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Wood Identification of the Veneer Species that grow in Korea[1]

— I. Wood Characteristics and Identification by the Gross Features —

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韓國産 單板樹種의 木材識別[1]

— I. 肉眼的 性質에 의한 木材의 特性 및 그 識別 —

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要 約

本 硏究는 韓國産 單板樹種의 木材特性을 調査하여 合板工業에 必要한 基礎資料를 제공하기 위해 實施하였다.

最近 木材資源이 점차 枯渴되어 外材의 導入事情이 惡化됨에 따라 合板工業에 國産材의 活用을 增進시키고 그 加工技術을 發展시킴에 있어서 單板樹種의 木材特性에 關한 硏究는 우선적으로 취급되어야 할 것이다.

本 硏究에서 取扱된 單板樹種은 우리 나라에 生長하고 있는 33個의 屬으로부터 50個의 經濟樹種을 選定하였으며 이들 樹種에 대하여 주로 肉眼的 木材特性을 調査하여 樹種別로 記載하였고 이를 바탕으로 하여 針葉樹材 및 濶葉樹材別로 木材識別 檢索表를 簡略하게 作成하여 報告한다.

本 硏究에서 肉眼的 特性에 따른 識別 圖表를 作成하고 이를 바탕으로 하여 만든 우리나라産 單板樹種의 肉眼的 識別 檢索表를 나타내면 다음과 같다.

肉眼的 性質에 의한 木材의 檢索表

A. 裸子植物(針葉樹)의 檢索表

1. 樹脂溝가 存在한다 ——— 2
1. 樹脂溝가 存在하지 않는다 ——— 7
   2. 樹脂溝가 多數 存在하며 그 判明度는 明이다 ——— 3
   2. 樹脂溝의 判明度는 약간 不明 또는 全不明이다 ——— 6
3. 春材에서 秋材로의 假導管 移行은 약간 急이다. 心材는 黃褐色 邊材는 赤黃色을 나타낸다 —잣나무
3. 春材에서 秋材로의 假導管 移行은 急이다. 心材는 赤褐色을 나타낸다 ——— 4
   4. 年輪界의 判明度는 極明이고 邊材는 淡黃白色을 나타낸다 ———곰솔
   4. 年輪界의 判明度는 明이고 邊材는 黃白 또는 淡黃白色을 나타낸다 ——— 5
5. 心邊材의 判明度는 極明이고 邊材는 淡黃白色을 나타낸다 ———소나무
5. 心邊材의 判明度는 明이고 邊材는 黃白色을 나타낸다 ———리기다소나무

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6. 年輪界와 心邊材의 判明度는 明이다. 心材는 褐色, 邊材는 白色을 나타낸다 ——— 일본잎갈나무
6. 年輪界의 判明度는 極明이나 心邊材의 判明度는 약간 不明이다. 材色은 黃色을 나타낸다 ——— 가문비나무
7. 心材는 짙은 色을 나타낸다 ——— 8
7. 心材는 비교적 옅은 色을 나타낸다 ——— 10
8. 心材는 暗赤 또는 黑褐色, 邊材는 白色을 나타낸다. 年輪界 및 心邊材의 判明度는 明이다 ——— 삼나무
8. 心材는 赤褐 또는 暗赤褐色을 나타내고 年輪은 波狀의 走向을 나타낸다 ——— 9
9. 心材는 赤褐色, 邊材는 黃白色을 나타낸다. 心邊材의 判明度는 極明, 年輪界의 判明度는 明 또는 全不明이며 木材特有의 약한 香氣를 지닌다 ——— 주목
9. 心材는 暗赤褐色, 邊材는 白色을 나타내고 心邊材의 判明度는 極明이다. 年輪界의 判明度는 全不明이고 木材 特有의 강한 香氣를 지닌다 ——— 향나무
10. 年輪界와 心邊材의 判明度는 明이다. 春材에서 秋材로의 假導管 移行은 약간 急이다. 心材는 褐黃白色, 邊材는 黃色을 나타낸다 ——— 젓나무
10. 心邊材의 判明度는 약간 不明이다 ——— 11
11. 年輪界의 判明度는 明이고 春材에서 秋材로의 假導管 移行은 漸이다. 心材는 淡黃褐色 또는 淡赤色, 邊材는 淡黃白色을 나타낸다 ——— 편백
11. 年輪은 波狀의 走向을 나타내는데 그 判明度는 약간 不明이다. 春材에서 秋材로의 假導管 移行은 極漸이며 心材는 赤褐色, 邊材는 黃白色을 나타낸다 ——— 은행나무

B. 被子植物(濶葉樹)의 檢索表

1. 環孔材이다 ——— 2
1. 散孔材 또는 放射孔材이다 ——— 18
2. 年輪界의 判明度는 明이다 ——— 3
2. 年輪界의 判明度는 極明이다 ——— 16
3. 春材에서 秋材로의 管孔 移行은 약간 急부터 極急이다 ——— 4
3. 春材에서 秋材로의 管孔 移行은 漸 또는 極漸이다 ——— 15
4. 春材에서 秋材로의 管孔 移行은 極急이며 年輪界는 거미줄 모양의 角을 지닌다. 心材는 淡黃褐色, 邊材는 淡黃白 또는 淡赤白色을 나타낸다 ——— 음나무
4. 春材에서 秋材로의 管孔 移行은 急 또는 약간 急이다 ——— 5
5. 心邊材의 判明度는 明 또는 極明이다 ——— 6
5. 心邊材의 判明度는 약간 不明이다 ——— 13
6. 邊材는 淡褐白色이다 ——— 7
6. 邊材는 黃白 또는 淡黃白色을 나타낸다 ——— 10
7. 心邊材의 判明度는 極明이다 ——— 8
7. 心邊材의 判明度는 明이다 ——— 9
8. 心材는 暗黃褐色이다 ——— 떡갈나무
8. 心材는 明黃褐色이다 ——— 갈참나무
9. 心材는 暗褐色이며 春材에서 秋材로의 管孔 移行은 가끔 漸이다 ——— 느릅나무
9. 心材는 淡黃褐色이며 春材에서 秋材로의 管孔 移行은 가끔 急이다 ——— 졸참나무
10. 心材는 赤褐, 黃褐 또는 綠褐色을 나타낸다 ——— 11
10. 心材는 暗黃色이며 邊材幅이 좁다 ——— 아까시나무
11. 導管溝의 判明度는 明이다 ——— 12

