syn. *Pinus excelsa*). Five-needle pines usually grow straighter than two-needle pines and are easier to work with.

As for the samples of the archaeologist Quentin Devers, sample no. 1 from a lintel of the entrance gate of Shey City was *Populus* sp. and sample no. 2 was a liana or vine.

4 Conclusions

The wood identifications of the temple structures showed a restricted number of wood species, compared with the temples identified in Sikkim of the Eastern Himalayas. This becomes understandable, when comparing altitude and climate. The temples in Sikkim are located at an altitude of 1400–2800 m, whereas those of Ladakh range between 3000–4000 m. More important is the climate, with an annual rainfall of 2700–3200 mm in Sikkim, with a heavy monsoon between June and September, whereas Ladakh, which is a cold desert area, has only 102 mm of annual rainfall (Leh) (Wikipedia). The forests of Sikkim are much more species-rich than those of the Ladakh region.

As for the criteria of wood selection, the choice was limited to the four timber tree species poplar, willow, five-needle pine, and juniper.

Another criterion, that of the sacredness of a tree, could be mentioned here. The Tsuglag-khang Temple of Kanji Village was made from juniper. This timber is considered a purifying wood, as it is used as incense for purification.

As a final remark, it is important to note that a great number of the samples showed that the wood was deteriorated. The deteriorated or desiccated poplar showed crystal-like inclusions under the microscope (Fig. 15). It is highly possible that the extremely desiccated wood led to the replacement of the wood structure by silica, or by calcium carbonate (Cartwright 2015). The more advanced the desiccation, the greater the number of crystals. Wood identification was possible because of the quantity of material available and because comparisons with other samples were possible.

Acknowledgements

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FIGURE 15 Sample No. 76 from Tsa Tsa Puri temple, room 3. Tangential section of poplar bark. The bark had remained attached to the roundwood sample. The rays are only visible as hollow shapes. The bark tissue is mainly composed of very long strands of chambered cristalliferous phloem parenchyma.

Appendix

The following lists the results of the microscopic wood identifications performed in the laboratory of Kyoto University's Research Institute for Sustainable Humanosphere (RISH). The microscopic slides are preserved in RISH's Xylarium. Under the location names are three columns with, from left to right, the serial number under which the slides are preserved at RISH's Xylarium, the structural part name, and the timber species name.

Leh Old Town (18 September 2014) – 3505 m asl, sampling with Stanzin Tundup THF

1. Roke Bano House – early 1900s, lower Stalam Road – ground floor. The house belongs to a Muslim family but is rented by THF staff.

001	Main pillar	<i>Populus</i> sp.
002	Bracket on main pillar	<i>Salix</i> sp.
003	Main beam/purlin (supported by bracket and main pillar)	<i>Populus</i> sp.
004	Rafter	<i>Salix</i> sp.
005	Sticks or <i>talū</i> (on rafters)	<i>Salix</i> sp.

2. Sofi House – early 1900s, beside the Stagopilog Stupa Gate

Ground floor

006	Rafter	<i>Populus</i> sp.
007	Main beam	<i>Populus</i> sp.
008	Stick on rafter (<i>talū</i>)	<i>Salix</i> sp.
009	One pillar	<i>Populus</i> sp.

Outer porch

010	One pillar	<i>Populus</i> sp.
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3. Stagopilog Stupa Gate, next to Sofi House

011	Beam on ceiling of stupa	<i>Salix</i> sp.
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4. Lakruk House – early 1700s, Upper Stalam Road, near Leh Palace and Chamba Gonba. On the top floor, the THF rents an office

1st floor (kitchen)

012	Pillar	<i>Populus</i> sp.
013	Bracket	<i>Populus</i> sp.
014	Main beam	<i>Populus</i> sp.
015	Rafter	<i>Populus</i> sp.
016	Stick on rafter (<i>talū</i>)	<i>Salix</i> sp.

(cont.)

5. West Stupa Gate, next to the Central Asian Museum

017	Lintel in wall	<i>Salix</i> sp.
018	Two beams on ceiling of the stupa	a) <i>Populus</i> sp. b) <i>Salix</i> sp.

6. Two holy trees (Sikh trees) next to the Central Asian Museum. Tree(s) brought from India, wood is used for toothpicks

019	Living tree	<i>Populus</i> sp.
020	Dead tree	<i>Populus</i> sp.

Kanji Village – 3850 m asl (25 September 2014), sampling with Yutaka (THF) + Jigmet Namgial (Achi Association India). All samples deteriorated to various degrees (24 + 25 best).

Tsuglag-khang temple (a one-room structure) – 700 years old

Inside

021	Main central pillar (deteriorated)	<i>Juniperus</i> sp.
022	Lintel	<i>Juniperus</i> sp.
023	Beam support (extremely deteriorated)	<i>Juniperus</i> sp.

Outside

024	Main pillar	<i>Juniperus</i> sp.
025	Roof-supporting beam	<i>Juniperus</i> sp.
026	Central bracket	<i>Juniperus</i> sp.

Wanla Village – 3200 m asl (25 September 2014). Sampling with Yutaka (THF) + Jigmet Namgial (Achi Association India)

Chuchig-zhal Temple (temple of the Eleven-headed Avalokhiteshvara [Chuchig-zhal]) – 700 years old

Inside

027	NW pillar	<i>Pinus wallichiana</i> (syn. <i>P. excelsa</i>)
028	NE pillar	<i>Pinus wallichiana</i>
029	SE pillar base	Conifer ? (extremely det.)
030	SE pillar shaft	<i>Pinus wallichiana</i>
031	SW pillar base	<i>Salix</i> sp.

