

VENTILATION TECHNIQUES

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INTRODUCTION

Ventilation is the “systematic” removal of heat, smoke, and fire gases from a structure, and replacing it with cooler, clean, fresh air.

Ventilation does NOT put out fires. However, effective ventilation DRAMATICALLY assists in the attack, control, and extinguishment of a structure fire.

Effective ventilation will accomplish four main objectives.

1. Save lives.
2. Assist in firefighter access.
3. Control the horizontal spread of fire.
4. Reduce the possibility of flashover and backdraft.

SAVE LIVES

Proper ventilation will save lives by simplifying and expediting rescue operations. The removal of heated smoke and fire gases from a structure will increase the chances of survival to trapped or unconscious occupants. The replacement of heated smoke and fire gases with cooler, fresh air will help the occupants to breathe better. Proper ventilation also makes interior conditions safer for firefighters and improves visibility so that trapped and/or unconscious victims can be located quicker and easier.

FIREFIGHTER ACCESS

A properly placed ventilation hole aids in the removal of super-heated smoke and fire gases from the building, which in turn permits firefighters to safely and more rapidly locate and extinguish the fire. Heat is reduced and visibility is increased. Ventilation will also reduce the chance of steam burns to firefighters from their hose stream. Rapid extinguishment of the fire will also reduce water, heat, and smoke damage. This rapid extinguishment reduces property damage. Proper ventilation will also assist firefighters in fire extinguishment, rescue, salvage, and overhaul operations.

CONTROL THE HORIZONTAL SPREAD OF FIRE

In a structure fire, heat, smoke, and fire gases travel upward to the highest point of the building, usually the roof or ceiling. If the heat, smoke, and fire gases are not released, they will accumulate at the highest point of the structure and begin to bank down and spread laterally. This process is generally known as MUSHROOMING. Proper ventilation will reduce mushrooming, which in turn will reduce the rate that fire can spread over an area. Ventilation provides an escape for the accumulating heat, smoke, and fire gases.

Strip ventilation, when used in conjunction with an offensive ventilation hole (heat hole), can help stop the horizontal spread of fire.

REDUCES THE POSSIBILITY OF FLASHOVER AND BACKDRAFT

FLASHOVER

Flashover is a condition where all of the contents of a room are heated to their ignition temperature. Once their ignition temperature is reached, the entire room will quickly be involved in flames. Each year in the United States, there is an average of 100 deaths to firefighters in the fire service. On an average, 85 of those deaths are due to flashover, and the number is slowly rising each year. Proper ventilation helps eliminate this condition because the heat is removed from the structure before the contents reach their ignition temperatures.

BACKDRAFT

In a confined area, if the structure's contents reach their ignition temperature and there is not sufficient oxygen to support combustion, a very dangerous condition exists. In this very dangerous condition, all that is needed is an air (oxygen) supply to explosively change the superheated area into an instant inferno. This condition is best known as backdraft. To remove this explosive condition, roof (vertical) ventilation must be provided to release the heat, smoke, and fire gases.

Backdraft is NOT limited to large commercial structures. Under the right conditions, any confined area can result in a backdraft.

TYPES OF VENTILATION

HORIZONTAL VENTILATION

Horizontal ventilation is the systematic removal of heat, smoke, and fire gases through wall openings such as doors and windows. With horizontal ventilation, there are two methods usually performed, which are natural and positive pressure ventilation.

Natural ventilation is easily done by opening doors and windows and allowing the wind to ventilate the building. Natural ventilation is limited, due to the location of the fire in relation to the structure's openings and wind direction. Positive pressure ventilation is a method of forcing clean, fresh, pressurized air into a structure with blowers. By systematically opening doors and windows to channel the pressurized clean air, you can effectively ventilate smoke out of a structure.

VERTICAL VENTILATION

Vertical ventilation is the opening of the roof or existing roof openings (skylights, hatch covers, etc.) for the purpose of allowing heat, smoke, and fire gases to escape from the structure into the atmosphere. In order to properly and safely open a roof, you must have a good working knowledge of building construction. The key to safe and effective roof ventilation is the knowledge of rafter type and rafter direction.

RAFTER TYPE AND DIRECTION

In order to safely and effectively cut a roof, you must know how it is built. Rafter type is very important to know. With older conventional construction, rafters are made from solid pieces of lumber. Roofs built with conventional construction will usually withstand fire for a much greater length of time than lightweight truss construction, resulting in a safer roof to operate on. With conventional construction, if time and safety permits, the roof team “WILL” cut the heat hole directly over the fire.

When exposed to fire, roofs built with lightweight truss construction will fail at a very fast rate, resulting in a significantly reduced time for the roof team to operate. **When operating on a lightweight truss roof (or suspected lightweight truss), the ventilation team shall never conduct ventilation operations directly over the fire.** Members should employ the practice of “trading space for time” so that they may complete their roof-cutting operation prior to the fire impinging on a given ventilation hole.

Rafter direction is important to know because we usually cut 1” x 4” and 1” x 6” sheathing parallel to rafters. On roofs sheathed with plywood, the “Head Cut” is made perpendicular to rafters. You need to know rafter direction in order to accomplish any Heat Hole or Strip Ventilation Hole.

There are basically only TWO (2) types of ventilation holes:

- Heat Hole (Offensive)
- Strip Ventilation (Defensive).

HEAT HOLE (OFFENSIVE)

A heat hole is a hole placed directly over the fire or as close to the fire as safety will allow. A properly placed heat hole saves lives and will allow firefighter access by reducing heat, smoke, and fire gases inside the structure. A heat hole will also reduce the possibility of backdraft and flashover, and will slow down the horizontal spread of fire. **When operating on any lightweight roof, or suspected lightweight roof (panelized or lightweight truss), the ventilation team shall never conduct ventilation operations directly over the fire.** Members should employ the practice of “trading space for time” so that they may complete their roof-cutting operation prior to the fire impinging on a given ventilation hole.

