

# Study on Wood Species Identification for Daeungjeon Hall of Jeonghyesa Temple, Suncheon<sup>1</sup>

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## ABSTRACT

This study was conducted to identify wood species from main pillars of Daeungjeon Hall, the main building of Jeonghyesa Temple located in Suncheon, Jeollanamdo Province in Korea. It was known that this temple had been built in the 8<sup>th</sup> century by Hyeso, a national master in the Unified Silla period, and was designated as Treasure No. 804 in 1984 due to its historic and academic values. The results of wood species identification showed that main pillars from Daeungjeon Hall of the Jeonghyesa Temple were made of hard pine, Korean fir (*Abies* spp.) and Zelkova tree (*Zelkova* spp.). In addition to the wood species identification, floor plan documentation was also done to help identify what wood species had been used for main pillars. These results could be applied and utilized for the conservation and restoration of Daeungjeon Hall in future. This study may help with the authenticity of conservation works.

**Keywords** : wood species identification, traditional wooden building, Jeonghyesa Temple, conservation science

## 1. INTRODUCTION

Jeonghyesa Temple, Suncheon was built in the 8<sup>th</sup> century in United Silla dynasty period. In Hyesoguksajemunui, a national master Hyeso wanted to build Jeonghyesa Temple for his old age. However, because of the sudden death of national master Hyeso, his disciples completed to build the Jeonghyesa Temple. Old documents such as Donggukyeojisungnam, Sungpyeongji and Beomwugo indicated that Jeonghyesa

Temple was large scale of temple. Through the Japanese Invasion in 1592 and 1597, it lost many wooden buildings and became small scale of temple. It was rebuilt by buddhist monk Sinwuk in 1617. Size of Daeungjeon Hall of Jeonghyesa Temple is 3 room scale in front and 2 room scale in side (Korea Creative Content Agency, 2016). Daeungjeon Hall have Dapo style and Korean gambrel roof style in architectural aspects (Fig. 1 and 2). Because of its historic and academic values, it was designated as Treasure No.

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Fig. 1. Scenery of Jeonghyesa Temple.



Fig. 2. Scenery of Daeungjeon Hall.

804 in 1984 (Cultural Heritage Administration of Korea, 2016). The Cultural Heritage Charter of Korea states that cultural heritage must be preserved in its original formation and be restored by original materials. In addition, it mentions the authenticity of cultural heritage and conservation materials (Cultural Heritage Administration of Korea, 1997). Therefore, investigation for wood species identification of important Korean traditional buildings such as National Treasure and Treasure are required. Conservation and restoration works must reflect investigated data. However, only few studies of wood species identification regarding Daeungjeon Hall of Jeonghyesa Temple have been carried out.

In this study, species identification regarding main pillars for Daeungjeon Hall of Jeonghyesa Temple are investigated. With this database, great help could be given to authenticity of conservation and restoration works.

## 2. MATERIALS and METHODS

### 2.1. Materials

Firstly, past studies and floor plans of Daeungjeon Hall of Jeonghyesa Temple were

collected. Based on this, sampling locations for main pillars were selected (Table 1). Next, field works were performed. It should be checked whether pre-inspection and field situations are in accordance. To decide the appropriate tools and equipment necessary for sampling, the inside of the buildings and the environment should be researched. The scaffoldings, multi-purpose ladders and ladders could be used for sampling. The sampling must be carried out from natural cleavages using scalpels. If there are no natural cleavages, sampling should be performed in inconspicuous areas of wooden structural members. The samples are stored in zipper bags and the name of building and location of wooden structural members are labelled as specifically as possible.

### 2.2. Methods

Wood species identification was carried out by preparing thin sections of samples of 20~30  $\mu\text{m}$  width with a razor blade (ST-300, Dorco, Korea) or microtome blade (YL-MBA35, YLS, Korea) for the cross, radial and tangential

**Table 1.** List of collected samples for wood species identification

Sample number	Sample label	Note
1	Pillar 1	-
2	Pillar 2	-
3	Pillar 3	-
4	Pillar 4	Upper side of pillar
5	Pillar 5	Down side of pillar
6	Pillar 6	-
7	Pillar 7	-
8	Pillar 8	-
9	Pillar 9	-
10	Pillar 10	-
11	Pillar 11	-

sections. The thin sections were stained with aqueous safranin solution (0.5 ~ 1 wt% concentration) for 2 minutes, and washed thoroughly before being placed on the slide glass. To complete the preparat, glycerine (50%, aq. soln.) was used to mount the sample with cover glass and slide glass. Optical microscope (Eclipse Lv 100, Nikon, Japan) was used to identify anatomical characteristics of wood species (Kim *et al.*, 2016). The wood species were identified according to the standards set by IAWA: List of Microscopic Features for Identification (Park and Lee, 2007; Park *et al.*, 2005; Park *et al.*, 2003; Lee and Park, 2012; Lee, 1997). Final confirmations were made by comparing with the standard samples from Korea National University of Cultural Heritage. After the wood species identification, floor plan documentation was performed to assist in the recognition of the location of each main pillars.

