Curve sawing spruce sawlogs containing sweep can reduce drying distortion when compared with conventional sawing

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Summary

Research presented in this paper compares the drying degrade and bending stiffness of sawn timber produced from Sitka spruce (Picea sitchensis (Bong.) Carr) sawlogs containing natural curvature, which were subjected to either curve or conventional straight sawing. A total of 132 square-edged battens measuring 4.8 m × 97 mm × 47 mm were produced from 44 Sitka spruce sawlogs which contained sweep. After either curve or straight sawing, all battens were measured for wet bow and spring (crook), prior to being kiln dried and then remeasured for dry bow, spring, twist and three-point bending stiffness. Significant differences existed in drying degrade between the two sawing methods. Wet and dry bow were significantly lower in the straight sawn battens but the reduction after drying was much greater for curve sawing compared with straight sawing. Wet and dry spring and dry twist were all significantly lower in the curve sawn battens. There was no significant difference between the two sets of battens when measuring three-point bending stiffness. These results provide evidence that shape distortion can be reduced in square-edged sawn timber that has been cut from spruce sawlogs containing sweep if logs are processed using curve rather than conventional straight sawing.

Introduction

Across the British Isles, Sitka spruce (Picea sitchensis (Bong.) Carr) dominates the forested landscape with a total land cover of more than 690 000 ha (Forestry Commission, 2003) and a growing stock estimated to be in the region of 88 000 000 m³ (FAO, 2005). Largely concentrated in uniform even-aged plantations, stands of Sitka can demonstrate rapid rates of growth (16–24 m³ ha⁻¹ annum⁻¹) leading to rotation lengths of 40–60 years. This rotation length can have an adverse affect on the resultant density of the timber. Vigorous trees grown on relatively short rotations contain a high proportion of juvenile core wood, which has been shown to reduce timber strength when compared with trees of longer rotation (Dinwoodie, 2001; Gartner, 2005). Low-density wood with high grain and microfibril angles characterize this core wood area, which usually extends up to 15 rings from the pith, and can impact negatively on both the volume and the value yield (Desch and Dinwoodie, 1996).

As one of the main grading characteristics, deviation in stem geometry, also referred to as sweep or curvature, has been described as being the smooth deflection of a sawlog as measured at the midpoint of a straight line between the log ends (Lewis, 1985). Using the scoring method described in Macdonald et al. (2001), Hubert et al. (2003) carried out an extensive survey of British grown Sitka spruce stem straightness and found that more recently planted stands contained a higher percentage of poorly formed stems. In the survey areas of south Scotland and north England, they also found stem form to be significantly negatively affected by an increase in altitude and wind exposure. Baldwin (1993) also recorded that exposure to strong wind conditions can be a contributory factor in the development of crook within the stems of Sitka spruce planted on upland sites.

Concerns from the sawmilling sector over the scale of decline in sawlog quality due to poor stem form have led the industry to develop more sophisticated sawing technology that will help improve utilization of inferior log grades, such as curved cant sawing equipment. This technology uses three-dimensional in-line scanners to record external log geometry data followed by computer optimization of the sawlog in combination with the sawmill’s cutting pattern requirements. The sawlog shape is then transferred to the computer controlling the headsaw, which then proceeds with moving the infeed mechanism or the saws along the natural curvature of the log. Although the equipment can process tighter sawing curves, the log curve is generally limited to a maximum deflection of 100 mm in a 4.8-m long log due to subsequent automated handling equipment limitations (Bowyer et al., 2003).
A number of studies conducted on the use of curve sawing equipment have identified that an increase in volume yield is achievable for either softwood or hardwood sawlogs containing sweep when compared with conventional straight sawing methods (Wilson, 1992; Pease, 1998; Carino et al., 2006; Hamner et al., 2006; Hamner et al., 2007). Wang et al. (1992) and Carino et al. (2006) reported an increase in volume recovery when sawing logs containing sweep with curve sawing equipment compared with straight sawing and both studies found that the mean difference in volume recovery between the two sawing methods decreased as the sawlog small end diameter increased. Hamner et al. (2006) found that an increase in volume recovery was achievable when curve sawing logs that contained larger proportions of sweep. Part of this increase in volume yield may have resulted from the curve sawing equipment recovering a greater proportion of longer sawn sections from swept logs than if conventionally straight sawing was used.