11. 導管溝의 判明度는 약간 不明이며 心材는 綠褐色을 나타낸다 ——— 뽕나무
12. 心材는 黃褐色이다 ——— 들메나무
12. 心材는 赤褐色이다 ——— 느티나무
13. 心材는 淡褐色, 邊材는 淡赤黃色을 나타낸다. 나무결은 거칠다 ——— 상수리나무
13. 心材는 極淡黃色, 邊材는 白色을 나타낸다 ——— 14
14. 導管溝는 참오동나무보다 덜 明確하다 ——— 오동나무
14. 導管溝는 오동나무보다 더 明確하다 ——— 참오동나무
15. 心邊材의 判明度는 약간 不明이며 材色은 淡黃褐色이다 ——— 팽나무
15. 心邊材의 判明度는 明이고, 心材는 褐色, 邊材는 褐灰色을 나타낸다. 邊材幅이 좁다 ——— 밤나무
16. 春材에서 秋材로의 管孔 移行은 急이다 ——— 17
16. 春材에서 秋材로의 管孔 移行은 極急이며 心材는 黃褐色, 邊材는 淡黃色이다 ——— 신갈나무
17. 心邊材의 判明度는 極明이며 心材는 暗黃褐色, 邊材는 黃白色을 나타낸다 ——— 다릅나무
17. 心邊材의 判明度는 全不明이다 ——— 물푸레나무
18. 散孔材이다 ——— 19
18. 放射孔材이다 ——— 33
19. 年輪界의 判明度는 明이다 ——— 20
19. 年輪界의 判明度는 약간 不明 또는 全不明이다 ——— 27
20. 春材에서 秋材로의 管孔 移行은 漸 또는 極漸이다 ——— 21
20. 春材에서 秋材로의 管孔 移行은 약간 急 또는 急이다. 心邊材의 判明度는 약간 不明이다. 心材는 黃褐色, 邊材는 淡黃褐色이다 ——— 버드나무
21. 春材에서 秋材로의 管孔 移行은 極漸이다 ——— 22
21. 春材에서 秋材로의 管孔 移行은 漸이다 ——— 25
22. 心邊材의 判明度는 明이며 邊材는 白에서 淡黃褐 또는 淡赤褐色, 心材는 淡褐에서 暗褐 또는 赤褐色을 나타낸다 ——— 양버즘나무
22. 心邊材의 判明度는 全不明이다 ——— 23
23. 材色은 淡黃白 또는 淡赤白色이다 ——— 24
23. 材色은 白色이다 ——— 단풍나무
24. 材色은 淡赤白色이다 ——— 신나무
24. 材色은 淡黃白色이다 ——— 후박나무
25. 心邊材의 判明度는 약간 不明이며 心材는 褐色, 邊材는 灰白色이다 ——— 호도나무
25. 心邊材의 判明度는 全不明이다 ——— 26
26. 材色은 淡黃白色이다 ——— 피나무
26. 材色은 紅褐色이다 ——— 고로쇠나무
27. 年輪界의 判明度는 全不明이고 春材에서 秋材로의 管孔 移行은 極漸이다 ——— 28
27. 年輪界의 判明度는 약간 不明이다 ——— 29
28. 心邊材의 判明度는 明이며 邊材는 淡黃褐色, 心材는 赤褐色이다 ——— 산벚나무
28. 心邊材의 判明度는 약간 不明이며 材色은 黃白 또는 淡黃褐이다 ——— 자작나무
29. 春材에서 秋材로의 管孔 移行은 極漸이다 ——— 30
29. 春材에서 秋材로의 管孔 移行은 漸이다 ——— 31
30. 心邊材의 判明度는 極明이며 心材는 黑色, 邊材는 淡黃色을 나타낸다 ——— 감나무
30. 心邊材의 判明度는 약간 不明이며 心材는 淡黃褐色, 邊材는 白 또는 極淡褐色을 나타낸다 ——— 황철나무
31. 心邊材의 判明度는 明이며 心材는 暗褐色, 邊材는 灰白色을 나타낸다 ——— 가래나무
31. 心邊材의 判明度는 약간 不明 또는 全不明이다 ——— 32

32. 心材는 赤褐 또는 紅褐色, 邊材는 淡黃褐色이다 ——— 박달나무
32. 心材는 淡灰褐色, 邊材는 거의 白色을 나타낸다 ——— 현사시나무
33. 年輪界의 判明度는 明이며 春材에서 秋材로의 管孔 移行은 漸이다 ——— 34
33. 年輪界의 判明度는 약간 不明 또는 全不明이다 ——— 36
34. 心邊材의 判明度는 약간 不明이며 邊材는 極淡黃褐色, 心材는 黃褐色이다 ——— 물오리나무
34. 心邊材의 判明度는 全不明이다 ——— 35
35. 材色은 淡紅白色이다 ——— 찰피나무
35. 材色은 淡紅褐色이다 ——— 함박꽃나무
36. 年輪界의 判明度는 全不明이며 材色은 黃白 또는 紅黃白色을 나타낸다 ——— 서어나무
36. 年輪界와 心邊材의 判明度는 약간 不明이다 ——— 37
37. 心材는 淡褐色, 邊材는 褐白色을 나타낸다 ——— 붉가시나무
37. 心材는 黃褐色, 邊材는 淡黃褐色을 나타낸다 ——— 오리나무

Summary

This study was executed to offer the basical data needed to the plywood industry as examining on the wood characteristics of veneer species that grow in Korea.

According to the aggravation of log import from foreign countries caused by the gradual exhaustion of wood resources in recent years, the study on wood characteristics of veneer species growing in Korea should be carried out preferentially in promotion of the domestic timber utilization and development of it's processing technique for plywood industry.

50 commercial veneer species in this study were selected from 33 genuses, and general macroscopical wood characteristics for them were examined and described by the species. And also keys for the identification based on gross features were briefly prepared and presented by gymnosperm and angiosperm respectively.

Key words: veneer species that grow in Korea, macroscopical wood characteristics, gymnosperm (softwood), angiosperm (hardwood), key for identification.

Introduction

Plywood industry in Korea has been developed rapidly during short period of past 20 years since 1961. According to the Korea Plywood Industry Association(1982), it reached to recent peak of 6,880,833 thousand square feet in production in 1978. After that year, the production has shown decreasing tendency a little but it is one of the most important wood processing industries in Korea.

During past two decades, Korean plywood industry has attained a fine reputation for their high quality coupled with relatively low price in world market. However, because the timber prices in Indonesia and Malaysia are rising rapidly and oil and labor costs are jumping as a whole, the Korean plywood industry is evidencing a change from general panel production into high quality specialty plywood or processing custom products to the customer's order. By the report of Lee. P. W.(1980) there are 94 plywood mills but large scale 14 mills located in the harbor cities such as Pu-San, Gun-San and In-Cheon are producing most of the plywoods. However they suffered from the insufficient log supply from foreign sources in recent days.

In Korea, veneer logs for plywood manufacturers were dependent on foreign sources except small quantity of decorative hardwood veneer. Accordingly, massive quantity of veneer logs needed to the plywood industry was imported each year from the southeastern pacific regions such as Indonesia, Malaysia, Philippines and Papua New Guinea. Because of worldwide general tendency of steadily rising cost and exhausted resources of timber, Korean plywood industry is destined to very strain-

ed circumstances in log supply. Therefore, it is forced to exploit the domestic resources of veneer species for the sake of dissolution of hard log supplying condition even a little.

As a summarized first report, this paper purposes to report the timber and wood characteristics on the more important species relevant to veneer production that grow in Korea.

Description method of veneer species

In the Korean peninsula, it was known that more or less abundant about 1,000 woody species including varieties are growing by the reported papers of Korea Government Forest Experiment Station (1939), Shim et al(1949), Chung(1961) and Lee (1966, 1980).

Panshin and De Zeeuw(1980),however,described in their text that the number of commercial timbers in a country was never so large as the number of tree species because woods frequently can not be separated with certainly "to species" and also many arborescent species seldom attain a size that would make them of merchantable value in terms of saw logs. Accordingly, only 50 species believed economical in the future as veneer producing ones were selected from the views of tree size, wood quality, and values of technological development in wood industry.

The scientifical names were described by the papers of Shim et al (1949) and Lee(1966, 1980) and also Korean common names were listed from translation by author. Macroscopical wood characteristics of the selected species were checked with magnifier or naked eye such as growth ring, transition from springwood to summerwood tracheid or pore, resin canal, wood ray, sapwood and heartwood feature, and what not on cross, radial, and tangential surface. Timber characteristics, physical or mechanical features and wood uses were described from the extraction of Yamabayashi(1938), Korea Government Forest Experiment Station (1939), Chung(1961), Lee(1966), and Park et al (1980), and description form followed IUFRO Working Party on Slicing and Veneer Cutting (1976) and Lutz(1972) except veneer cutting and drying characteristics which were not studied as yet in Korea.

At the same time, keys for the identification based on gross features in this study were prepared and presented by the gymnosperm and angiosperm of veneer species that grow in Korea respectively.

Timber and wood characteristics

A. Gymnosperm(Softwood)

***Abies holophylla* Max. (Jeot-namoo)**

Mature trees attain a diameter of 150 centimeters and a height of 40 meters. It grows on mountainside and valley. Growth rings and boundary between sapwood and heartwood are distinct to the naked eye and ring width is almost uniform. Wood colors are brownish to yellowish white heartwood and yellow in sapwood. Transition from springwood to summerwood tracheids shows slightly decrease in its size. Wood has coarse texture, luster, light weight and is soft in hardness. Air dry specific gravities are 0.37 heartwood and 0.33 in sapwood. Shrinkages are 3.6 radial and 7.8% in tangential direction. Strengthes are 580 bending, 410 compression and 76 kg/cm^2 in shear. It is used for building construction, box, civil engineering work, furniture, veneer, and pulpwood.