STRIP VENTILATION (DEFENSIVE)

A strip ventilation hole should be placed well ahead of the fire, and the strip ventilation hole should extend the entire width of the building, creating a firebreak. Strip ventilation helps to stop the horizontal spread of fire. Strip ventilation must be done in conjunction with a heat hole. The heat hole must be accomplished first, which will slow down the horizontal spread of fire and allow the entire strip to be completed before the fire reaches the strip ventilation hole.

VENTILATION TERMINOLOGY

CENTER RAFTER CUT

Center rafter cut is a technique used when cutting plywood sheathing (4 cuts). Center rafter provides the largest hole possible with the minimum amount of cuts. Sheathing removal (louvering) requires a minimal effort. Center rafter can also be used for cutting strip ventilation on 1" x 4" or 1" x 6" sheathed roofs.

DECKING

Decking is the material used to comprise the base and exterior covering for the roof. The base is the material attached to the roof rafters. The base material can consist of solid wood sheathing, plywood-type materials, corrugated metal, and other materials.

DIAPHRAGM NAILING

Plywood sheathing is installed so that the 8' dimension of the plywood crosses the rafters or joists and the 4' dimension parallels the rafters or joists. The sheets of plywood are then staggered much like a brick or block wall.

DICING

Dicing is a technique used to cut 1" x 4" or 1" x 6" solid, spaced, or diagonally sheathed roofs. Dice cuts are made parallel to rafters with no concern to locating rafters.

"H" CLIPS

"H" clips are metal clips used to hold the butted ends of plywood together. "H" clips are common on pitched roofs.

HEAD CUT

A head cut is a cut made through the roof decking that is made perpendicular to rafters. A head cut is used to locate rafters. This cut involves rolling rafters. A head cut must be done on roofs covered with plywood and diagonal sheathing. A head cut is usually the first cut made on a center rafter cut.

HEAT HOLE “OFFENSIVE VENTILATION”

A heat hole is a hole placed directly over the fire or as close to the fire as safety will allow. A properly placed heat hole saves lives and will allow firefighter access by reducing heat, smoke, and fire gases inside the structure. A heat hole will also reduce the possibility of backdraft and flashover, and will slow down the horizontal spread of fire. **When operating on any lightweight roof, or suspected lightweight roof (panelized or lightweight truss), the ventilation team shall never conduct ventilation operations directly over the fire.** Members should employ the practice of “trading space for time” so that they may complete their roof-cutting operation prior to the fire impinging on a given ventilation hole. Constantly evaluate the effectiveness of the roof-cutting operation and weigh RISK vs. GAIN allowing for a timely and safe exit from the roof.

“J” HOOK

The removal of sheathing is enhanced by a “J” hook motion with an appropriate tool (pick head axe). The “J” hook motion brings the pulling tool under and up to the decking in a smooth, forceful motion that will separate the decking materials from the rafters. This is more efficient if the pulling tool is used near the rafters.

KERF CUT

A kerf cut is a single cut made through the roof decking, the same width as the chain saw blade. Although not as effective, the kerf cut can be used as an alternative to using the smoke indicator hole.

LADDERING

Ground ladders should be thrown to the uninvolved corners of the structure. The exception to the rule is when using a roof ladder. Your ground ladder must be thrown to the base of the roof ladder. It is preferable to have the wind to your back. For roof ventilation, a “MINIMUM” of two ladders should be thrown to the involved structure.

LOUVER

It is not practical in most cases to remove cut plywood from a roof due to the method in which the plywood is nailed to the roof rafters. The best alternative is to louver the plywood. Once all 4 cuts are complete, use a rubbish hook and push down on the near side (the side closest to your ladder) and pull on the far side. This method is used with the center rafter louver technique.

NAILING BLOCKS

Nailing blocks are usually made from a 2" x 4" laid flat between rafters to provide a nailing surface for the edge of the plywood sheathing. Since the plywood normally used is 4' x 8' in size, a nailing block will usually be found every 4 feet.

PARALLEL CUT

A cut through the roof decking made parallel to the roof rafters.

PENTHOUSE DOOR

A door leading from the interior stairwell to the roof. Opening the penthouse door can be a quick way to clear smoke out of the stairwell and any hallway that is open to the stairwell.

PLUG CUT

A plug cut is a small triangular piece of roof covering (composition), which is removed from the roof to expose the roof sheathing. A plug cut is used to determine sheathing type and roof composition thickness.

PLYWOOD TYPE SHEATHING

Plywood, chip board, and oriented strand board (OSB) are all materials used for floor and roof decking. The normal and most common size for plywood is 4' x 8'. Under fire conditions, plywood burns at a quicker rate than solid wood sheathing and plywood delaminates.

ROLLING RAFTERS

Rolling rafters are used to make a head cut. When a rafter is felt with the chain saw, the saw is backed off and lifted or rolled over the rafter and then re-inserted into the sheathing, and the cut is resumed.

SCORE CUT

A score cut is a light cut of the roof covering, usually composition only. A score cut is used to facilitate the removal of multiple layers of roofing material (composition).

SKIM CUT

A skim cut is a light cut made with the chain saw, cutting through the roof covering and plywood sheathing. The saw is not inserted deep enough to cut through the rafters. You “skim” over the top of the rafters. The skim cut is used on a panelized roof when you are performing the cutting technique known as “louver off a purlin.”

SKYLIGHTS

Skylights are usually constructed from glass or plastic. On apartment buildings, skylights will be placed over hallways and stairwells. On commercial buildings, they will be placed over manufacturing areas. When using skylights in conjunction with roof ventilation, it is imperative that you systemically remove skylights. Remove skylights in the same direction and order as you would cut ventilation holes.

