Lagging

By George Porter

If you look up "lag" in the dictionary you will find lots of definitions, none of which seem to have much to do with securing a roof. A few of these are; poke, as in slow poke I guess; holdup; dawdle and detainment. The last definition would probably suite us the best because they do (hopefully) detain the two halves from coming apart. It would seem that it would be equally correct to refer to them as "dawdle screws" according to Mr. Webster's dictionary, but the folks at the hardware store might not understand.

The problem with lagging the roof is not necessarily with the lag screw but how it is installed. If you put two pieces of 2 x 6 in a vise and put some lag screws into them like you do with the roof you will be surprised at what you can learn. I did exactly this and it gave me something to think about. It is one of those things that you do that you never give much thought to, you put the lags in the roof as far apart as the factory manual says, put on the ridge cap and forget it. Let's look a little more closely at what we are doing.

First of all let's examine what a lag screw is. A screw is really a wedge. If you were to "unwrap" the threads from a screw you would notice that they are all on an upward angle towards the head of the screw. Take a piece of paper and cut it at an angle from corner to corner, place the paper on a pencil and wrap it so the cut you made is on the outside of the wrap and what you get is something that looks like a screw. (Example 1) The angle of the cut you made is the pitch of the screw thread. The steeper the angle the harder the screw is to turn but each revolution will put it farther in. Screws that go into very hard things have more threads per inch of screw and therefore a lot less pitch. Drywall screws have a lot of pitch because gypsum is soft and the screw is pretty thin. Sheet metal screws always have much less pitch or threads per inch because metal is hard. Think of it as having to climb up that angle you cut on the paper, the steeper it is the more power it takes to get to the top but the shorter the trip if you can do it. So it is important to think of a screw as a wedge and the bigger the wedge the more wood it must displace to go into it.

In fact if you ever used a wedge to split firewood then you know how this works. When you start driving the wedge in not much happens until the thickness of the wedge reaches a certain proportional size to the wood. What this means is that you could use a little wedge on little wood but you have to use a big wedge on big wood. You can bury a little wedge in a big chunk of wood and you will have a lot of trouble getting your wedge back out. This is how the screw threads work also. Too big a screw for the wood, it splits, the right size and it is hard to get out. Now you can split wood with a small wedge, but you have to take care to put the wedge very near the edge of the wood so it will crack a piece off. So, it also depends how much wood is between the screw and the edge, too close and it splits. Apparently there is some point at which the wood around the screw just can't compress together any more and it pops and splits the wood to the edge. When the screw or wedge enters the wood it is displacing a volume of wood the size of the screw, but there is a way to keep this from happening. You remove some of the wood so there is less to squeeze apart. This is called

a pilot hole. Like a pilot it will give the screw a direction to follow but it will also prevent splitting. Little screws usually don't get pilot holes unless they are located very near the edge of the wood, remember there is a relationship between how much wood you are displacing and the distance to the edge of the wood.

There is a rule of thumb for pilot holes; they must be 2 the diameter of the screw when installed in most wood. Some kinds of exotic hardwoods need a slightly larger hole because of their density but we are not likely to see our homes framed with them. Pine or one of it's close relatives is what we are talking about here and it comes in different grades. You don't frame homes with cabinet or furniture grade lumber so it might have a small crack and/or a knot here and there. This fact does not improve our chances of having the lags hold as they should.

This brings us to the meat of the problem. If you want the home to meet its HUD Code requirements then each half must have a good grip on the other. The manufacturers of the home all state how far apart the lags go depending on the wind zone they are built to, but none say the angle of the lag into the roof. Most say you must engage both halves with the lag. If there is a gap between them then it must be shimmed and a longer lag should be used if necessary. The problem is that when the lag disappears down into the roof you can't see exactly what is happening under there.