***Chamaecyparis obtusa* Endl.(Pyeon-bag)**

Mature trees attain a diameter of 100 to 200 centimeters and a height of 40 meters. It grows around village and tombs. Growth rings are distinct and boundary between sapwood and heartwood is slightly inconspicuous to the naked eye. Wood colors are light yellowish brown or light red heartwood and light yellowish white in sapwood. Transition from springwood to summerwood tracheids shows gradual decrease in its size and width of summerwood is narrow. Wood has straight grain, coarse texture, light weight and is soft in hardness. Air dry specific gravity is 0.40. Shrinkages are 3.6 radial and 6.9% in tangential direction. Strengthes are 840 bending, 470 compression and 82 kg/cm^2

in shear. It is used for building construction, implement, furniture, machine, car and ship construction, civil engineering work, carving, crate, musical instrument, and pulpwood.

***Cryptomeria japonica* D. Don(Sam-namoo)**

Mature trees attain a diameter of 100 to 200 centimeters and a height of 40 meters. It grows on valley having pertinent humidity. Growth rings and boundary between sapwood and heartwood are distinct to the naked eye. Wood colors are dark red or blackish brown heartwood and white in sapwood. Transition from springwood to summerwood tracheids shows slightly abrupt decrease in its size and summerwood width is wide. Wood has straight grain, coarse texture, very light weight and is soft in hardness. Air dry specific gravity is 0.37. Shrinkages are 3.0 radial and 7.5% in tangential direction. Strengthes are 730 bending, 410 compression and 65 kg/cm^2 in shear. It is used for building construction, pole, furniture, crate, car and ship construction, implement, veneer, carving, and wine keg.

***Ginkgo biloba* L.(Eun-hang-namoo)**

Mature trees attain a diameter of 400 centimeters and a height of 61 meters. It grows around village and temple. Growth rings which show wave-like running and boundary between sapwood and heartwood are slightly indistinct to the naked eye. Wood colors are light brownish yellow to white heartwood and yellowish white in sapwood. Transition from springwood to summerwood trachieds shows very gradual decrease in its size. Wood has fine texture and straight grain. Air dry specific gravity is 0.50 to 0.60. Shrinkages are 3.0 radial and 4.9% in tangential direction. Strengthes are 500 bending, 430 compression and 65 kg/cm^2 in shear. It is used for carving, implement, building construction, and badoog board.

***Juniperus chinensis* L. (Hyang-namoo)**

Mature trees attain a diameter of 100 centimeters and a height of 23 meters. It grows on mountain-side, the foot of mountain, and around village. Growth rings, which show irregular running in part, are thoroughly invisible and boundary between sapwood and heartwood is very conspicuous to the naked eye. Wood colors are dark reddish brown heartwood and near white in sapwood. Transition from springwood to summerwood tracheids shows abrupt decrease in its size. Wood has characteristic strong odor, straight grain and fine texture. Air dry specific gravity is 0.64. It is used for carving and furniture.

***Larix leptolepis* Gord. (Il-bon-ip-gal-namoo)**

Mature trees attain a diameter of 100 centimeters and a height of 30 meters. It grows on inland area with small precipitation during winter and likes low temperature. Resin canals are slightly or quite inconspicuous, growth rings are distinct and boundary between sapwood and heartwood is conspicuous to the naked eye. Wood colors are brown heartwood and white in sapwood. Transition from springwood to summerwood tracheids shows very abrupt decrease in its size and distinguishness of these two is distinct to the unaided eye. Wood has straight grain, coarse texture, and easy drying, splitting properties. Air dry specific gravity is 0.50. Strengthes are 450 compression and 800 kg/cm^2 in bending. It is used for building construction, railroad crosstie, pole, ship construction, and pulpwood.

***Picea jezoensis* Carr. (Ga-moon-bi-namoo)**

Mature trees attain a diameter of 100 centimeters and a height of 40 meters. It grows on upper part of mountains. Resin canals are slightly or quite inconspicuous, growth rings are very distinct to the naked eye and ring width is almost uniform without variation. Boundary between sapwood and heartwood is slightly invisible to the unaided eye. Wood color is yellowish white. Transition from springwood to summerwood tracheids shows very gradual decrease in its size and summerwood width is very narrow. Wood has coarse texture and straight grain. Air dry specific gravity is 0.43. Shrinkages are 2.6 radial and 4.8% in tangential direction. Strengthes are 350 compression and 700 kg/cm^2 in bending. It is used for building construction, pulpwood, implement, soundboard of piano, furniture, and ship construction.

***Pinus densiflora* S. et Z.(So-namoo)**

Mature trees attain a diameter of 180 centrimeters and a height of 30 meters. It grow on mountainous land through the nation. Resin canals are numerous and conspicuous, growth rings are distinct, and boundary between sapwood and heartwood is very conspicuous to the naked eye. Wood colors are light yellowish white sapwood and reddish brown in heartwood. Transition from springwood to summerwood tracheids shows abrupt decrease in its size and width of summerwood is wide. Wood has straight grain, coarse texture, light weight and is soft in hadrness. Air dry specific gravity is 0.52. Shrinkages are 4.9 radial and 9.1% in tangential direction. Strengthes are 890 bending, 480 compression and 101 kg/cm^2 in shear. It is used for building construction, furniture, implement, crate, carving, plywood, and pulpwood.

***Pinus koraiensis* S. et Z.(Jiat-namoo)**

Mature trees attain a diameter of 82 centimetrs and a height of 33 meters. it grows on mountainside and valley. Resin canals are numerous and conspicuous, growth rings and boundary between sapwood and heartwood are distinct to the naked eye. Wood colors are yellowish brown heartwood and reddish yellow in sapwood. Transition from springwood to summerwood tracheids shows slightly abrupt decrease in its size. Wood has narrow rays, which are barely visible to the unaided eye on cross surface, ginseng steamed red-like odor, straight grain, coarse texture, luster and light weight. Air dry specific gravity is 0.48. Shrinkages are 2.8 radial and 7.4% in tangential direction. Strengthes are 770 bending, 430 compression and 95 kg/cm^2 in shear. It is used for building construction, implement, crate for ginseng steamed red, car and ship construction, railroad crosstie, musical instrument, carving, and pulpwood.

***Pinus rigida* Mill.(Ri-gi-da-so-namoo)**

Mature trees attain a diameter of 100 centimeters and a height of 25 meters. It grows on the foot of mountain and mountainside. Resin canals are numerous and conspicuous, growth rings delineated by a pronounced band of dark summerwood and boundary between sapwood and heartwood are distinct to the naked eye. Wood colors are reddish brown heartood and yellowish white in sapwood. Transition from springwood to summerwood tracheids shows abrupt decrease in its size. Wood has straight grain, coarse texture, light weight and is soft in hardness. Air dry specific gravity is 0.54. Shrinkages are 5.5 radial and 7.9% in tangential direction. Strengthes are 950 in bending, 470 compression and 103 kg/cm^2 in shear. It is used for building construction, implement, crate, plywood, and pulpwood.

***Pinus thunbergii* Parlatore(Gom-sol)**

Mature trees attain a diameter of 100 centimeters and a height of 28 meters. It grows on mountainous land adjacent to the waters. Resin canals are numerous and conspicuous, growth rings are very distinct, and boundary between sapwood and heartwood is distinct to the naked eye. Wood colors are reddish brown heartwood, yellowish white in sapwood. Transition from springwood to summerwood tracheids shows abrupt decrease in its size. Wood has straight grain, coarse texture, light weight and is soft in hardness. Air dry specific gravity is 0.54. Shrinkages are 4.4 radial and 8.3% in tangential direction. Strengthes are 990 bending, 570 compression and 135 kg/cm^2 in shear. It is used for building construction, civil engineering work, crate, ship and car construction, furniture, implement, and pulpwood.