### 3. RESULTS

#### 3.1. Wood Species Identification

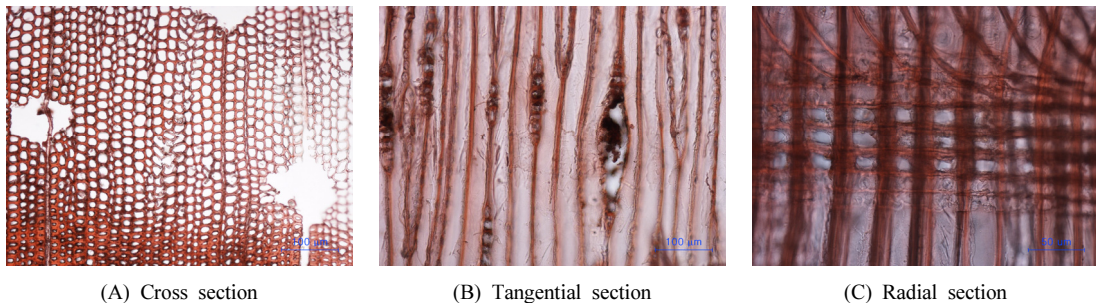
Hard pine, Korean fir (*Abies* spp.), Zelkova tree (*Zelkova* spp.) was identified in main pillars of Daeungeon Hall of Jeonghyesa Temple (Table 2). Hard pine was identified in pillar 8, 9 and 10. Korean fir (*Abies* spp.) was identified in pillar 1, 2, 3, 4, 5, 6 and 11. Zelkova tree (*Zelkova* spp.) was identified in pillar 7. These results assumed that hard pine, Korean fir and Zelkova tree were used in main temple during ancient times in Korea.

##### 3.1.1. Anatomical characteristics of hard pine

As the micro observation result of species identification through optical microscope for each preparat, the latewood turns rapidly to the early wood and vertical resin canal can be found in cross section. Ray tracheid have dentate toothed thickening and bordered pit mainly in one row. Also, crossfield pitting observed

**Table 2.** Result of species identification

Sample Number	Sample Name	Species	Note
1	Pillar 1	<i>Abies</i> spp.	-
2	Pillar 2	<i>Abies</i> spp.	-
3	Pillar 3	<i>Abies</i> spp.	-
4	Pillar 4	<i>Abies</i> spp.	Upper side of pillar
5	Pillar 5	<i>Abies</i> spp.	Down side of pillar
6	Pillar 6	<i>Abies</i> spp.	-
7	Pillar 7	<i>Zelkova</i> spp.	-
8	Pillar 8	Hard pine	-
9	Pillar 9	Hard pine	-
10	Pillar 10	Hard pine	-
11	Pillar 11	<i>Abies</i> spp.	-

**Fig. 3.** Micrograph of hard pine.

as fenestriform. Tangential section is composed of uniseriate rays and radial parenchyma cells (Fig. 3). Dentate toothed thickening, fenestriform of crossfield pitting and vertical resin canal are the specific anatomical characteristics of hard pine (National Research Institute of Cultural Heritage, 2015; Lee, 1997).

### 3.1.2. Anatomical characteristics of Korean fir (*Abies* spp.)

As the micro observation result of species identification through optical microscope for each prepart, the latewood turns gradually to

the early wood. There are narrow width in latewood. Traumatic resin occasionally found in transverse section. In tangential section, bordered pits generally located in one row. Radial section is mainly composed of uniseriate rays. Horizontal wall of radial parenchyma cell is generally thick and have moniliform (Fig. 4). Cross field pitting observed as *Cryptomeria* type (National Research Institute of Cultural Heritage, 2015; Lee, 1997).