While these studies have indicated that volume improvements from sawlogs containing sweep are possible through the use of specialized sawing equipment, other factors relating to the trees’ natural variability may have some influence when dealing specifically with sawn timber volume recovery and therefore should at least be considered. Steele (1984) identified a total of seven factors including log diameter, log length, rate of taper and timber quality, while Todoroki and Rönnqvist (1998) also included factors such as crook, areas of swelling, cross-sectional ovality, defect distribution, defect size and shape as contributing factors that will potentially affect volume recovery within the sawmill. Liu et al. (2007) found that tree diameter at breast height had the most positive influence on tree product value in their model predictions, with tree taper having a negative effect.

The location of the sawlog within the tree can also influence mechanical properties of the resultant sawn timber. Maun (1992) found that battens cut from logs that had been taken from the butt section of British grown Sitka spruce trees had reduced stiffness compared with logs taken from higher up the stem.

To overcome some of the variability that may be caused by these other factors, a number of studies have used computer simulations to compare what effect sawing methods have when converting theoretically identical straight sawlogs against those that contain varying degrees of curvature (Todoroki and Rönnqvist, 1998; Rönnqvist et al., 2000; Monsrud et al., 2004 et al.and). Monsrud et al. (2004) concluded from their computer simulations that there was a strongly linear relationship of decreasing product recovery with increasing sweep deflection when conventional straight sawing. Rönnqvist et al. (2000) found when assessing simulated logs through the computer programme AUTOSAW that increases in volume from curve sawing averaged 5.7 per cent with recoverable board length improving in the longest length class (4.8 m) by 22 per cent.

Along with improvements in yield recovery, the use of curve sawing equipment on logs containing sweep has also been shown to lead to other tangible benefits such as improving the strength of the sawn timber and reducing drying defects (Hunt and Winandy, 2003). Where sawlogs contain natural sweep, their conversion with conventional straight sawing equipment running parallel to the pith would result in an increase in the occurrence of cross-grain due to an increase in log taper (Brazier, 1977). As this inherent grain direction is caused by spirality of the grain within the tree, it can lead to drying defects and influence the rejection rate of battens prior to strength grading (Maun, 1992). In contrast to this, curve sawing logs containing sweep will allow the saws to follow much closer to the grain angle and can potentially result in less slope of grain in the sawn timber (Bond, 2006).

However, the grain angle relative to the longitudinal axis of a sawn batten is determined not only by the inherent grain angle of the tree and by the degree of taper but also by the straightness of the stem and sawing pattern used in the sawmill (Macdonald and Hubert, 2002). This has been well demonstrated by Taylor and Wagner (1996) who used only conventional straight sawing equipment to breakdown three categories of Douglas-fir logs (straight, single sweep and double sweep) in their analysis of how log shape affects drying degrade. While their findings showed no significant difference in bow or spring (crook), the occurrence of twist was in fact lower in both the categories of logs with sweep than it was in the straight sawlogs. They state that the reason for this may be as a result of less spiral grain being contained within the logs with natural sweep as opposed to those that were straight. However, one of the key failings of their study was that they did not limit variability of the sample population as logs were identified on the basis of stem straightness directly from a sawmill stockyard, which may have included sawlogs from a wide age range as well as varying growing environments.

Wagner et al. (2002) also used three categories of sweep severity for their small diameter Douglas-fir sample logs but utilized curve sawing prior to kiln drying. They recorded that the category exhibiting the highest degree of sweep contained the lowest levels of twist and the highest mean Modulus of Elasticity (MoE), speculating that this may have been as a result of the swept trees containing lower quantities of spiral grain. However, the sample logs would have included a low proportion of juvenile wood that may have influenced the rate of warp found following kiln drying as they were taken from trees that were 73-year old.

Possibly the most conclusive evidence found on the benefits of curve sawing logs with sweep was conducted by Bedard and Tremblay (2004), who evaluated three sawing methods on over two hundred 4.8-m long black spruce sawlogs. They compared conventional straight sawing against two variations of curve sawing, namely natural curve sawing where the saws follow the external geometry of the log and optimized curve sawing where the saws are moved along a course that has been selected by a computer-based optimization programme based on product value and the external characteristics of the log. In comparing the sawn timber elements, they found that while mean dry
The 44 sawlogs were randomly split into two equal groups of 22 logs and each was measured for length, small end and butt end diameter and maximum sweep (Table 1). The logs were then dispatched from the forest to one of the two study sawmills for processing.