***Taxus cuspidata* S. et Z.(Joo-mog)**

Mature trees attain a diameter of 300 to 500 centimeters and a height of 17 meters. It grows on mountain's breast and valley. Growth rings, which show narrow width and irregular running, are distinct or quite invisible and boundary between sapwood and heartwood is very distinct to the naked eye. Wood colors are reddish brown heartwood and yellowish white in sapwood. Transition from springwood to summerwood tracheids shows gradual or abrupt decrease in its size. Wood has characteristic weak odor. Air dry specific gravity is 0.50. Strenghes are 700 bending and 400 kg/cm^2 in compression. It is used for implement, carving, and building construction.

B. Angiosperm (Hardwood)

Acer ginnala **Max. (Sin-namoo)**

Mature trees attain a height of 8 meters. It grows on the mountain and plains. Growth rings are distinct and boundary between sapwood and heartwood is slightly to thoroughly invisible to the naked eye. Wood color is light reddish white. Transition from springwood to summerwood pores shows gradual, very gradual decrease or some uniformity in its size. Wood is medium in hardness. Diffuse-porous wood. Air dry specific gravity is 0.60. It is used for implement, pole, and carving.

Acer mono **Max. (Go-ro-sae-namoo)**

Mature trees attain a diameter of 100 centimeters and a height of 20 meters. It grows on the valley Growth rings are distinct but boundary between sapwood and heartwood is indistinct to the naked eye. Wood has much ripple marks, ray flecks, fine texture and pinkish brown color. Transition form springwood to summerwood pores shows very gradual decrease or some uniformity in its size. Diffuse-porous wood. Pores are small or very small in size. Air dry specific gravity is 0.75 and shrinkages are 5.3 radial and 8.8% in tangential direction. Strengthes are 1130 bending, 510 compression and 177 kg/cm^2 in shear. It is used for implement, furniture, sporting goods, musical instrument, lathing, decoration in car or ship construction, and plywood(face veneer).

Acer palmatum **Thunb. (Dan-poong-namoo)**

Mature trees attain a diameter of 60 to 80 centimeters and a height of 10 meters. It grows on valley. Growth rings are distinct and boundary between sapwood and heartwood is thoroughly invisible to the naked eye. Wood color is white. Transition from springwood to summerwood pores shows very gradual decrease in its size. Wood is medium in hardness. Diffuse-porous wood. Air dry specific gravity is 0.79. It is used for plywood, carving, crate, and implement.

Alnus hirsuta **Rupr. (Mool-o-ri-namoo)**

Mature trees attain a diameter of 60 centimeters and a height of 20 meters. It grows on mountainous area. Growth rings are distinct and boundary between sapwood and heartwood is slightly invisible to the naked eye. Wood colors are very light yellowish brown sapwood and yellowish brown in heartwood. Transition from springwood to summerwood pores shows usually gradual but occasionally very gradual or slightly abrupt decrease in its size. Vessel lines are slightly invisible to the unaided eye and ray in color is light brown on radial surface. Wood is radial-porous and soft in hardness. Air dry specific gravity is 0.54. Shrinkages are 3.6 radial and 9.0% in tangential direction. Strengthes are 690 bending, and 340 kg/cm^2 in compression. It is used for implement, stationery(pencil), furniture, ship construction, and pulpwood.

Alnus japonica **Steudel (O-ri-namoo)**

Mature trees attain a diameter of 70 centimeters and a height of 20 meters. It grows on low wet site, occasionally mountainous land or around village. Growth rings and boundary between sapwood and heartwood are slightly indistinct to the naked eye. Wood colors are yellowish brown heartwood and light yellowish brown in sapwood. Pores are small or very small in size and very numerous in numbers. Transition from springwood to summerwood pores shows gradual, very gradual decrease in its size. Radial-porous wood having diffused pores. Air dry specific gravity is 0.51. Shrinkages are 3.6 radial and 9.0% in tangential direction. Strengthes are 950 bending, 530 compression and 164 kg/cm^2 in shear. It is used for implement, furniture, lathing, plywood, and pulpwood.

Betula schmidtii **Regel (Bag-dal-namoo)**

Mature trees attain a diameter of 100 centimeters and a height of 30 meters. It grows on upper parts or deep forest of Mt. Chi-Ri. Growth rings are indistinct to the naked eye. Sapwood and heartwood are light yellowish brown and reddish or pinkish brown in color, respectively. Transition from springwood to summerwood pores shows gradual or very gradual decrease in its size. Diffuse-porous wood. Air dry specific gravity is 0.90. Shrinkages are 7.4 radial and 9.2% in tangential direction. Strengthes are 1100 bending and 527 kg/cm^2 in compression. It is used for implement,

car construction, machine, carving, comb, fine wood working, and veneer.

***Betula platyphylla var. japonica* Hara(Ja-jag-namoo)**

Mature trees attain a height of 20 meters. It grows on deep mountainous land. Growth rings and boundary between sapwood and heartwood are slightly indistinct to the naked eye. Wood color is yellowish white or light yellowish brown. Transition from springwood to summerwood pores shows very gradual decrease or some uniformity in its size. Wood has fine texture. Diffuse-porous wood. Air dry specific gravity is 0.52. Shrinkages are 4.9 radial and 8.6% in tangential direction. Strengthes are 760 bending, 400 compression and 104 kg/cm^2 in shear. It is used for implement, musical instrument, plywood, machine, building construction, carving, and pulpwood.

***Carpinus laxiflora* Blume (Seo-namoo)**

Mature trees attain a diameter of 100 centimeters and a height of 15 meters. It grows on mountainous forest and valley. Growth rings and boundary between sapwood and heartwood are indistinct to the naked eye. Wood color is yellowish white or pinkish yellow white. It is observable narrow or broad rays in cross surface to the naked eye. Transition from springwood to summerwood pores shows very gradual decrease or some uniformity in its size. Pores are very small in size and very few in number. Radial-porous wood. Air dry specific gravity is 0.74. Shrinkages are 7.3 radial and 13.1% in tangential direction. Strengthes are 660 bending, 400 compression and 131 kg/cm^2 in shear. It is used for building construction, sporting goods, carving, lathing, musical instrument, and veneer.

***Castanea crenata* S. et Z. (Bam-namoo)**

Mature trees attain a diameter of 100 centimeters and a height of 15 meters. It grows on mountainous area and plains. Growth rings and boundary between sapwood and heartwood are distinct to the naked eye. Wood colors are brown heartwood and brownish gray in sapwood. Transition from springwood to summerwood pores shows gradual decrease in its size. Wood has coarse texture, light weight, and narrow sapwood width. Ring-porous wood. Air dry specific gravities are 0.81 heartwood and 0.59 in sapwood. Shrinkages are 5.1 radial and 10.8% in tangential direction. Strengthes are 850 bending, 390 compression and 80 kg/cm^2 in shear. It is used for civil engineering work, building construction, musical instrument, ship and car construction, furniture, spindle, and carving.

***Celtis sinensis* Persson (Pang-namoo)**

Mature trees attain a diameter of 150 centimeters and a height of 20 meters. It grows on level land, the foot of mountain, valley, riverside and around village. Growth rings are comparatively distinct and boundary between sapwood and heartwood is slightly invisible to the naked eye. Wood color is light yellowish brown. Transition from springwood to summerwood pores shows comparatively gradual decrease in its size and springwood pores are visible but indistinct to the unaided eye. Ring-porous wood. Air dry specific gravity is 0.62. Strengthes are 350 compression and 480 kg/cm^2 in bending. It is used for building construction, implement, sporting goods(racket), furniture, and machine.

***Diospyros kaki* Thunb. (Gam-namoo)**

Mature trees attain a height of 14 meters. It grows around villages. Growth rings are slightly invisible and boundary between sapwood and heartwood is very distinct to the naked eye. Wood colors are black heartwood and light stained yellow in sapwood. Transition from springwood to summerwood pores shows very gradual decrease in its size. Vessel lines are very conspicuous to the unaided eye. Diffuse-porous wood. Air dry specific gravity is 0.59. Strengthes are 350 compression and 550 kg/cm^2 in bending. It is used for carving, implement, building construction, sporting goods, and wooden tube for textile manufacturing.