(cont.)

032	SW pillar	<i>Pinus wallichiana</i>
033	Entrance door frame	<i>Salix</i> sp.
Outside		
034	NW pillar (right side)	<i>Pinus wallichiana</i>
035	NE pillar (left side)	<i>Pinus wallichiana</i>
036	Right pillar's bracket	<i>Salix</i> sp.
037	Lion bracket	<i>Salix</i> sp.
038	Left pillar's under bracket	<i>Salix</i> sp.
039	Beam on top of bracket (right side)	<i>Salix</i> sp.
040	Lintel above entrance door	<i>Salix</i> sp.
041	Mani wheel	<i>Salix</i> sp.
042	Entrance door sill	<i>Salix</i> sp.

Alchi village: Alchi Monastery – 3060 m asl (26 September 2014) Sampling with Yutaka (THF) + Jigmet Namgial (Achi Association India)

Lotsawa Lhakhang – 11–12th century

043	Main central pillar	<i>Populus</i> sp.
044	Door lintel	<i>Populus</i> sp.
045	Main beam	<i>Populus</i> sp.
046	Lion bracket (prob. <i>Juniperus</i>)	conifer
047	Rafter	<i>Populus</i> sp.
048	Board between rafters	<i>Populus</i> sp.
049	Ceiling board	<i>Populus</i> sp.
050	Bracket on top of main pillar	<i>Populus</i> sp.
051	Small bracket under big one	<i>Populus</i> sp.

Tsa Tsa Puri (three separate rooms, one two-storied the others one-storied) – ca. 15th century

Room 1

052	SE pillar	<i>Populus</i> sp.
053	SW pillar extremely deteriorated	<i>Populus</i> sp.
054	NW pillar	<i>Populus</i> sp.
055	NE pillar	<i>Populus</i> sp.
056	Door lintel	<i>Populus</i> sp.

(cont.)

057	Door frame	<i>Populus</i> sp.
058	Door blade	<i>Populus</i> sp.
059	Door sill	<i>Populus</i> sp.
Room 2		
060	NW pillar	<i>Populus</i> sp.
061	NE pillar	<i>Populus</i> sp.
062	SE pillar	<i>Populus</i> sp.
063	SW pillar	<i>Populus</i> sp.
064	Floorboard	<i>Juniperus</i> sp.
065	Floorboard frame (nodules)	<i>Juniperus</i> sp.
066	Door frame	<i>Populus</i> sp.
067	Door lintel	<i>Populus</i> sp.
068	Door sill	<i>Populus</i> sp.
Room 3 (2nd floor of room 2)		
069	Rafter	<i>Populus</i> sp.
070	Main beam	<i>Populus</i> sp.
071	SW pillar	<i>Populus</i> sp.
072	SE pillar	<i>Populus</i> sp.
073	Small bracket	<i>Populus</i> sp.
074	Big bracket	<i>Populus</i> sp.
075	Top beam	<i>Populus</i> sp.
076	Rafter	<i>Populus</i> sp.
077	Ceiling board	<i>Populus</i> sp.
078	Lion bracket	<i>Populus</i> sp.
079	Window frame	<i>Populus</i> sp.
080	Door lintel	<i>Populus</i> sp. (deteriorated!)
081	Hinge (scharnier)	<i>Populus</i> sp.
082	Door blade	<i>Populus</i> sp. (deteriorated!)
083	Door sill	<i>Populus</i> sp.
084	Willow (?) parapet (from outside)	<i>Salix</i> sp.
Room 4		
085	SW pillar	<i>Populus</i> sp.
086	Northern supporting beam	<i>Populus</i> sp.
087	SE pillar	<i>Populus</i> sp.

(cont.)

088	Small bracket on SE pillar	<i>Populus</i> sp.
089	Bigger bracket	<i>Populus</i> sp.
090	Rafter	<i>Populus</i> sp. (deteriorated!)
091	SW pillar beam	<i>Populus</i> sp. (deteriorated!)
092	Ceiling board	<i>Populus</i> sp.
093	Window frame	<i>Populus</i> sp.

Chumathang – 4050 m asl, “Old Temple”. Sampling with Yutaka and Stanzin Tundup of the THF (4 October 2014)

094	South pillar (left from entrance)	<i>Populus</i> sp.
095	Bracket on south pillar	<i>Populus</i> sp.
096	North pillar	<i>Populus</i> sp.
097	Bracket on north pillar	<i>Populus</i> sp.
098	Main beam/purlin on top of rafters	<i>Populus</i> sp.
099	Board between rafters on top of	<i>Populus</i> sp.
	098	
100	Rafter 1	<i>Salix</i> sp.
101	Rafter2	<i>Salix</i> sp. (semi-ring porous)
102	Door lintel	<i>Populus</i> sp.
103	Door frame	<i>Populus</i> sp.
104	Door sill	<i>Populus</i> sp.
105	Door hinge	<i>Populus</i> sp.

Basement

106	Door hinge of basement	<i>Populus</i> sp.
107	Door frame	<i>Populus</i> sp. (ray cells roundish)
108	Lintel 1	<i>Populus</i> sp.
109	Rafter	<i>Salix</i> sp. (little resin)
110	Lintel 2 (vessel-ray pits net-like)	<i>Salix</i> sp. (resin abundant)

Presented by Reeyork Guesthouse, Leh (4 October 2014)

111	Branch piece of juniper (needle parts are used as incense for purification)	<i>Juniperus</i> sp.
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