SMOKE INDICATOR HOLE

A smoke indicator hole is a small triangular hole cut through the roof decking (sheathing and roofing material) made with the chain saw or an axe. A smoke indicator hole is used to indicate smoke and fire conditions directly below the indicator hole. Smoke indicator holes should be placed along the path of access or egress every few yards. Smoke indicator holes should be continually monitored to ensure all routes of travel and escape are safe throughout the roof operation. When placed directly in an area where a roof crew is working, they give a good indication of changing conditions, which may be vital for the safety of the roof ventilation team. Placing smoke indicator holes in the path of the fire can monitor fire spread. Smoke indicator holes can be placed on roofs of buildings attached to fire buildings to indicate interior exposure.

SOUNDING

Sounding is a technique used to assist the roof team to safely walk on a roof. Sounding utilizes a long-handled tool (rubbish hook/pike pole) used to hit the roof. Because of its weight and reach, a long-handled rubbish hook is superior to, and recommended over, a pick-head axe as a sounding tool. Sounding the roof will allow you to determine the condition of the roof. On some roofs (panelized), sounding can be used to locate main beams, i.e., lam-beams or purlins.

STRIP VENTILATION “DEFENSIVE VENTILATION”

Strip ventilation is a long, narrow section of roofing material that has been removed well ahead of the fire. The strip acts as a firebreak. Strip ventilation is usually performed across the width of the roof, from parapet to parapet.

VENTILATORS

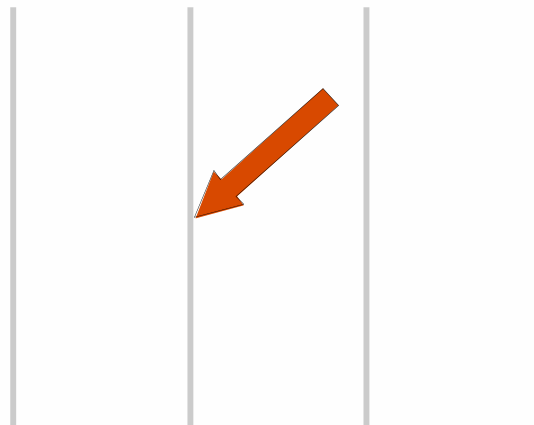
Ventilators are placed on roofs to ventilate attics and building interiors. Ventilators can be used to assess the progression of a fire. If ventilators are working correctly, leave them alone. A turbine-style ventilator is about 30% more effective when the turbine is spinning. Ventilators are designed to ventilate; let them do their job.

VENT PIPES

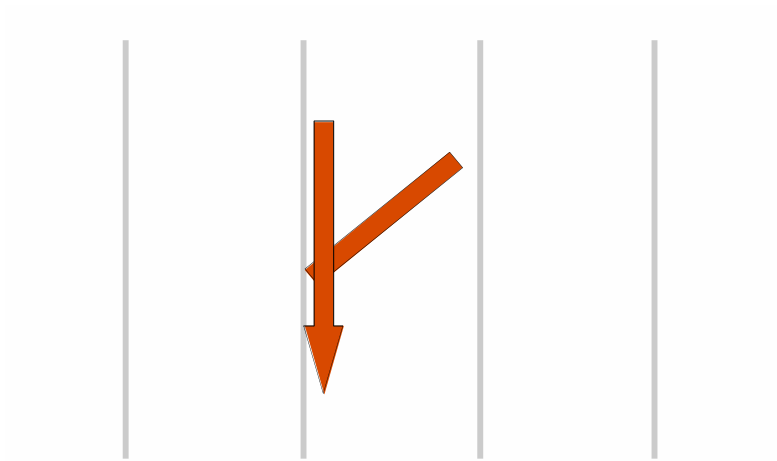
Vent pipes are plumbing pipes that extend from inside the structure through the roofline. Vent pipes can be constructed from ABS plastic, cast iron, or steel pipe. Vent pipes travel vertically through a structure (pipe alleys) and can become an avenue for fire to travel. If vent pipes appear to be growing out of the roof, this should be an indication that the roof has sagged or dropped. This condition is known as “growing vent pipes.”

45-DEGREE CUT

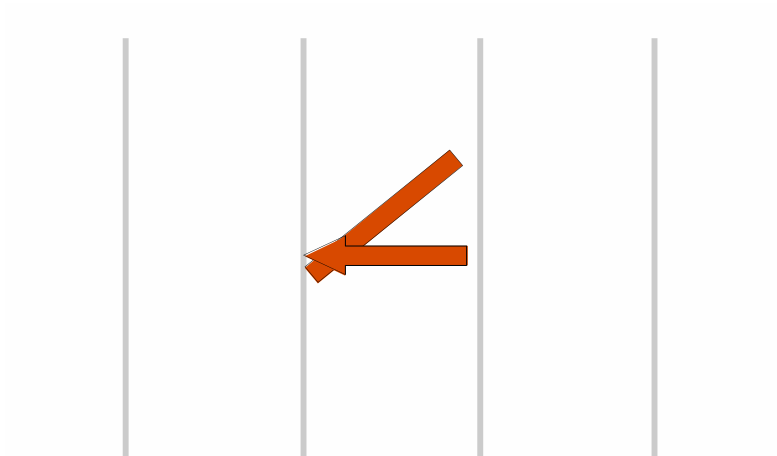
A 45-degree cut is a series of two cuts used to identify rafter direction “ONLY.” The first 45-degree angle cut is made toward or away from any exterior wall. A 45-degree cut will ensure the saw will intersect a structural member. When you hit a rafter, “STOP.” Make a second cut parallel or perpendicular to the exterior wall.



Make a 45-degree cut toward or away from any exterior wall.



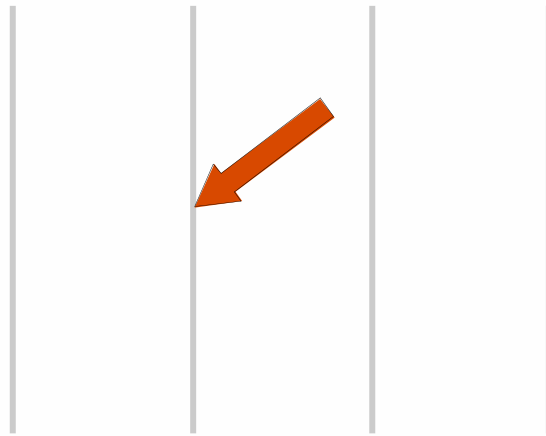
Make a second cut parallel to any exterior wall.