### Straight and curve sawing

To enable a comparison of curve sawing against conventional straight sawing logs with sweep, the two groups of logs were separated for the initial breakdown process into sawn timber sections. One group of logs, Group A, were selected for straight sawing and were sent to mill A, located in north-west England, while the other group of logs, Group B, were sent for curve sawing to mill B in southwest Scotland. Both mills were provided with identical cutting pattern detail prior to sawing. The cutting pattern is shown in Figure 1.

At both sawmills, logs were first passed through two chipper canters to produce a square-edged cant ready for sawing. For the logs that were processed through the curve sawing equipment, all the logs were placed ‘horns down’ (Figure 2) prior to being fed through the first chipper canter in order that the curvature of the log could be followed through the second canter.

The square-edged cants at both sawmills were then sawn longitudinally, parallel to the pith, into three battens all measuring 97 × 47 mm (4 in × 2 in) with the log curvature being sawn along the thickness of the batten. For the logs that were curve sawn, a three-dimensional image was recorded by a computerized scanner prior to the cant being fed through the circular breakdown saws, thus enabling the saws to follow a path close to the true shape of the swept cant. All logs that were straight sawn at mill A were processed with horizontal band saws. At both sawmills, a record of the batten location within the log was taken. As all battens were dried in the same kiln charge, the curve sawn battens were transported from mill B to mill A the day following sawing.

Following sawing, all battens were placed into a specially designed metal jig and measurement of the maximum green bow and green spring (crook) were recorded with a digital calliper prior to kiln drying. Maximum bow of each batten was measured by placing each batten on its edge and recording the greatest horizontal distance between the batten and the jig. Spring (crook) was measured by placing the batten flatwise on the jig and recording the greatest horizontal distance between the jig and the batten.

### Materials and methods

#### Sawlog selection and measurement

A total of 44 sawlogs were selected from a single stand of unthinned Sitka spruce growing on a site in Kielder Forest District, north England (55° 3′ 3″ N, 2° 36′ 58″ W). Site elevation ranged from 280 to 320 m above mean sea level with a south-facing aspect. Initial tree spacing was 1.7 × 1.7 m and the stand was 50 years old at the time of felling. All sample logs were taken from the butt of the tree and measured 4.8–4.9 m in length with under bark small end diameters within a range of 190–250 mm. Only logs that contained a gentle sweep along a single plane with the total deviation being a minimum of 50 mm and a maximum of 120 mm were selected.

To obtain the sweep deviation measurement, each log was rotated until the greatest curved surface was identified. In accordance with BS EN 1310:1997 (Section 5.3 – Sweeps), a length of cord was stretched between the two ends of each log and a measurement of maximum sweep was recorded at the point of greatest deviation from the cord to the log.

### Table 1: Summary of sawlog measurements

<table>
<thead>
<tr>
<th>Sawmill destination</th>
<th>No. of logs</th>
<th>Length (m)</th>
<th>Small end diameter (mm)</th>
<th>Butt end diameter (mm)</th>
<th>Maximum deviation from centre line (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sawmill A (straight sawing)</td>
<td>22</td>
<td>4.90</td>
<td>219</td>
<td>313</td>
<td>69</td>
</tr>
<tr>
<td>Sawmill B (curve sawing)</td>
<td>22</td>
<td>4.89</td>
<td>223</td>
<td>317</td>
<td>70</td>
</tr>
</tbody>
</table>

The 44 sawlogs were randomly split into two equal groups of 22 logs and each was measured for length, small end and butt end diameter and maximum sweep (Table 1). The logs were then dispatched from the forest to one of the two study sawmills for processing.
twist was not recorded as the weight of the wet batten
design of the metal jig collectively resulted in all batten
Figure 3 provides a graphical illus-
three no. 97 x 47 mm battens removed from each log).

battens having zero twist. Figure 3 provides a graphical illustration of the measurement recorded for each of the warp characteristics. Battens were then stacked in preparation for drying with wooden stickers placed within the timber stack to ensure all battens were exposed to air flow within the kiln chamber.

Kiln drying
To achieve dimensional stability in the sawn timber, both packs of 66 battens were dried in a static load batch-type kiln at mill A with the target moisture content being 17 per cent. As the kiln chamber had a maximum capacity of 200 m³ of timber, the two packs of battens used in this study were placed side by side on top of other packs of similar-sized timber, so that drying conditions would be as equal as possible for both packs. A top load of concrete slabs (540 kg m⁻²) was then applied to restrain all timber within the chamber.