***Fraxinus mandshurica* Ruprecht (Deul-me-namoo)**

Mature trees attain a diameter of 200 centimeters and a height of 30 meters. It grows on valley and in the deep forest. Growth rings and boundary between sapwood and heartwood are distinct to the naked eye. Wood colors are yellowish white sapwood and yellowish brown in heartwood.

Transition from springwood to summerwood pores shows abrupt decrease in its size and vessel line is clear to the unaided eye. Ring-porous wood. Air dry specific gravity is 0.82 to 0.85. Shrinkages are 5.3 radial and 11.2% in tangential direction. Strengthes are 930 bending, 510 compression and 120 kg/cm^2 in shear. It is used for furniture, sporting goods, implement, car and ship construction, machine, musical instrument, lathing, and decorative face veneer.

***Fraxinus rynchophylla* Hance (Mool-poo-re-namoo)**

Mature trees attain a height of 10 meters. It grows on the foot of mountains, valley and riverside. Growth rings are very distinct and boundary between sapwood and heartwood is thoroughly invisible to the naked eye. Wood color is yellowish white. Transition from springwood to summerwood pores shows abrupt decrease in its size. Vessel lines are distinct to the unaided eye. Wood has coarse texture, heavy weight and is hard in hardness. Pith flecks are occasionally occurred on cross surface. Ring-porous wood. Air dry specific gravity is 0.77. Shrinkages are 3.6 radial and 7.3% in tangential direction. Strengthes are 1080 bending, 510 compression and 121 kg/cm^2 in shear. It is used for sporting goods, implement, machine, and car construction.

***Juglans mandshurica* Max. (Ga-rae-namoo)**

Mature trees attain a height of 20 meters. It grows on the base of mountain and valley. Growth rings and boundary between sapwood and heartwood is conspicuous to the naked eye. Wood colors are reddish to dark brown heartwood and grayish white in sapwood. Transition from springwood to summerwood pores shows gradual decrease in its size and springwood pores, which look like ring-porous, are large. It has very narrow or narrow ray and coarse texture. Diffuse-porous wood. Air dry specific gravities are 0.71 sapwood and 0.76 in heartwood. Shrinkages are 1.9 radial and 3.3% in tangential direction. Strenghthes are 420 compression and 800 kg/cm^2 in bending. It is used for rifle head, airplane construction, furniture, implement, carving, and decorative face veneer.

***Juglans sinensis* Dode (Ho-do-namoo)**

Mature trees attain a height of 20 meters. It grows around village. Growth rings and boundary between sapwood and heartwood are visible to the naked eye. Wood colors are brown heartwood and grayish white in sapwood. Transition from springwood to summerwood pores shows gradual decrease in its size. Wood has coarse texture, light weight and is soft in hardness. Diffuse-porous wood. Air dry specific gravities are 0.44 heartwood and 0.55 in sapwood. Shrinkages are 5.4 radial and 9.2% in tangential direction. Strengthes are 900 bending, 500 compression and 120 kg/cm^2 in shear. It is used for implement, building construction, furniture, machine, carving, sporting goods(racket), and musical instrument.

***Kalopanax pictus* Nak. (Eum-namoo)**

Mature trees attain a diameter of 150 centimenters and a height of 25 meters. It grows on sunny place of mountain ridge, roadside and within forest stand. Growth rings, which often have spider's web-like angle, are distinct and boundary between sapwood and heartwood is inconspicuous to the naked eye. Transition from springwood to summerwood pores shows very abrupt decrease in its size. Wood colors are light yellowish brown heartwood and light yellowish or reddish white in sapwood. Wood has coarse texture, lustre and is soft in hardness. Ring-porous wood. Air dry specific gravities are 0.73 heartwood and 0.68 in sapwood. Shrinkages are 5.1 radial and 10.2% in tangential direction. Strengthes are 880 bending, 380 compression and 82 kg/cm^2 in shear. It is used for building construction, implement, plywood, furniture, ship construction, car frame, machine, musical instrument, match pole, sporting goods, and carving.

***Maackia amurensis* Rupr. et Max (Da-reub-namoo)**

Mature trees attain a height of 15 meters. It grows on deep mountains and occasionally hillrock. Growth rings and boundary between sapwood and heartwood are very distinct to the naked eye. Wood colors are dark yellowish brown heartwood and yellowish white in sapwood. Transition from

springwood to summerwood pores shows abrupt or very abrupt decrease in its size. Wood has coarse texture. Ring-porous wood. Air dry specific gravity is 0.59. Strengthes are 400 compression and 930 kg/cm^2 in bending. It is used for building construction, furniture, implement, musical instrument, carving, and decorative veneer.

***Machilus thunbergii* S. et Z. (Hoo-bag-namoo)**

Mature trees attain a diameter of 100 centimeters and a height of 20 meters. It grows on the foot of mountain and the seaside district in south of nation. Growth rings are distinct and boundary between sapwood and heartwood is throughly invisible to the naked eye. Wood color is light yellowish white. Transition from springwood to summerwood pores shows very gradual decrease or some uniformity in its size. Vessel lines are distinct to the unaided eye. Wood has strong lustre and is medium in hardness. Diffuse-porous wood. Air dry specific gravity is 0.58. It is used for seal-engraving, carving, veneer, and crate.

***Magnolia parviflora* S. et Z. (Ham-bag-ggot-namoo)**

Mature trees attain a height of 7 meters. It grows on mountainous area. Growth rings are distinct and boundary between sapwood and heartwood is thoroughly invisible to the naked eye. Transition from springwood to summerwood pores shows abrupt or slightly abrupt decrease in its size. Wood color is light pinkish brown. Air dry specific gravity is 0.50 and radial-porous wood.

***Morus alba var. romana* Loddiges (Bbong-namoo)**

It grows around villages. Growth rings and boundary between sapwood and heartwood are distinct to the naked eye. Wood colors are greenish brown heartwood and yellowish white in sapwood. Transition from springwood to summerwood pores shows slightly abrupt decrease in its size. Vessel lines are slightly indistinct to the naked eye. Ring-porous wood. Air dry specific gravities are 0.65 heartwood and 0.71 in sapwood. It is used for implement and carving.

***Paulownia coreana* Uyeki (O-dong-namoo)**

Mature trees attain a diameter of 60 to 90 centimeters and a height of 15 meters. It grows around the village. Growth rings are distinct to slightly invisible and boundary between sapwood and heartwood is slightly invisible to the naked eye. Wood colors are very light yellow heartwood and white in sapwood. Transition from springwood to summerwood pores shows abrupt decrease in its size. Vessel lines are less distinct than *Paulownia tomentosa* (Thunb.) Steud.. Ring-porous wood. Air dry specific gravity is 0.27. It is used for musical instrument, furniture, crate, and fire-tolerant material.

***Paulownia tomentosa* (Thunb.) Steud. (Cham-o-dong-namoo)**

Mature trees attain a diameter of 120 centimeters and a height of 15 meters. It grows around the village. Growth rings are distinct and boundary between sapwood and heartwood is slightly invisible to the naked eye. Wood colors are very light yellow heartwood and white in sapwood. Transition from springwood to summerwood pores shows abrupt decrease in its size. Vessel lines are more conspicuous than *Paulownia coreana* Uyeki. Ring-porous wood. Air dry specific gravities are 0.32 heartwood and 0.36 in sapwood. It is used for musical instrument, furniture, crate, and fire-tolerant material.

***Platanus occidentalis* L. (Yang-beo-zeum-namoo)**

Mature trees attain a diameter of 80 centimeters and a height of 40 to 60 meters. It grows on fertile soils and used as roadside tree. Growth rings are distinct, delineated by a narrow band of lighter tissue at the outer. Sapwood is whitish to light yellowish or reddish brown, heartwood is light to dark brown or reddish brown in color and boundary between these two is conspicuous to the unaided eye. Pores are small, indistinct or barely visible to the naked eye, numerous and frequently crowded. Wood has irregular interlocked grain and comparatively wide rays. Diffuse-porous wood. Wood is moderately heavy (specific gravities are approximately 0.46 green and 0.54 ovendry) and moderately hard. It is used for fruit and vegetable basket, cigar box, crate, pallet, furniture, and pulpwood.

