Handplane blade angles

VARY THE ANGLE OF ATTACK TO ENSURE SUCCESS ON A WIDE RANGE OF WOODS

BY LYN J. MANGIAMELI

It is no surprise that most woodworkers have limited knowledge of handplane blade angles: For most of the 20th century, little attention was paid to the link between the angle that the blade entered the wood and the resulting surface. The rule of thumb was to select a low angle (37°), bevel-up plane for end grain, and a standard pitch (45°), bevel-down plane for everything else. Correct to a point, but you're missing a lot of capability.

While many factors determine a plane's performance, including how well it is tuned, the depth of cut, and the size of the mouth's opening, altering the angle at which the blade enters the wood, or the effective cutting angle (hereafter known as the cutting angle), can vastly expand the types of wood that you can handplane successfully.

As well as covering low- and high-angle planes that are available off the shelf, I'll show you how you can modify existing planes and adjust the way you orient your plane to tackle difficult woods.

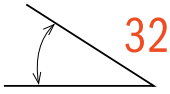
Think of the fibers

Before learning which type of plane to choose when faced with a challenging board, it helps to understand what happens when the blade enters the wood. Maximum smoothness, color, and clarity on a planed board are achieved when all the wood fibers fail (separate) right at the cutting edge. Defects occur when the fibers part away from the edge and instead fail along natural weaknesses in the wood.

These defects fall into two main categories based on the cutting angle and the type of wood.

Softer fibers tend to bend and stretch—A plane with a standard 45° cutting angle often poses problems for large-celled, more elastic softwoods and spalted woods. Considerable deformation of the wood can occur before the fibers separate. In some cases, the wood bends and stretches, piling up in front of the cutting edge, and then cyclically fails in a process called compression shearing. This leaves a rougher, often "fuzzy" texture as the surface goes through cycles of piling up and failing. In

Low angles



BEST SUITED FOR

Softwoods, poorly supported end grain, and areas of rot and spalting.

PERSONAL OBSERVATIONS

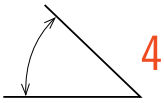
Lower angles are better, but there are two limiting factors. First, is the bed angle of the plane so much below 12° that it becomes too thin and weak? Second, a blade angle of less than 20° is too thin to retain a sharp edge. These limitations can be overcome by skewing the plane when using it (see p. 100).

Block planes for small areas. *A low-angle block plane is the best choice for planing small areas of end grain.*

Low angles for smoothing spalted wood. *Spalted wood is very soft, so you need a low-angle blade to slice through it with minimal compression.*

Photos: Mark Schofield

Medium angles



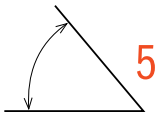
42°-47°

BEST SUITED FOR

Easily worked hardwoods like poplar and mahogany.

PERSONAL OBSERVATIONS

This versatile angle is easy to obtain, gives decent edge life, and requires little effort to push. It is used for other planing tasks besides smoothing, such as flattening rough boards.



50°

BEST SUITED FOR

Straight-grained boards of moderate-density hardwoods such as walnut, cherry, and ebony.

PERSONAL OBSERVATIONS

Little added resistance to cutting from 45° and a good alternative standard angle for those who favor these woods.

A different angle for different species. *Easily worked boards of low-density hardwoods such as this piece of mahogany work best with the blade at a medium angle of around 45°.*

the worst case, the flexible, elastic fibers bend and stretch before the blade, then pull loose behind the blade edge, and usually well below it, leaving large irregular pits. This is most common in areas of poor integrity such as spalting. The solution is to use the lowest possible cutting angle so that the blade slices the wood while compressing it as little as possible.

Dense and highly figured woods break before they bend—For small-celled, dense, hard, rigid woods that deform little in the face of shearing forces, a very high cutting angle can leave a glass-smooth surface when a lower angle results in tearout.