A standard kiln-drying schedule for Sitka spruce was used to dry all the battens. This schedule had a total drying time within the kiln of 85 h, which included time for the kilns to warm to operating temperature. Initial dry bulb temperature was 37°C, wet bulb temperature 33.5°C and relative humidity 78.6 per cent. At the end of the schedule, the dry bulb temperature was 74.9°C, wet bulb temperature 63.5°C and relative humidity 59.2 per cent.

Once dried, all battens were removed from the chamber and left unrestrained in a dry area for 3 days (72 h) prior to being measured for warp characteristics. The procedure for measuring and recording bow and spring (crook) was the same as described above. Maximum twist of each dry batten was also recorded at this stage with the individual

Strength grading
All battens were then fed through a Tandem Cook Bolinder mechanical strength-grading machine at mill A. Each batten was subjected to three-point bending to 5.4-mm deflection and an indicating parameter (IP) was recorded for each batten. Set-up of the machine was in accordance with the criteria detailed in BS EN 14081-4:2005.

The IP (reaction load measured in kilonewton) was recorded by the machine a total of 19 times along each batten (starting 600 mm from one end, then every 200 mm and finishing 600 mm from the other end) for each of the two deflection modules. For each deflection module, the lowest IP recorded was then identified and these figures were used to determine an overall low mean score for the batten. The low mean score for each batten was then converted to a three-point bending stiffness (MoE) to provide data that could be used to compare MoE for the two sawing methods. The equation used to calculate three-point MoE from machine-generated low mean IP measurements is detailed below:

$$\text{MoE (N/mm}^2) = \frac{\text{IP}.900^{1.100}}{4.b.t^3 a}$$

where IP = indicating parameter, b = width of timber cross section (mm), t = thickness (+1 mm) of timber cross-section
(mm) and \(a = 5.4\) (mm) deflection for 47 mm nominal thickness battens.

Once the measurement data had been recorded, independent \(t\) tests were performed (SPSS, 1999) on each of the drying characteristics measured and the strength grading results to identify if there were significant differences between the battens produced from the two sawing methods.

**Results**

**Bow, spring (crook) and twist measurements**

The measurement data collected from the wet and dry battens were analysed to identify whether differences existed between the two sawing methods. Table 2 shows a summary of the statistics recorded for each of the warp conditions and the results from independent \(t\) test analysis used to compare means of the measurement data.

**Bow**

Mean bow measurements for both the wet and dry bow were found to be lowest for battens produced from logs that were straight sawn (Table 2). Greatest significant difference (\(P < 0.001\)) was found in wet bow measurement with the curve sawn battens (21.5 mm) more than double those battens that were straight sawn (10.4 mm). Following kiln drying, the straight sawn battens still recorded a significantly lower (\(P = 0.002\)) mean (11.6 mm) than did the curve sawn battens (17.4 mm). However, it should be noted that kiln drying caused a 10.7 per cent increase in bow for straight sawn logs, whereas curve sawing produced a 18.9 per cent reduction in bow. The overall effect of kiln drying was therefore to reduce the difference between the two methods from 11.0 to 5.8 mm. As the curve sawn battens exhibited greater bow in both wet and dry form, the null hypothesis was rejected.

**Spring (crook)**

Both wet and dry spring (crook) mean measurements were found to be lower in the battens that were curve sawn (Table 2). These battens recorded lower mean spring measurements for both wet (9.2 mm for curve sawn and 11.8 mm for straight sawn) and dry (5.9 mm for curve sawn and 10.9 mm for straight sawn) conditions. Independent \(t\) test analysis, Table 2, showed that while there was evidence of a significant difference (\(P = 0.043\)) between the means of the two sawing methods for wet spring, this difference increased following kiln drying and there was overwhelming evidence of a significant difference (\(P < 0.001\)) between the means for the kiln-dried battens. In addition, the reduction in spring after kiln drying was much higher for curve sawn battens (35.4 per cent) compared with straight sawn battens (7.6 per cent). As the curve sawn battens produced lower spring when wet and dry, the null hypothesis was accepted.

**Twist**

As recorded with the wet and dry spring conditions, mean dry twist was found to be lower in the curve sawn battens (3.2 mm) than the straight sawn battens (6.0 mm) (Table 2). This was supported when analysed through the independent \(t\) test, which found overwhelming evidence of a significant difference (\(P < 0.001\)) between the means of the two sawing methods. The null hypothesis was accepted as the curve sawn battens proved to contain less dry twist.