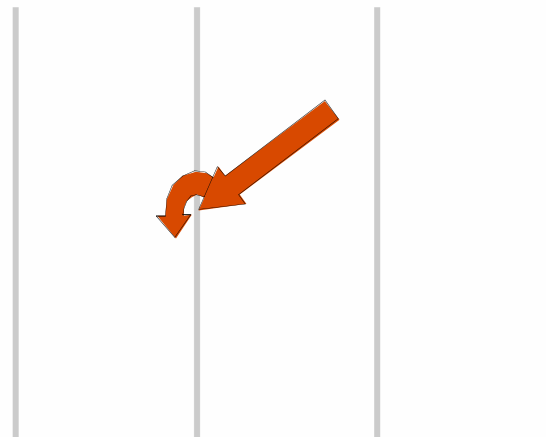
Second cut perpendicular to any exterior wall.

45-DEGREE "INSPECTION" CUT

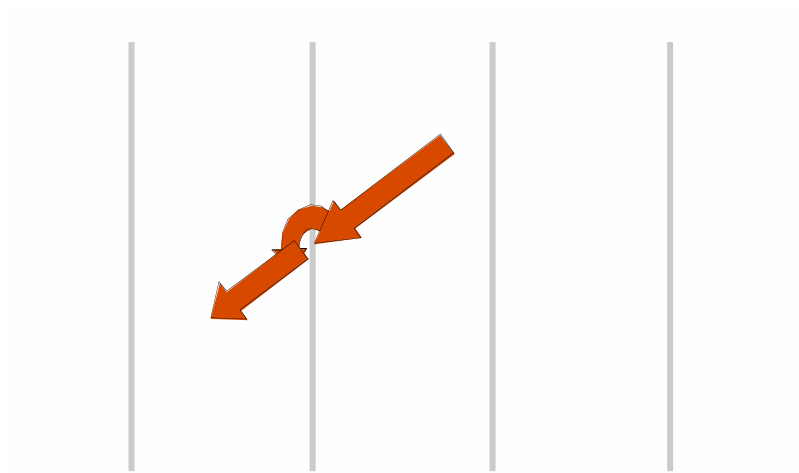
It is imperative for the roof team to know rafter type, and rafter direction. If rafter type and rafter direction are unknown, a 45-degree inspection cut will tell you rafter type and rafter direction, the sheathing type, the thickness of roof composition and when complete, it can act as a smoke indicator hole. A 45-degree inspection cut is accomplished by cutting through the roof decking at a 45-degree angle toward or away from any exterior wall. A 45-degree cut will ensure the saw will intersect a structural member. When the saw makes contact with a rafter, roll over the rafter and continue the cut for approximately 6 to 10 inches. Complete the cut by removing a small triangle of decking directly over the structural member.



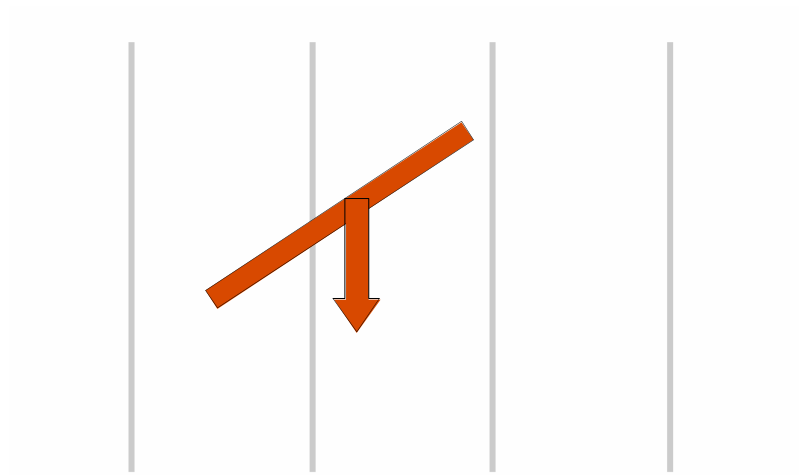
Make a 45-degree cut toward or away from any exterior wall.



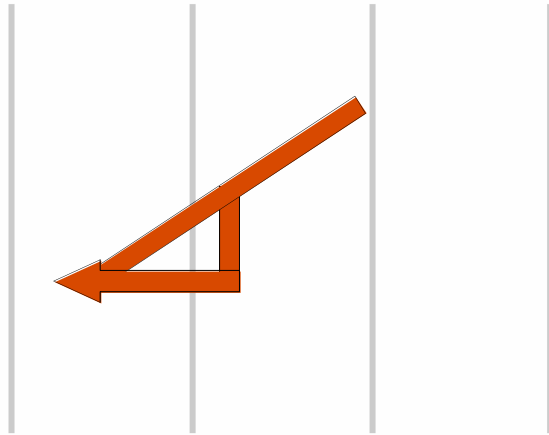
Roll the rafter.



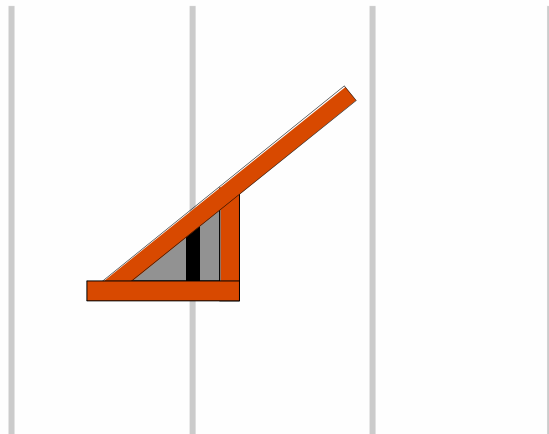
Continue the cut approximately 6 to 10 inches.



