Background

The majority of early circular saw guides (in the 1970’s) were a hydrostatic bearing design. These designs, taken directly from the engineering handbooks, worked satisfactory for the thicker floating collar saw configuration prevalent at the time. However, a closer look at these hydrostatic guides showed that they were not the most correct approach for a circular sawing application. A hydrostatic bearing should be placed at the center of rotation with respect to the surface it is supporting in high surface velocity applications. In these early guided machines the hydrostatic guide pad was required to be placed off-center at the saw periphery near the cutting. The off-center guide positioning created a condition where only a partial area of the pad received direct lubrication (figure 1). Thus, there were significant opportunities to improve upon the design of guide pads.

With the exception of a small group in Northern California that began using guided splined arbor saws (collarless saw configuration), the other primary sawing approach during this time was with unguided strob saws, a configuration in which the saw was collared and fixed to the arbor. However, because the guided splined arbor machines were able to use significantly thinner kerf saws, it became the predominant configuration for circular gang machines.

The two principal areas of circular saw guide research are in lubrication and circular saw dynamic stability. Initial studies of guided saw systems were carried out in the latter 70’s and throughout the 80’s at UC Berkeley and at the Weyerhaeuser Research Center. Further work has been done more recently at the University of British Columbia.

Lubrication Studies

Lubrication studies focused upon how to design guides to reduce heat, friction, and wear between the saw and the guide: First to be investigated was whether pressurized fluid films could be developed between the saw and the guide, a very desirable condition for proper lubrication. Once verified that hydrodynamic fluid pressures could exist, studies examined the effects of various guide parameters on the fluid pressure. Parameters such as guide clearance, flow rates, and surface velocity were studied.

Flow visualization studies were performed with clear plastic guide pads to observe the flow paths of lubricating fluids between the saw and the guide at high surface
speed. Based upon these studies recommended guide pad shapes and location of lubricating holes were established.

It was found that between the guide pad and the saw the lubricating fluids follow the radius of the saw very closely. This suggested that the lubricating holes should be placed on the leading edge and that the guide pad shape should follow the radii of the saw (figure 2). These basic criteria are the starting point when designing new guides.

**Circular Saw Dynamic Stability**

Computer models have been developed over the years to help understand how guide pad shape and size affect saw static and dynamic stiffness and critical speeds. Finite element models, CSAW (I), and other computer models have been used.

As might be expected, larger guide pads produce a more stable saw but they have practical limits. Larger guides require greater amounts of lubricating fluids and are cumbersome to handle. Large guides can detrimentally restrict saw movement during sawing problems and during curve sawing. With large diameter saws, smaller multiple pads can be more effective than single large pads.

These models have been used effectively to predict how various guide shapes, sizes and multiple pads will perform.

**Guides for Thin Kerf Sawing**

Past studies have greatly assisted in the evolution of guide designs. However, there are other factors that have also contributed to current designs, two such factors being water lubrication usage and curve sawing.

In most sawmills it is desirable to operate guided circular saw machines with the lowest water volumes possible. Recessing the center of the guide pad, which reduces potential saw-to-guide contact area, has helped to reduce water usage. Recessing the center of guide pads is the most common approach today. As an aside, another water reducing procedure has been to use new saw guide oils that have been developed over the past few years that adhere to metals better and have superior film strength properties.

Curve sawing has added another guide design consideration. Observations in the field with earlier curve saw machines showed that guiding too close to the arbor usually resulted in very high saw and guide wear and saw heating near the saw eye. Moving the inside of the guide some distance away from the arbor allows the saw to flex in the center during curve sawing, reducing the high stresses created at the inside of the guide and saw interface. The desired distance appears to be dependent upon the curve sawing radius of curvature, guide pad width, and saw plate
thickness, as well as other parameters. The optimum distances have not been conclusively determined although they currently range between 1.25” to 2.5”.

Figure 2 highlights some of the key parameters to consider when designing guide pads for circular saws. Figures 3 and 4 show the most current guide design being recommended today for thin kerf circular saws.

Reference

1. Schajer, G.S. 1985. CSAW guided circular saw vibration and stability Program version 2.4 Univ. of British Columbia, Vancouver, B.C. Canada
Conditions Increasing Saw-Guide Pad Contact

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| Curve Sawing       |
Figure 1. Centered and Off-Centered Hydrostatic Guide Pad

Figure 2. Important Guide Considerations

1. Note 1: Lubrication Holes on Leading Edge
2. Note 2: Guide Shape Curved
3. W = Pad Width
4. C = Inner Pad Clearance to Arbor
5. S = Pad Span
6. D = Depth of Recess
7. L = Width of Land
Figure 3. Guide Pad Based on Lubrication Studies

Figure 4. Guide Location with Over-Arbor Climb-Cut Saw