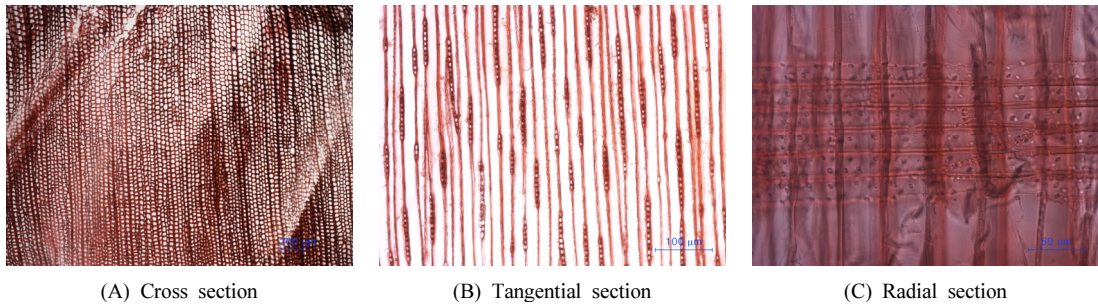


Fig. 4. Micrograph of Korean fir (*Abies* spp.).

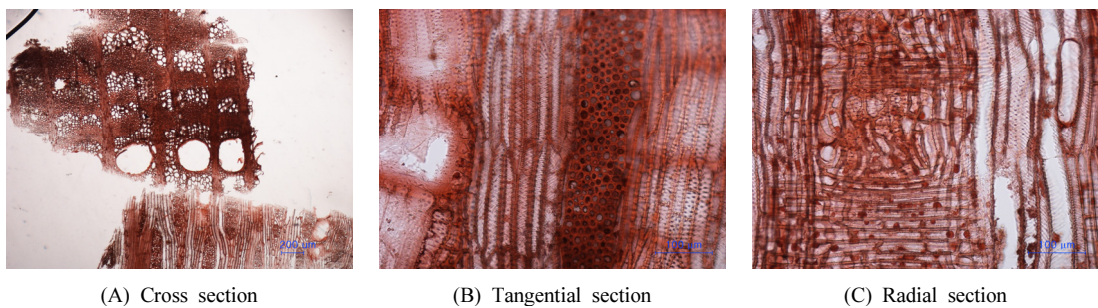


Fig. 5. Micrograph of Zelkova tree (*Zelkova* spp.).

### 3.1.3. Anatomical characteristics of Zelkova tree (*Zelkova* spp.)

As the micro observation result of species identification through optical microscope for each preparat, ring-porous wood can be found in cross section. Large scale of vessels are observed as 1 or 2 rows. Pore cluster are surrounded by axial parenchyma. Intervascular tracheid observed in alternative type (Fig. 5). Spiral thickening can be found in small size of vessel (National Research Institute of Cultural Heritage, 2015; Lee, 1997).

## 3.2. Floor Plan Documentation

Floor plan documentation was performed to present the visual representation of the re-

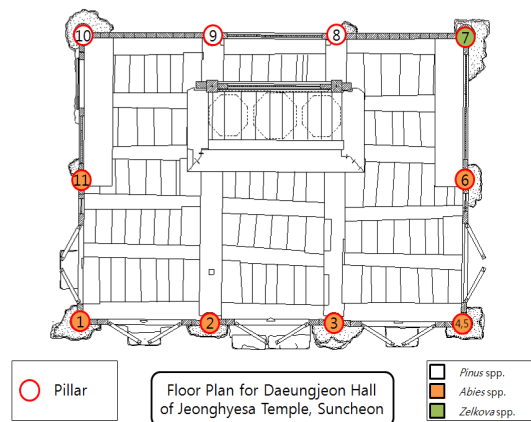


Fig. 6. Floor plan documentation for Daeungjeon Hall of Jeonghyesa Temple, Suncheon.

searched and analysed data (Fig. 6). The floor plan documentation data is expected to aid in the application and utilization of conservation

and restoration of cultural heritage in the future.

#### 4. CONCLUSION

Through species identification of Daeungjeon Hall of Jeonghyesa Temple, Suncheon, there were 3 pillars and identified as hard pine. 7 pillars were identified as Korean fir (*Abies* spp.). 1 pillar was identified as Zelkova tree (*Zelkova* spp.). Interestingly, most of main pillar were made of Korean fir (*Abies* spp.) and hard pine. Also, Zelkova tree (*Zelkova* spp.) was used in pillar. The significance of this is that it implies the use of hard pine, Korean fir (*Abies* spp.) and Zelkova tree (*Zelkova* spp.) in constructing temples in Korea. This also implies the existence of hard pine, Korea fir (*Abies* spp.) and Zelkova tree (*Zelkova* spp.) in ancient times of Korea. Most importantly, this database let us use same species of wood in the conservation and restoration for Daeungjeon Hall of Jeonghyesa Temple, aiding in the authenticity.

Furthermore, through species identification of other important traditional wooden buildings, more databases can be gathered, ultimately leading to authentic conservation and restoration of wooden cultural heritage in Korea.

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