Right now is a good time to mention that not all homes use lag screws in the roof, some use metal strapping or bolts. If you put lags in a roof that was meant to have strapping you have made a huge error. The lags are probably screwed into nothing and the roof is about 1/10 as strong as it was supposed to be! Read the manual

Example II shows the target area for the lag to go through. All the things we just discussed about screws apply here. The most common roof lags are 3/8" dia. and 6" long so with that in mind I took some measurements. To get an equal "bite" on each half it has to be in one 2 x 6 as much as the other and passing through the inside center does this. If we went straight across, and some homes do, we could get an equal amount of wood all around the screw but the amount of screw in the wood would never be more than 1 2 inches, the thickness of the wood. You would also be missing the "x" of opposing lags that would help hold the home even if there were no threads on the lags. When you go straight across only the threads on the lags are doing the holding so generally the factory will spec them closer together.

There are three main things that installers must consider when lagging a roof:

1. The angle of the lag from vertical.
2. The entry point of the lag from the centerline of the home.
3. The length of the lag if you have a gap to fill.

As you can see from my crude drawings, probably the best we can hope for when lagging through the roof is to have the lag going through each ridge beam with about a 60/40 proportion of wood on each side of the screw. The more vertical we get the more lopsided this ratio becomes if it still passes

through the target point.

Eventually we just sort of crack the edges off the top of one 2 x 6 and the bottom edge off the other. Needless to say this doesn't have much holding power. Most manuals show the lags starting at the top outside corner or the roof beams. This produces a problem, when the lag head gets to the 2 x 6 it of course stops and leaves a bump under the shingles because it sticks up higher than the roof. If you want a roof with no bumps, the lag head must be at least level with the roof surface. This means that it has to penetrate the roof surface or mash it down some so it will look level. In an effort to make this happen some people have drilled holes in the roof, some manuals say to do this, some don't, but there is no other suitable way. Some people have even bashed holes with a 22 oz. claw hammer for each lag! Not exactly what you would call a caring person, but we do have a few of these around.

Example III shows two lags. The one on the left is installed at a 30 deg. angle and has to crush the roof a little to become flush but it has the 60/40 ratio in each board and should hold the expected load. If there is a 3/16" pilot hole for this 3/8" lag this

is a good job as far as holding goes, the roof part, while not too bad, can be improved upon. Notice the lag from the right has a hole (cut with a hole saw) in the roof so the lag and it's washer are up tight against the beams. The angle here is 50 deg. from vertical and passes through the center target area. In order to do this the hole is about 6" from the center line down the roof. This hole must be covered with metal flashing but it is the surest and strongest way to do this. It will take more time and a little more money but I'll bet this is how you would want your own home done. Example IV shows two not so good lags. The one on top has very little wood around it and has probably split the 2 x 6. The one on the bottom has a good bite on the wood but the head of the lag stops at the roof not the beam. It is much stronger with the head and washer against the 2 x 6. This lag must enter the roof 6" down form the centerline and at an angle of 60 deg. from vertical. This is a pretty flat angle but necessary so the lag will be where it should be in the beams. If the lag is installed as shown it needs to be 10" long, the factory probably only sends 6". If you don't go get some longer lags you won't have much screw in the other side, if any.

Some home manuals allow a certain amount of gap in the roof as long as it is filled before close up. Example V shows what happens when a _" gap is between the beams. The factory may say you should fill the gap with shims but if you use the same 30 deg. angle you will get almost none of the other 2 x 6. In order for this to work you need to enter the roof 6" from the centerline which is now in the center of the _" gap and install it at a 68 deg. angle. If the gap was 1 2" the entry point would be at 7_" down the roof at 75 deg angle from vertical to try to maintain at least a 60/40 amount of wood around the lag on both sides. If you stopped at the roof you would need a 12" lag.

All of this is assuming you have at least 2 x 6's or heavy plywood in the roof ridge. If you have 2 x 4's you had better be paying very close attention. There is no margin for error and the 2 x 4 will easily split if the lag is not centered and piloted.

This ends my attempt to try to put into words what you can find out for yourself in 2 minutes buy just putting two 2 x 6's in a vise and running a few lags in them.

Change the angles and notice where the lags go in and come out. Look for splitting and then try the same thing again but with a pilot hole. Try to duplicate the same thing you have been doing on the roof for years and see how it looks in the vise. I think you will be surprised and I know it will make you a better installer. You certainly don't want to be "lagging" behind in your profession.

Note: Thank you Bill Farish at Fleetwood for making the drawings.