**MoE (three-point bending)**

As indicated in Table 2, mean MoE for individual battens was recorded as being greater in those that had been subjected to straight sawing (6145.09 N/mm\(^2\)) compared with those that had been curve sawn (5996.26 N/mm\(^2\)). However, when comparing the mean difference through an independent \(t\) test, Table 2, no significant difference was found (\(P = 0.453\)) and therefore, the null hypothesis was rejected.

**Discussion**

The results of this study provide some evidence of the benefits in utilizing specialist curve sawing equipment to reduce

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**Table 2: Statistical data for each of the warp conditions measured**

<table>
<thead>
<tr>
<th>Condition</th>
<th>Straight sawn battens</th>
<th>Curve sawn battens</th>
<th>F</th>
<th>df</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean (mm)</td>
<td>SE</td>
<td>Mean (mm)</td>
<td>SE</td>
<td>F</td>
</tr>
<tr>
<td>Wet bow</td>
<td>10.440</td>
<td>1.013</td>
<td>21.450</td>
<td>1.622</td>
<td>18.406</td>
</tr>
<tr>
<td>Dry bow</td>
<td>11.560</td>
<td>0.916</td>
<td>17.390</td>
<td>1.595</td>
<td>14.754</td>
</tr>
<tr>
<td>Wet spring</td>
<td>11.770</td>
<td>0.918</td>
<td>9.200</td>
<td>0.865</td>
<td>1.445</td>
</tr>
<tr>
<td>Dry spring</td>
<td>10.880</td>
<td>1.023</td>
<td>5.940</td>
<td>0.387</td>
<td>10.716</td>
</tr>
<tr>
<td>Dry twist</td>
<td>5.980</td>
<td>0.595</td>
<td>3.240</td>
<td>0.417</td>
<td>3.331</td>
</tr>
<tr>
<td>MoE (N/mm(^2))</td>
<td>6145.09</td>
<td>141.45</td>
<td>5996.26</td>
<td>137.98</td>
<td>0.960</td>
</tr>
</tbody>
</table>

There were 66 samples for each method of sawing (N = 132).

\* \(P = 0.05–0.01\) evidence; \** \(P = 0.01–0.001\) strong evidence; \*** \(P < 0.001\) overwhelming evidence.
sawlogs containing sweep into square-edged sawn timber as opposed to conventional straight sawing equipment.

Following analysis of the results, it was clear that there existed significant differences in both wet and dry bow measurements when comparing the battens produced from the two sawing methods. Although mean measurements were lowest in the battens that had been straight sawn for both wet and dry bow, there was a reduction in the mean difference between the sawing methods after the timber had been kiln dried.

The results obtained for wet bow were greater in the curve sawn battens which was likely to be as a result of the saws following a path along the curvature of the sawlog. Lower bow for the curve sawn battens compared with straight sawn following kiln drying was expected but this was not the case. However, it was encouraging that the mean bow in the curve sawn battens decreased following kiln drying compared with the increase recorded for those battens that had been straight sawn. These results support previous research conducted by Waranesjö (2003) who also found that the extent of bow decreased during the drying process when examining battens that had been curve sawn.

Mean wet and dry spring (crook) measurements were found to be lower in the battens that had been curve sawn compared with those that had been straight sawn. While there was evidence of a significant difference between the means of the wet spring measurements, this difference became more evident following kiln drying as the battens that had been curve sawn recorded a reduction in mean spring of 35.4 per cent compared with the straight sawn battens which recorded a reduction of 7.6 per cent. The occurrence of spring found in sawn battens has been described by Desch and Winwoodie (1996) as common in boards cut from close to the centre of the log and is a result of a release of growth stresses in the timber. As the battens at both sawmills were cut from close to the centre of the log, it is proposed that the curve sawn battens recorded a lower mean measurement for both wet and dry spring due to this sawing method favouring a more even distribution of growth stresses in the sawn battens (reduced asymmetry).

With regards dry twist, the mean results were lowest once again in the curve sawn battens with overwhelming evidence of a significant difference between the measurements recorded from the two sawing methods. The dry twist measurements were lower than any of the other warp characteristics measured for each set of battens produced through either straight or curve sawing.