Cut perpendicular to any exterior wall.



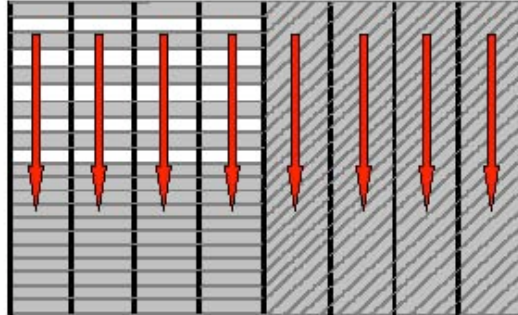
Complete the cut by making a triangle.



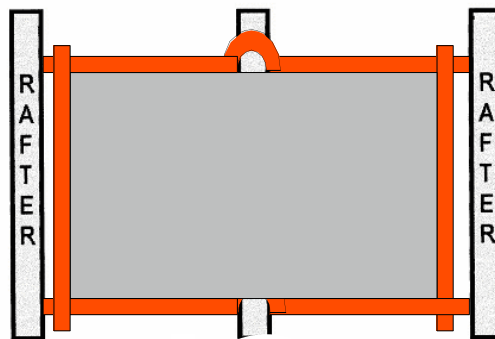
Remove triangle.

CUTTING TECHNIQUES

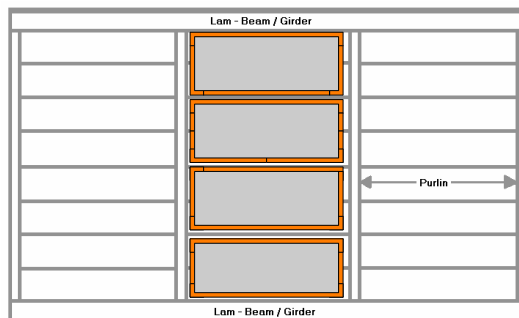
DICING



CENTER RAFTER LOUVER

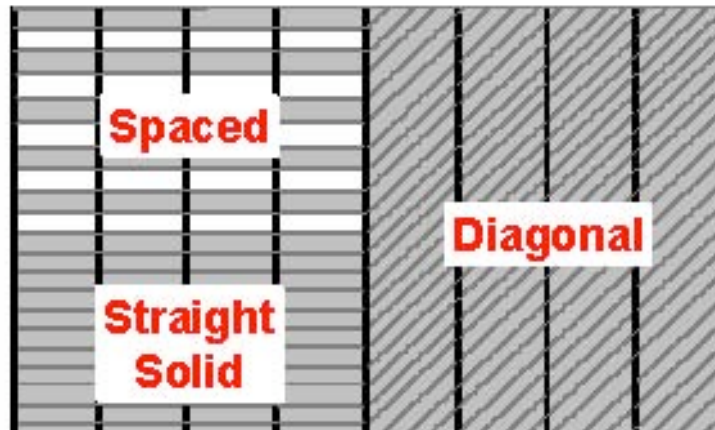


PANELIZED

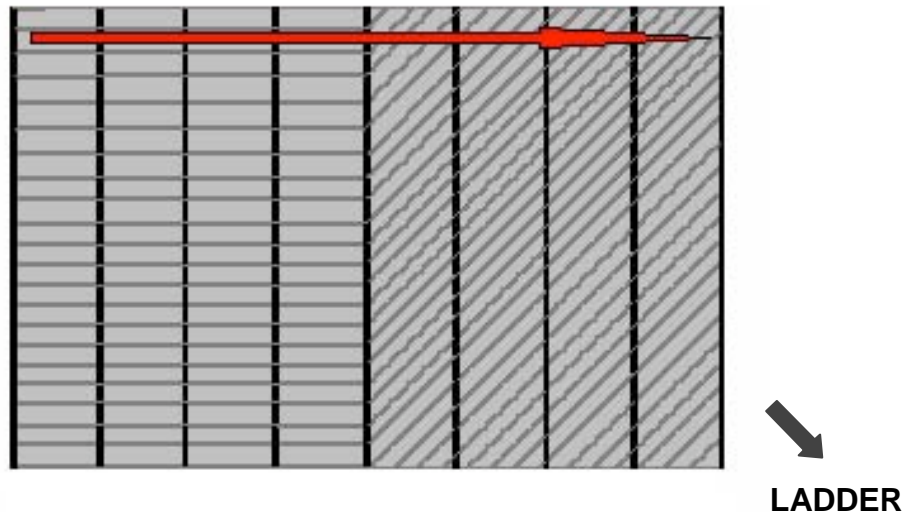


DICING

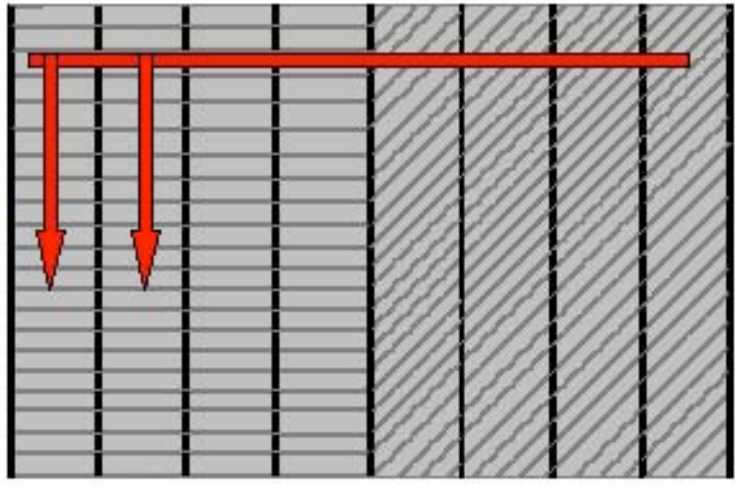
This technique is used for cutting 1" x 4" or 1" x 6" solid, spaced, or diagonal sheathed roofs. Dicing has many advantages. First, it is directional. The roof team will always be working back toward their ladder. The roof team can work simultaneously. After the chain saw operator makes the third cut, the puller can start pulling boards, and the chain saw operator can continue cutting the roof.