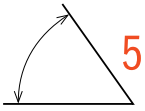
On woods such as tiger maple, it is impossible to avoid planing against the grain. When planing at a low or medium cutting angle, the blade lifts the wood instead of slicing it, causing the wood to fail ahead of the blade, a failure known as diagonal splitting. Other such woods are those with reversing grain such as ribbon-stripe and dense, figured woods such as cocobolo. The solution is to use a much higher cutting angle. This causes less of a wedging action into the fibers and more of a shearing action; the shaving is more quickly turned upward by the steeper blade face behind the cutting edge, thus "breaking" the chip earlier.

Two ways to obtain low-angle cuts

Now that you know the angle to use, how do you obtain it? For a low-angle cut you can purchase a

High blade angles. *Woods such as tiger maple cut best at about 55° (top), while cocobolo (above) should be worked with the blade cutting at 60° to 65°.*

High angles



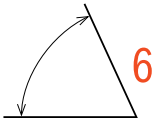
55°-57°

BEST SUITED FOR

Denser figured hardwoods, and most hard maple and white oak.

PERSONAL OBSERVATIONS

Noticeable but still moderate increase in resistance, but with a clearly improved surface finish on these dense or figured woods.



60°-65°

BEST SUITED FOR

Highly figured woods such as cocobolo and many Australian woods.

PERSONAL OBSERVATIONS

Clearly greater resistance, particularly if the blade is wide. The cut must be very light to avoid strain on the operator or on the body of the plane.

low-angle, bevel-up plane, or you can skew the plane relative to the workpiece.

Bevel-up planes achieve lowest-angle cuts—The principle feature that divides smoothing planes into two families is whether a plane is designed to support its blade with the primary bevel facing down or up. The former support the blade on a fixed bed or movable frog, most commonly angled at 45°. No matter what angle the blade is ground at, the bed/frog angle is the lowest cutting angle that plane can achieve.

Planes with the primary bevel facing up typically have a bed angle of 12°-20°. Combined with a blade angle that offers reasonable edge retention (a minimum of 20° on softwoods, 25° on hardwoods), this achieves a minimum effective cutting angle of 32° to 37°. By "edge retention," I mean avoiding an edge that comes to such a point that it chips or otherwise deforms after minimal use. The usual term for these planes is low angle, but because they can be modified to cut at high angles, there is a move toward calling them bevel-up planes.

Lower the cutting angle by skewing the plane—So far the discussion has assumed that the plane travels only in a direction directly perpendicular to the blade's cutting edge. When that direction is changed, called skewing the plane, the wood climbs the blade somewhat diagonally at what is known as the functional cutting angle. Thus, a plane with a 45° effective cutting angle, when skewed to 20°, develops a functional cutting angle of 42°. If the skew is increased to 45°, the wood will climb only a 30° slope.

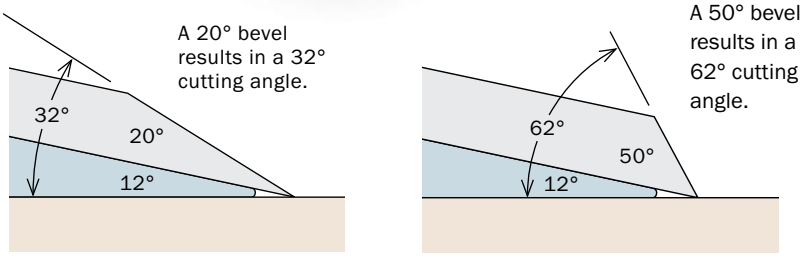
This principle applies to any plane: A bevel-up plane with a 12° bed, the blade beveled at 20° and skewed at 60°, (the lower limits in all three parameters), has a functional cutting angle of a little over 15°.

Skewing can be a very useful means to maximize the versatility of a single plane, and allows you to adapt to changing characteristics of the wood surface without having to turn to another plane or a different blade geometry. One warning about skewing: Don't counteract a deliberately high effective cutting angle by inadvertently skewing the plane during use—an easy thing to do when working a large surface.

Bevel-up planes

The bevel determines the cutting angle

Bevel-up, also known as low-angle, planes range in size from block planes to jointers. A fixed bed supports a plane iron whose bevel faces up.