***Populus alba-glandulosa* L. (Hyun-sa-si-namoo)**

Because of excellent growth, it grows through

the nation well. Growth rings are indistinct but visible somewhat and boundary between sapwood and heartwood is inconspicuous to the naked eye. Wood colors are light grayish brown heartwood and almost white in sapwood. Transition from springwood to summerwood pores shows gradual decrease in its size and diametral difference between initial pores of springwood and terminal pores of summerwood is comparatively conspicuous but it is difficult to recognize the pores with unaided eye. The proportion of pores is higher than any other hardwoods and represents about 30%. Wood has coarse texture, light weight and is soft in hardness. Diffuse-porous wood. Air dry specific gravity is 0.46. Shrinkages are 3.9 radial and 8.3% in tangential direction. Strengthes are 860 bending, 420 compression and 110 kg/m^2 in shear. It is used for veneer, implement, crate, match pole, and pulpwood.

***Populus maximowiczii* Henry (Hwang-cheol-namoo)**

Mature trees attain a diameter of 100 centimeters and a height of 30 meters. It grows on wet site of valley and fertile soils of riverside. Growth rings and boundary between sapwood and heartwood are slightly invisible to the unaided eye. Wood colors are light yellowish brown heartwood and white or very light brown in sapwood. Transition from springwood to summerwood pores shows very gradual decrease in its size. Pores are small in size and abundant in numbers. Pith flecks are revealed on cross surface. Wood is diffuse-porous and soft in hardness. Air dry specific gravities are 0.48 heartwood and 0.52 in sapwood. It is used for box, implement, match pole, and pulpwood.

***Prunus sargentii* Rehder (San-beot-namoo)**

Mature trees attain a diameter of 90 centimeters and a height of 20 meters. It grows on mountainous land near to the sea. Growth rings are indistinct, pith flecks are frequently revealed and boundary between sapwood and heartwood is conspicuous to the naked eye. Wood colors are light yellowish brown sapwood and reddish brown in heartwood. Transition from springwood to summerwood pores shows gradual decrease or some uniformity in its size, but it is difficult to recognize pores with unaided eye. Wood is diffuse-porous and has coarse texture. Air dry specific gravity is 0.62. Strengthes are 1050 bending, and 450 kg/cm^2 in compression. It is used for building construction, furniture, machine, musical instrument, ship construction, carving, crate, and decorative face veneer.

***Quercus acuta* Thunb. (Boog-ga-si-namoo)**

Mature trees attain a diameter of 60 centimeters and a height of 20 meters. It grows on the abdominal region of islands located in the south of nation. Growth rings and boundary between sapwood and heartwood are slightly invisible to the naked eye. Wood colors are light brown heartwood and light brownish white in sapwood. Transition from springwood to summerwood pores shows gradual decrease in its size. Wood is radial-porous and hard in hardness. Air dry specific gravities are 0.74 heartwood and 0.78 in sapwood. It is used for implement, car and boat construction, musical instrument, and building construction.

***Quercus acutissima* Carr. (Sang-soo-ri-namoo)**

Mature trees attain a diameter of 100 centimeters and a height of 25 meters. It grows on lower land and mountains. Growth rings are distinct and boundary between sapwood and heartwood is slightly invisible to the naked eye. Wood colors are light brown heartwood and light reddish yellow in sapwood. Transition from springwood to summerwood pores shows gradual or abrupt decrease in its size. Wood has coarse texture. Rays and springwood pores are observed with unaided eye. Ring-porous wood. Air dry specific gravity is 0.84. Shrinkages are 5.0 radial and 8.3% in tangential direction. Strengthes are 1480 bending, 530 compression and 142 kg/cm^2 in shear. It is used for furniture, building construction, plywood, ship and car construction, machine, sporting goods, and crates.

***Quercus aliena* Bl. (Gal-cham-namoo)**

Mature trees attain a diameter of 100 centimeters and a height of 25 meters. It grows on the bottom of mountains. Growth rings are distinct and

boundary between sapwood and heartwood is very distinct to the naked eye. Wood colors are bright yellowish brown heartwood and light brownish white in sapwood. Transition from springwood to summerwood pores shows abrupt decrease in its size. Wood has coarse texture and is hard in hardness. Ring-porous wood. Air dry specific gravities are 0.67 heartwood and 0.59 in sapwood. Shrinkages are 5.5 radial and 10.7% in tangential direction. Strengthes are 1330 bending, 560 compression and 154kg/cm^2 in shear. It is used for implement, car construction, and plywood.

***Quercus dentata* Thunb. (Ddeog-gal-namoo)**

Mature trees attain a diameter of 70 centimeters and a height of 20 meters. It grows on sunny place of the base of mountains. Growth rings are distinct and boundary between sapwood and heartwood is very distinct to the naked eye. Wood colors are dark yellowish brown heartwood and light brownish white in sapwood. Transition from springwood to summerwood pores shows abrupt decrease in its size. Wood has coarse texture and is soft in hardness. Ring-porous wood. Air dry specific gravities are 0.84 heartwood and 0.74 in sapwood. Shrinkages are 5.0 radial, 8.3% in tangential direction. Strength is 740 kg/cm^2 in compression. It is used for implement, carving, veneer, and crate.

***Quercus mongolica* Fischer (Sin-gal-namoo)**

Mature trees attain a diameter of 100 centimeters and a height of 30 meters. It is observed in the stand mixed with genus *picea*. Growth rings and boundary between sapwood and heartwood are very conspicuous to the naked eye. Wood colors are yellowish brown heartwood and light yellow in sapwood. Transition from springwood to summerwood pores shows very abrupt decrease in its size. Vessel lines are clear and broad rays are conspicuous to the unaided eye. Wood has coarse texture and is ring-porous. Air dry specific gravities are 0.69 sapwood and 0.74 in heartwood. Shrinkages are 5.1 radial and 9.5% in tangential direction. Strengthes are 1010 bending and 510 kg/cm^2 in compression. It is used for implement, car construction, furniture and decorative face veneer.

***Quercus serrata* Thunb. (Jol-cham-namoo)**

Mature trees attain a diameter of 100 centimeters and a height of 23 meters. It grows on mountainous area. Growth rings and boundary between sapwood and heartwood are distinct to the naked eye. Wood colors are light yellowish brown heartwood and light brownish white in sapwood. Transition from springwood to summerwood pores shows abrupt or slightly abrupt decrease in its size. Wood has medium texture and is hard in hardness. Ring-porous wood. Air dry specific gravities are 0.81 heartwood and 0.76 in sapwood. Shrinkages are 5.2 radial and 10.3% in tangential direction. Strengthes are 1150 bending, 510 compression and 109 kg/cm^2 in shear. It is used for implement, plywood, crate, and furniture.

***Robinia pseudoacacia* L. (A-gga-si-namoo)**

Mature trees attain a height of 20 meters. It grows on every mountainous land and plains through the nation. Growth rings are distinct and boundary between sapwood and heartwood is conspicuous to the naked eye. Wood has characteristic narrow sapwood width, coarse texture and heavy weight. Transition from springwood to summerwood pores shows abrupt decrease in its size. Wood colors are dark yellow heartwood and yellowish white in sapwood. Ring-porous wood. Air dry specific gravities are 0.63 heartwood and 0.78 in sapwood. Shrinkages are 5.1 radial and 8.4% in tangential direction. Strengthes are 1190 bending, 660 compression and 210 kg/cm^2 in shear. It is used for railroad crosstie, implement, machine, crate, ship construction, and flooring.

***Salix koreensis* Anderson (Beo-deu-namoo)**

Mature trees attain a diameter of 80 centimeters and a height of 20 meters. It grows on riverside and plains. Growth rings are distinct and boundary between sapwood and heartwood is slightly inconspicuous to the naked eye. Wood colors are yellowish or light yellowish brown heartwood and light yellowish brown in sapwood. Transition from springwood to summerwood pores shows abrupt or slightly abrupt decrease in its size and pores are small and very numerous. Wood has characteristic

odor and is soft in hardness. Diffuse-porous wood. Air dry specific gravities are 0.52 heartwood and 0.59 in sapwood. It is used for implement, and clog.