Dicing does not require the cutter to know the exact location of the rafters. Rafter type and direction are all that is required to be known. Rafter type and direction has already been determined with diagnostic tools (plug cut, 45-degree inspection cut, sounding, etc.).

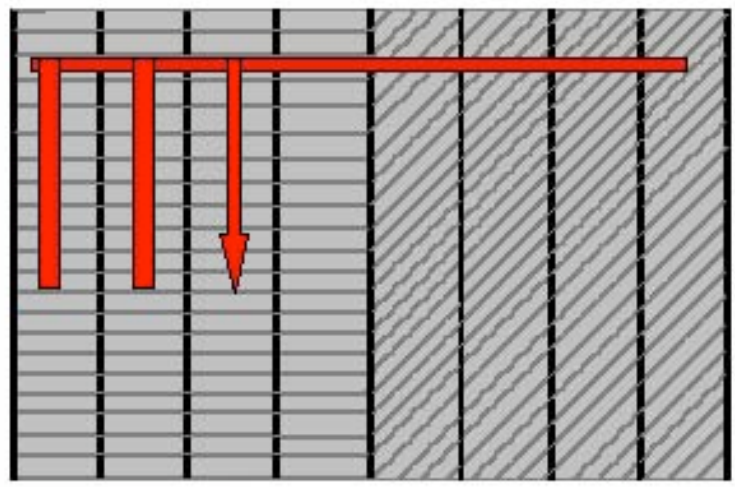


If needed, the first cut performed in this operation is a score cut or a head cut. This cut is perpendicular to rafter direction and should be cut as long as the intended ventilation hole.



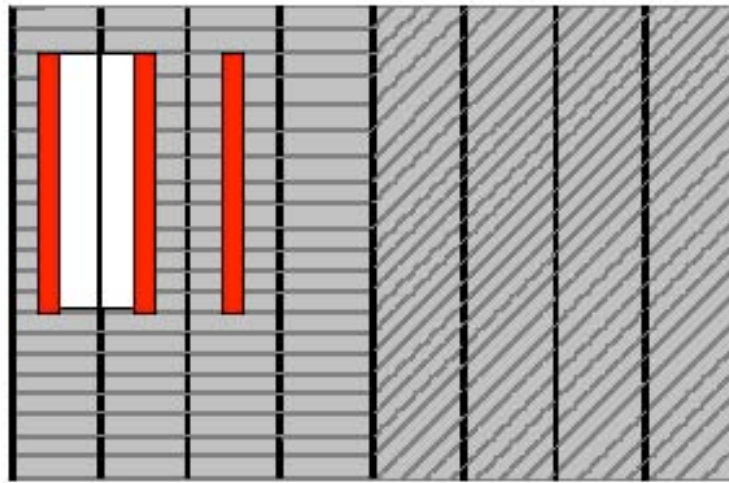
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LADDER

If needed, make a score cut or head cut first. The ventilation team moves back to the starting point of the cut and begins making parallel cuts (parallel to rafters) between rafters, without concern as to the location of the rafters. The length of the dice cut is determined by the reach of the tool being used to pull the sheathing (pick-head axe, rubbish hook). The chain saw operator should be aware of rafter spacing; “Do Not” span two rafters. If the rafter spacing has not been previously determined, spacing should be apparent after the first few dice cuts have been removed. If two cuts are made between rafters, the cut material will fall through and possibly cause injury to interior firefighting crews. If the cuts are spaced too far apart and span two rafters, the cut sheathing may be difficult to pull and impossible to louver. The ventilation team should always work and cut toward the path of safety (towards ladder).



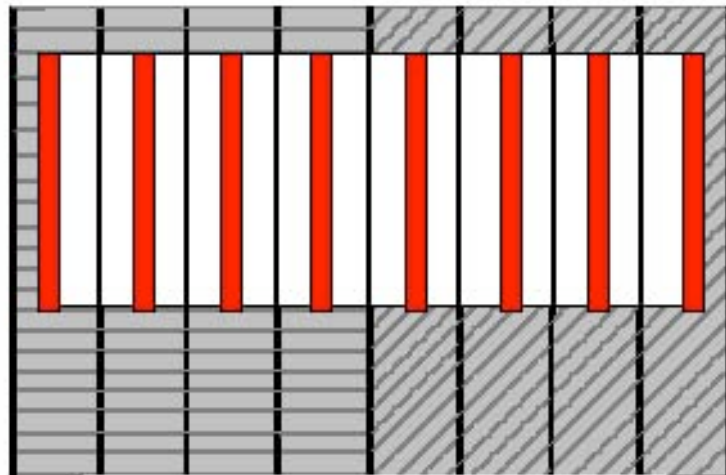
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The chain saw operator should cut a minimum of three dice cuts before the puller begins removing sheathing.



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After the third dice cut is complete, the puller removes the roof sheathing. Always leave a minimum of one un-pulled section between the cutter and the puller.

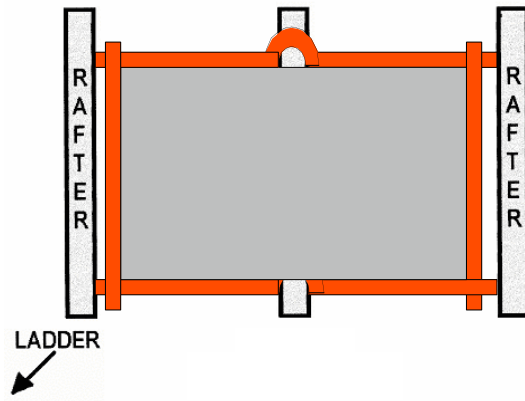


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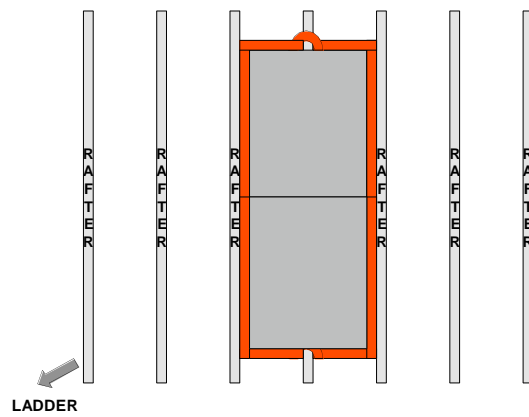
Always work back towards your ladder. On a roof constructed with multiple layers of roof composition or diagonal roof sheathing, an additional score cut or bottom cut may be necessary.