The discovery of a low mean twist measurement recorded in timber that had been curve sawn supports previous research by Taylor and Wagner (1996) and Wagner et al. (2002) which both found significantly less twist when sawing logs that contained sweep compared with straight logs. However, only the Wagner et al. (2002) study utilized curve sawing equipment and in that study, they recorded only a marginally significant difference in twist measurements between the battens produced from swept sawlogs compared with those that were deemed straight. Both studies, however, claim that the low levels of twist recorded were due to the swept logs containing lower levels of spiral grain as opposed to the straight logs. This has also been proposed by Hunt and Winandy (2003) who attribute the reduction of drying degrade to the curve sawing equipment following much closer to the grain angle of swept sawlogs as opposed to the straight sawing equipment which has greater potential to cut across the grain.

As grain angle was not measured within this study, this is difficult to substantiate, but it is possible that the reductions in warp recorded from the curve sawn battens were due in some part to this factor. As the trees were 50 years old when felled, the proportion of juvenile core wood, found within the log (first 12–15 growth rings), would have been lower than if younger trees were used and this may have reduced the incidence of spiral grain found within the sawlogs.

The dry twist results from this study are very encouraging, as this defect has been found to be one of the main issues relating to sawn timber rejection by consumers. Johansson et al. (1994) conducted interviews with members of the building industry in Sweden and found that the occurrence of twist was deemed to be the most serious defect when compared with other warp characteristics and in some cases had even caused individuals to make other material choices.

The results obtained from this study for all warp characteristics were similar to those found in the study performed by Bedard and Tremblay (2004) who used 4.8-m long black spruce sawlogs. They too found dry bow measurements to be greater in curve sawn battens compared with those that had been straight sawn, although the differences they found in dry spring (crook) and dry twist were much more marginal than those presented in this study.

It should be reiterated here that this study used sawlogs with a gentle centre sweep that was between 50 and 120 mm over the 4.8-m length of the log. In Britain, this amount of sweep would result in the sawlog being downgraded from a premium grade (green) to a lower grade (red) sawlog. However, the results obtained from this study provide evidence that processing lower quality sawlogs through curve sawing equipment will provide square-edged sawn timber that performs as well as sawn timber that has been produced through straight sawing.

The other element of this study looked to obtain MoE results from each batten following non-destructive strength grading. Described as the best predictor of timber strength (Lei et al. 2005), the MoE values recorded for the battens used in this study produced mean results that were not significantly different. This result is contrary to that recorded by Bedard and Tremblay (2004), who found that the two curve sawing methods used in their study produced sawn timber that had significantly higher MoE values than that produced through straight sawing. However, the MoE values used within this study were calculated from low mean IP produced for each batten as they passed through a tandem strength-grading machine. This method of testing batten stiffness is suitable for the production of values to compare battens within the same study but it will not produce MoE values to conform with the requirements of European Standard BS EN 408:2003 which requires battens to be tested to destruction through four-point bending tests.
There were other limitations that may have influenced the results recorded in this study. No record was made of the presence of defects such as knots, compression wood, spiral grain, juvenile core wood or pith location and individual batten moisture content. While the kiln drying charge was monitored and timber removed only once the total batch of 200 m³ had attained an average moisture content of 17 per cent, the individual batten moisture content was not recorded and this may have had an influence on the level of warp characteristics found.

The size of the sample selected for each of the two sawmills was also limited due to time and financial constraints. Without the aid of sophisticated scanning equipment, selection of sample sawlogs that fit both the desired criteria for size and shape of sweep and top diameter under bark measurement was time consuming with those sawlogs not fitting the selection criteria being discarded.

Conclusions

The square-edged sawn timber produced from Sitka spruce sawlogs containing sweep that had been subjected to curve sawing showed some reductions in the severity of warp characteristics when compared with similar sawlogs that had been subjected to conventional straight sawing. While the straight sawn battens recorded lower wet and dry bow measurement, the mean difference between the two sawing methods reduced following kiln drying. As for wet and dry spring (crook) and dry twist, those battens that had been produced from curve sawing recorded lower measurements than the straight sawn battens, with the differences between the two sawing methods being significant. With regard to three-point bending stiffness (MoE), the mean results obtained from the battens produced through both straight and curve sawing methods were not significantly different.

These results provide some evidence that tangible benefits exist when processing Sitka spruce sawlogs containing sweep to squared-edged sawn timber using curve sawing compared with conventional straight sawing equipment. The results also prove that it is possible to utilize seemingly inferior sawlog grades, which posses a larger degree of sweep than currently permitted in the premium (green) sawlog grade (Forestry Commission, 1993), to produce structural grade timber provided the correct sawing equipment and method is used.

Funding

Privately funded by M.D.Y.

Conflict of Interest Statement

None declared.

References


Received 20 June 2010