Technical Reports

BC Coastal Forest Sector Hem-Fir Initiative

Characterizing the Wood Attributes and Product Potential of 60-Year-Old Hem-fir in Coastal British Columbia

Program:	Resource Conversion	**Project No.:**	R.01
Project Leader:	Gerry Middleton and Dave Munro	**Date:**	January 2013

Abstract

The primary objective was to characterize 60 year-old hem-fir in terms of wood attributes that affect end-product value. Hem-fir is the commercial name for western hemlock (*Tsuga heterophylla* (Raf.) Sarg) and amabilis fir (*Abies amabilis* (Dougl.) Forbes). A total of 72 trees was sampled equally from 30, 40 and 50 cm breast-height (BH) diameter classes from three stands (site index ≥ 33 @50 years) on Vancouver Island. Sample average ages were 55, 62 and 72 years. Determined by X-ray densitometry, basic wood density of hemlock significantly exceeded that of amabilis fir. Density pith-to-bark in both species was high near the pith, declined rapidly to 5 years, reached minimums at 12 to 14 years, and increased thereafter. BH density was somewhat higher overall than total stemwood density. Stand and DBH effects on hemlock stemwood density were not significant but BH density in the 72 year-old sample was significantly higher than in the younger samples. Stand had no significant effect on amabilis fir density, but as DBH increased, BH density declined significantly as did stemwood density. Cumulative wood density to 60 years was well below published values in both species. Mean BH microfibril angle (MFA) in western hemlock (14.7º) was significantly higher than in amabilis fir (13.3º). Pith-to-bark MFA became stable at 10º in both species at cambial age 30 indicating a juvenile-to-mature wood transition at that age. Stand and DBH had no significant effect on MFA. Differences between amabilis fir and western hemlock mechanical properties were less than reported for old growth. Modulus of rupture (MOR) in static bending was 1.0 percent above species average in amabilis fir and 6.8 percent below in hemlock. Modulus of elasticity (MOE) in static bending, and MOE in compression parallel to grain were both below species averages by an equal 14.3 percent in amabilis fir, and by 21.4 and 16.7 percent in hemlock. Ultimate compression stress (UCS) was 22.2 percent below species average in hemlock and 17.7 percent below in amabilis fir. Stand and DBH had significant effect on bending MOE in amabilis fir, were insignificant in hemlock, and insignificant on bending MOR, and MOE and UCS in compression in both species. Further t tests showed significant stand effects on hemlock in bending, and on amabilis fir compression MOE. Correlations between density and small clear structural properties were relatively high and highly significant. MFA was not significantly correlated with any small clear structural property in either species, and made only made minor contributions to explained variation in stiffness. Acoustic velocity tested for *in situ* measurement of hem-fir tree stiffness was ineffective (R^2 = 0.06 to 0.09). Mean compression wood content was 5.7 percent in hemlock; 4.2 percent in amabilis fir. Mean spiral grain index in hemlock trees was 2.88º; significantly higher than in amabilis fir (2.01º). Veneer yields and structural properties were competitive with other species. A CT image stem bank created, provided an opportunity to explore transformative change in manufacturing practices. Compared to current harvest ages, harvesting hem-fir at 60 years will result in lower log grade yields, and reduced structural wood properties. TASS tree growth simulation showed stand volume at 60 years was 27 percent lower than at 80 years, and 40 percent lower than at 100, with smaller piece sizes and lower lumber yields in smaller dimensions. Delaying harvesting to 80 years should eliminate wood quality issues.

Unrealized mid-term growth and higher value potential are opportunity costs to be considered in the choice of an earlier harvest age.

Key words: Hem-fir, western hemlock (*Tsuga heterophylla* (Raf.) Sarg), amabilis fir (*Abies amabilis* (Dougl.) Forbes), harvest age, stand, DBH, wood density, microfibril angle, mechanical properties, spiral grain, compression wood, juvenile wood, acoustic velocity, dynamic MOE, CT imaging, log grades, veneer, TASS, log volume, lumber yield.

Contact:

Darrell Wong
FPInnovations
Email: Darrell.Wong@fpinnovations.ca