CENTER RAFTER LOUVER CUTTING TECHNIQUES

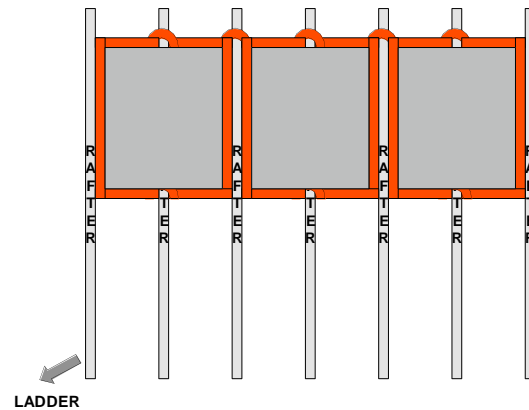
CENTER RAFTER LOUVER



EXPANDED WITH CONSTRUCTION

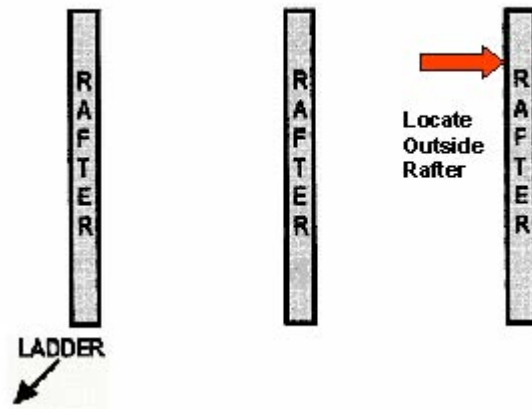


AGAINST CONSTRUCTION

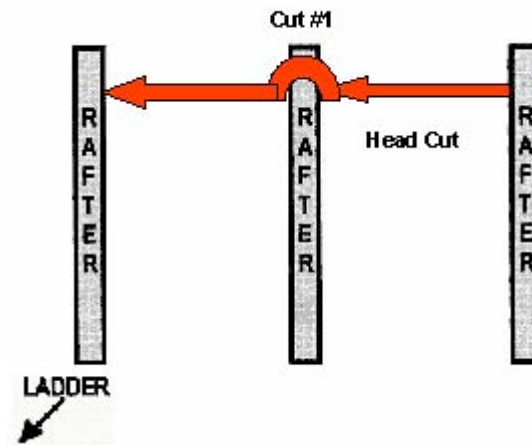


CENTER RAFTER LOUVER

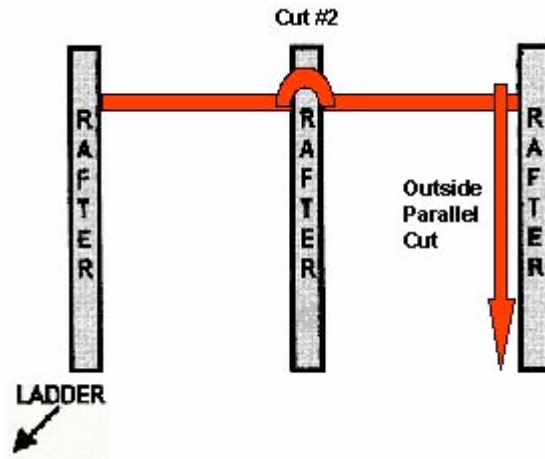
In order to make a center rafter louver, you must first know rafter type and rafter direction. Next, you must determine the location of three rafters. The rafter type and direction is determined by the use of diagnostic tools (plug cut, 45-degree inspection cut, sounding, etc.). When you are over the ventilation area, make a head cut to locate a minimum of three rafters.



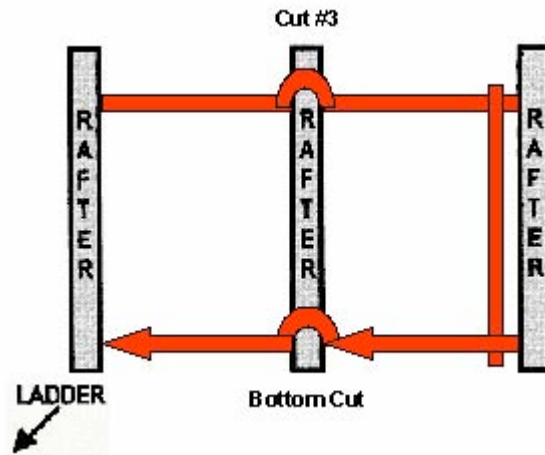
The head cut is started by first cutting away from your ladder to locate your first "outside" rafter.



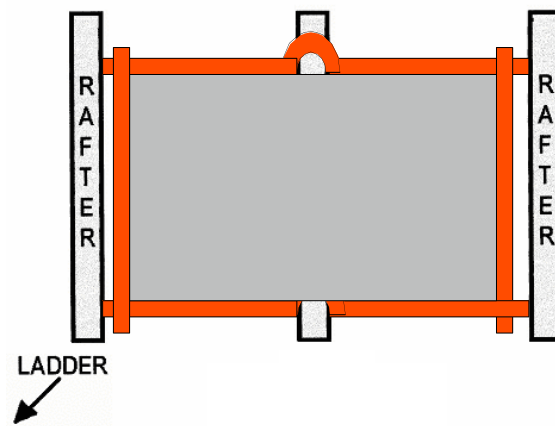
Reverse directions, and cut back towards your ladder. Roll the second "center" rafter and stop at the third "inside" rafter.