***Tilia amurensia* Rupr. (Pi-namoo)**

Mature trees attain a diameter of 90 centimeters and a height of 20 meters. It grows on the valley of high forest. Growth rings are distinct and boundary between sapwood and heartwood is thoroughly invisible to the naked eye. Wood color is light yellowish white. Wood has fine texture and light weight. Transition from springwood to summerwood pores shows gradual decrease or some uniformity in its size and pores are small in size and numerous in numbers. Diffuse-porous wood. Air dry specific gravity is 0.43. Shrinkages are 6.6 radial and 9.8% in tangential direction. Strengthes are 730 bending, 410 compression and 65 kg/cm^2 in shear. It is used for implement, building construction, musical instrument, pencil, and veneer.

***Tilia mandshurica* Rupr. et Max. (Chal-pi-namoo)**

Mature trees attain a diameter of 30 centimeters and a height of 10 meters. It grows on mountainous area and around temple. Growth rings are distinct and boundary between sapwood and heartwood is thoroughly invisible to the naked eye. Wood color is light reddish white. Transition from springwood to summerwood pores shows gradual or very gradual decrease in its size. Wood has odors and strong lustre. Radial-porous wood. Air dry specific gravity is 0.42. It is used for implement, and carving.

***Ulmus davidiana var. japonica* Nak. (Neu-reub-namoo)**

Mature trees attain a diameter of 60 to 90 centimeters and a height of 15 meters. It grows occasionally in the forest. Growth rings and boundary between sapwood and heartwood are distinct to the naked eye. Wood colors are light brownish white sapwood, dark brown in heartwood. Wood has coarse texture and is tough and soft somewhat. Transition from springwood to summerwood pores shows abrupt or gradual decrease in its size and vessel lines are clear to the unaided eye. Ring-porous wood. Air dry specific gravities are 0.76 sapwood and 0.77 in heartwood. shrinkages are 5.2 radial and 9.3% in tangential direction. Strengthes are 910 bending, 410 compression and 90 kg/cm^2 in shear. It is used for tool handle, car construction, furniture, and plywood.

***Zelkova serrata* Makino (Neu-ti-namoo)**

Mature trees attain a diameter of 300 centimeters and a height of 26 meters. It grows on the low site and valley of forest or occasionally around village. Growth rings and boundary between sapwood and heartwood are clear to the naked eye. Wood colors are light yellowish white sapwood and reddish brown in heartwood. Wood has lustre and heavy weight. Transition from springwood to summerwood pores shows abrupt decrease in its size. The numbers of pores are very small springwood, but numerous in summerwood. Vessel lines are clear to the naked eye. Ring-porous wood. Air dry specific gravity is 0.84. Shrinkages are 4.8 radial and 8.4% in tangential direction. Strengthes are 880 bending, 400 compression and 130 kg/cm^2 in shear. It is used for building and ship construction, furniture, and face veneer.

Key to wood identification based on gross features

A. Key to softwood based on gross features

1. Resin canals present ——— 2
1. Resin canals abscent ——— 7
   2. Resin canals are numerous and conspicuous to the naked eye ——— 3
   2. Resin canals are slightly or quite inconspicuous to the naked eye ——— 6
3. Transition from springwood to summerwood tracheids shows

slightly abrupt decrease in its size. Wood colors are yellowish brown heartwood and reddish yellow in sapwood ——— *Pinus koraiensis* S. et Z. (Jiat-namoo)

3. Transition from springwood to summerwood tracheids shows abrupt decrease in its size. Heartwood color is reddish brown ——— 4

4. Growth rings are very distinct to the naked eye. Sapwood color is light yellowish white ——— *Pinus thunbergii* Parlatore (Gom-sol)

4. Growth rings are distinct to the naked eye. Sapwood color is light yellowish white or yellowish white ——— 5

5. Boundary between sapwood and heartwood is very conspicuous to the naked eye. Sapwood color is light yellowish white ——— *Pinus densiflora* S. et Z. (So-namoo)

5. Boundary between sapwood and heartwood is conspicuous to the naked eye. Sapwood color is yellowish white ——— *Pinus rigida* Mill. (Ri-gi-da-so-namoo)

6. Growth rings and boundary between sapwood and heartwood are conspicuous to the naked eye. Wood colors are brown heartwood and white in sapwood ——— *Larix leptolepis* Gord. (Il-bon-ip-gal-namoo)

6. Growth rings are very distinct and boundary between sapwood and heartwood is slightly invisible to the naked eye. Wood color is yellowish white ——— *Picea jezoensis* Carr. (Ga-moon-bi-namoo)

7. Heartwood color is dark ——— 8

7. Heartwood color is comparatively light ——— 10

8. Wood colors are dark red or blackish brown heartwood and white in sapwood. Growth rings and boundary between sapwood and heartwood are distinct to the naked eye ——— *Cryptomeria japonica* D. Don(Sam-namoo)

8. Heartwood color is reddish brown or dark reddish brown. Growth rings shows wave-like running ——— 9

9. Wood colors are reddish brown heartwood and yellowish white in sapwood. Growth rings are distinct or quite indistinct and boundary between sapwood and heartwood is very conspicuous to the naked eye and wood has characteristic weak oder ——— *Taxus cuspidata* S. et Z. (Joo-mog)

9. Wood colors are dark reddish brown heartwood and white in sapwood. Growth rings are thoroughly invisible and boundary between sapwood and heartwood is very distinct to the naked eye. Wood has characteristic strong odor ——— *Juniperus chinensis* L. (Hyang-namoo)

10. Boundary between sapwood and heartwood and growth rings are distinct to the naked eye. Transition from springwood to summerwood tracheids shows slightly abrupt decrease in its size. Wood colors are brownish to yellowish white heartwood and yellow in sapwood ——— *Abies holophylla* Max. (Jeot-namoo)

10. Boundary between and heartwood is slightly inconspicuous to the naked eye ——— ——— 11

11. Growth rings are distinct to the naked eye. Transition from

springwood to summerwood tracheids shows gradual decrease in its size. Wood colors are light yellowish brown or light red heartwood and light yellowish white in sapwood ——— *Chamaecyparis* obtusa Endl. (Pyeon-bag)

11. Growth rings, which show wave-like running, are slightly inconspicuous to the naked eye. Transition from springwood to summerwood tracheids shows very gradual decrease in its size. Wood colors are reddish brown heartwood and yellowish white in sapwood ——— *Ginkgo biloba* L. (Eun-hang-namoo)

B. Key to hardwood based on gross features

1. Wood is ring-porous ——— 2
1. Wood is diffuse-porous or radial-porous ——— 18
2. Growth rings are distinct to the naked eye ——— 3
2. Growth rings are very distinct to the naked eye ——— 16
3. Transition from springwood to summerwood pores shows slightly to very abrupt decrease in its size ——— 4
3. Transition from springwood to summerwood pores shows gradual or very gradual decrease in its size ——— 15
4. Transition from springwood to summerwood pores shows very abrupt decrease in its size. Growth rings often have spider's web-like angle. Wood colors are light yellowish brown heartwood and light yellowish or reddish white in sapwood ——— *Kalopanax pictus* Nak. (Eum-namoo)
4. Transition from springwood to summerwood pores shows abrupt or slightly abrupt decrease in its size ——— 5
5. Boundary between sapwood and heartwood is distinct or very distinct to the naked eye ——— 6
5. Boundary between sapwood and heartwood is slightly indistinct to the naked eye ——— 13
6. Sapwood color is light brownish white ——— 7
6. Sapwood color is light yellowish white or yellowish white ——— 10
7. Boundary between sapwood and heartwood is very distinct to the naked eye ——— 8
7. Boundary between sapwood and heartwood is distinct to the naked eye ——— 9
8. Heartwood color is dark yellowish brown ——— *Quercus dentata* Thunb. (Ddeog-gal-namoo)
8. Heartwood color is bright yellowish brown ——— *Quercus aliena* Bl. (Gal-cham-namoo)
9. Heartwood color is dark brown. Transition from springwood to summerwood pores shows occasionally gradual decrease in its size ——— *Ulmus davidiana var. japonica* Nak. (Neu-reub-namoo)