Bevel-up planes have great versatility because altering the angle of the bevel will directly alter the cutting angle of the plane. The cutting angle is the sum of the bed and the bevel angles.

A GLOSSARY OF ANGLES

Bed angle
The angle of the fixed bed or movable frog relative to the sole of the plane.

Bevel angle
The angle of the blade's bevel relative to the back of the blade.

Effective cutting angle
The combination of the above two angles. Referred to simply as the cutting angle.

Functional cutting angle
The angle at which the blade cuts if the plane is skewed relative to the workpiece.

Modify your plane to cut at high angles

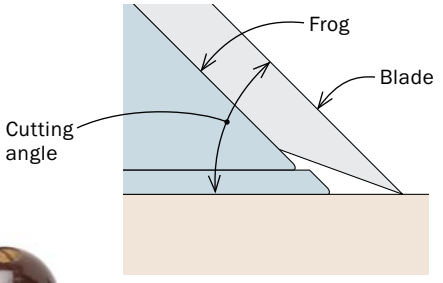
For most bevel-down planes, the angle of the bed or frog is established by the manufacturer and cannot be modified easily. The exception is the Lie-Nielsen bench planes that can be retrofitted with a 50° frog, increasing the cutting angle by 5°.

A more versatile option is to bevel the back of the blade in addition to the main bevel on the face. A back bevel is typically very narrow because it must

Drawings: Michael Pekovich

Bevel-down planes

The frog determines the cutting angle



On a typical bevel-down plane, the cutting angle is equal to the angle of the frog, on which the blade rests. The angle of the main bevel does not affect the cutting angle.

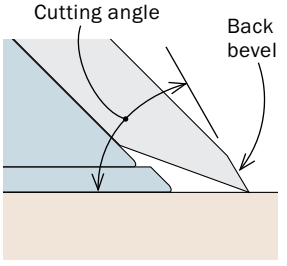
SKEW THE PLANE TO LOWER THE CUTTING ANGLE

Slice soft wood. *The effective cutting angle on any plane can be lowered by skewing the plane so that it is not perpendicular to the board.*

TWO WAYS TO RAISE THE CUTTING ANGLE

Use a plane with a high-angle frog. *Lie Nielsen makes an optional 50° frog (shown in the plane) as well as the standard 45° (in the foreground) for some of its bench planes.*

Grind a back bevel on the blade. *The cutting angle on bevel-down planes can be increased beyond the angle of the frog by grinding a shallow back bevel.*



extend only slightly beyond the depth of the cut—for smoothing purposes, about 1⁄32 in.

The effective cutting angle is now the back bevel and the bed angles combined. So on a plane with a typical bed angle of 45°, a back bevel of 10° gives an effective cutting angle of 55°. A narrow back bevel can easily be ground away to return a blade to a flat back or to establish another back bevel angle; better still, have an extra blade or two on hand.

Because back bevels are so narrow and the angle is typically 10° to 20°, they can be hard to hone freehand, and most commercial honing guides are not designed to produce these smaller angles. The best solution is the Veritas Mk.II (www.leevalley.com), designed to produce bevels from 2° to over 54°.

Convert your bevel-up plane to a high-angle plane—Increasing the effective cutting angle on a bevel-up plane only requires altering the blade's face bevel. Thus a plane with a 12° bed coupled with a blade beveled at 38° yields an effective cutting angle of 50°, while a bevel of 50° yields an effective cutting angle of 62°. Again, consider buying an extra blade or two. Lee Valley offers blades with different bevel angles for some bevel-up smoothing planes.

How best to increase your range of angles

If you are buying your first plane, consider a bevel-up one. The design allows a greater range of effective cutting angles (32° to 65° assuming a 12° bed) than the bevel-down design (45° to 65° assuming a 45° bed). On the other hand, if you already own a good-quality bevel-down plane, experiment with back bevels. If they work for you, buy an extra blade.

A well-tuned plane of either type will handle most boards, but when that special, highly figured board comes along and you are struggling to reveal it in all its glory, I hope this information assists you. □