9. Heartwood color is light yellowish brown. Transition from springwood to summerwood pores shows occasionally abrupt decrease in its size ——— *Quercus serrata* Thunb. (Jol-cham-namoo)

10. Heartwood color is reddish, yellowish, or greenish brown ——— 11

10. Heartwood color is dark yellow. Wood has characteristic narrow sapwood ——— *Robinia pseudoacacia* L. (A-gga-si-namoo)

11. Vessel lines are distinct to the naked eye ——— 12

11. Vessel lines are slightly indistinct to the naked eye. Heartwood color is greenish brown ——— *Morus alba var. romana* Loddiges (Bbong-namoo)

12. Heartwood color is yellowish brown ——— *Fraxinus mandshurica* Rupr. (Deul-me-namoo)

12. Heartwood color is reddish brown ——— *Zelkova serrata* Makino (Neu-ti-namoo)

13. Wood colors are light brown heartwood and light reddish yellow in sapwood. Wood has coarse texture ——— *Quercus acutissima* Carr. (Sang-soo-ri-namoo)

13. Wood colors are very light yellow heartwood and white in sapwood ——— 14

14. Vessel lines are less distinct than *Paulownia tomentosa* (Thunb.) Steud. to the naked eye ——— *Paulownia coreana* Uyeki (O-dong-namoo)

14. Vessel lines are more distinct than *Paulownia coreana* Uyeki to the naked eye ——— *Paulownia tomentosa*(Thunb.) Steud. (Cham-o-dong-namoo)

15. Boundary between sapwood and heartwood is slightly indistinct to the naked eye. Wood color is light yellowish brown ——— *Celtis sinensis* Persson (Pang-namoo)

15. Boundary between sapwood and heartwood is distinct to the naked eye. Wood colors are brown heartwood and brownish gray in sapwood. Wood has narrow sapwood ——— *Castanea crenata* S. et Z. (Bam-namoo)

16. Transition from springwood to summerwood pores shows abrupt decrease in its size ——— 17

16. Transition from springwood to summerwood pores shows very abrupt decrease in its size. Wood colors are yellowish brown heartwood and light yellow in sapwood ——— *Quercus mongolica* Fischer (Sin-gal-nomoo)

17. Boundary between sapwood and heartwood is very distinct to the naked eye. Wood colors are dark yellowish brown heartwood and yellowish white in sapwood ——— *Maackia amurensis* Rupr. et Max. (Da-reub-namoo)

17. Boundary between sapwood and heartwood is thoroughly invisible to the naked eye ——— *Fraxinus rynchophylla* Hance (Mool-poo-re-namoo)

18. Wood is diffuse-porous ——— 19

18. Wood is radial-porous ——— 33

19. Growth rings are distinct to the naked eye ——— 20

19. Growth rings are slightly or thoroughly indistinct to the naked eye ——— 27

20. Transition from springwood to summerwood pores shows gradual or very gradual decrease in its size ——— 21

20. Transition from springwood to summerwood pores shows abrupt or slightly abrupt decrease in its size. Boundary between sapwood and heartwood is slightly indistinct to the naked eye. Wood colors are yellowish brown heartwood and light yellowish brown in sapwood ——— *Salix koreensis* Anderson (Beo-deu-namoo)

21. Transition from springwood to summerwood pores shows very gradual decrease in its size ——— 22

21. Transition from springwood to summerwood pores shows gradual decrease in its size ——— 25

22. Boundary between sapwood and heartwood is distinct to the naked eye. Wood colors are whitish to light yellowish or reddish brown sapwood and light to dark brown or reddish brown in heartwood ——— *Platanus occidentalis* L. (Yang-beo-zeum-namoo)

22. Boundary between sapwood and heartwood is thoroughly indistinct to the naked eye ——— 23

23. Wood color is light yellowish or reddish white ——— 24

23. Wood color is white ——— *Acer palmatum* Thunb. (Dan-poong-namoo)

24. Wood color is light reddish white ——— *Acer ginnala* Max. (Sin-namoo)

24. Wood color is light yellowish white ——— *Machilus thunbergii* S. et Z. (Hoo-bag-namoo)

25. Boundary between sapwood and heartwood is slightly indistinct to the naked eye. Wood colors are brown heartwood and grayish white in sapwood ——— *Juglans sinensis* Dode (Ho-do-namoo)

25. Boundary between sapwood and heartwood is thoroughly indistinct to the naked eye ——— 26

26. Wood color is light yellowish white ——— *Tilia amurensis* Rupr. (Pi-namoo)

26. Wood color is pinkish brown ——— *Acer mono* Max. (Go-ro-sae-namoo)

27. Growth rings are thoroughly indistinct to the naked eye. Transition from springwood to summerwood pores shows very gradual decrease in its size ——— 28

27. Growth rings are slightly indistinct to the naked ey ——— 29

28. Boundary between sapwood and heartwood is distinct to the naked eye. Wood colors are light yellowish brown sapwood and reddish brown in heartwood ——— *Prunus sargentii* Rehder (San-beot-namoo)

28. Boundary between sapwood and heartwood is slightly indistinct to the naked eye. Wood color is yellowish white

or light yellowish brown ——— *Betula platyphylla var. japonica* Hara (Ja-jag-namoo)

29. Transition from springwood to summerwood pores shows very gradual decrease in its size ——— 30

29. Transition from springwood to summerwood pores shows gradual decrease in its size ——— 31

30. Boundary between sapwood and heartwood is very distinct to the naked eye. Wood colors are black heartwood and light stained yellow in sapwood ——— *Diospyros kaki* Thunb. (Gam-namoo)

30. Boundary between sapwood and heartwood is slightly indistinct to the naked eye. Wood colors are light yellowish brown heartwood and white or very light brown in sapwood ——— *Populus maximowiczii* Henry (Hwang-cheol-namoo)

31. Boundary between sapwood and heartwood is distinct to the naked eye. Wood colors are dark brown heartwood and grayish white in sapwood ——— *Juglans mandshurica* Max. (Ga-rae-namoo)

31. Boundary between sapwood and heartwood is slightly or thoroughly indistinct to the naked eye ——— 32

32. Wood colors are reddish or pinkish brown heartwood and light yellowish brown brown in sapwood ——— *Betula schmidtii* Regel (Bag-dal-namoo)

32. Wood colors are light grayish brown heartwood and almost white in sapwood ——— *Populus alba-glandulosa* L. (Hyun-sa-si-namoo)

33. Growth rings are distinct to the naked eye. Transition from springwood to summerwood pores shows gradual decrease in its size ——— 34

33. Growth rings are slightly or thoroughly indistinct to the naked eye ——— 36

34. Boundary between sapwood and heartwood is slightly indistinct to the naked eye. Wood colors are very light yellowish brown sapwood and yellowish brown in heartwood ——— *Alnus hirsuta* Rupr. (Mool-o-ri-namoo)

34. Boundary between sapwood and heartwood is thoroughly indistinct to the naked eye ——— 35

35. Wood color is light pinkish white ——— *Tilia mandshurica* Rupr. et Max. (Chal-pi-namoo)

35. Wood color is light pinkish brown ——— *Magnolia parviflora* S. et Z. (Ham-bag-ggot-namoo)

36. Growth rings are thoroughly indistinct to the naked eye. Wood color is yellowish white or pinkish yellow white ——— *Carpinus laxiflora* Blume (Seo-namoo)

36. Growth rings and boundary between sapwood and heartwood are slightly indistinct to the naked eye ——— 37

37. Wood colors are light brown heartwood and brownish white

in sapwood ——— *Quercus acuta* Thunb. (Boog-ga-si-namoo)

37. Wood colors are yellowish brown heartwood and light yellowish brown in sapwood ——— *Alnus japonica* Steudel (O-ri-namoo)

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