Move back to the first "outside" rafter and cut a parallel cut approximately 2 to 3 inches inside the rafter.

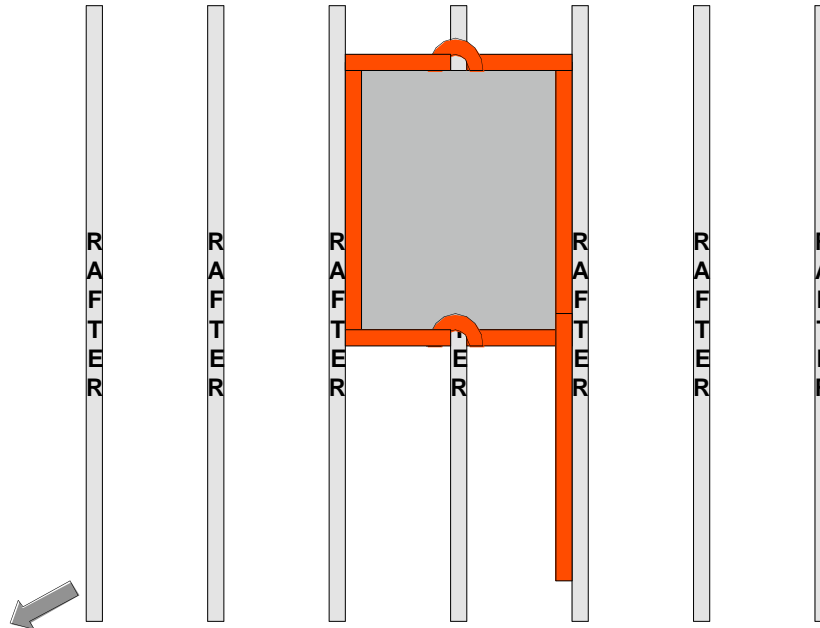


Make the bottom cut, cutting towards the ladder. Start at the first "outside" rafter, roll over the second "center" rafter, and stop at the third "inside" rafter.



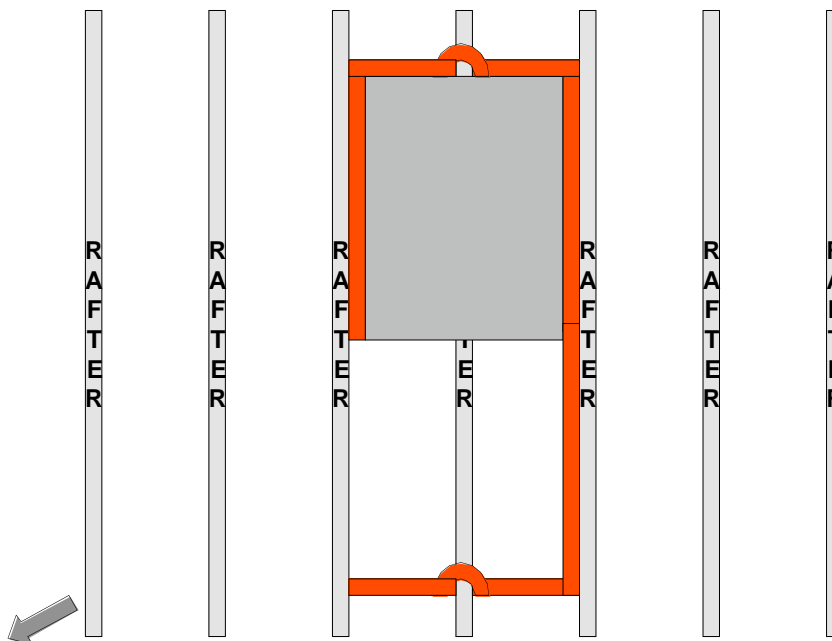
Make a parallel cut approximately 2 to 3 inches inside the third "inside" rafter. Then louver section.

EXPANDED CENTER RAFTER LOUVER, WITH CONSTRUCTION



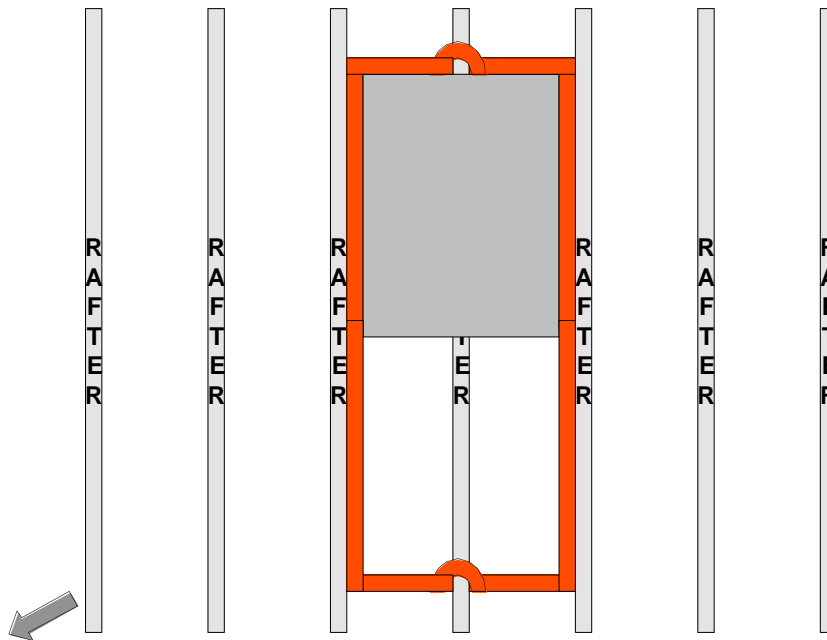
LADDER

Move back to the first “outside” rafter, and make a parallel cut approximately 2 to 3 inches inside the rafter.



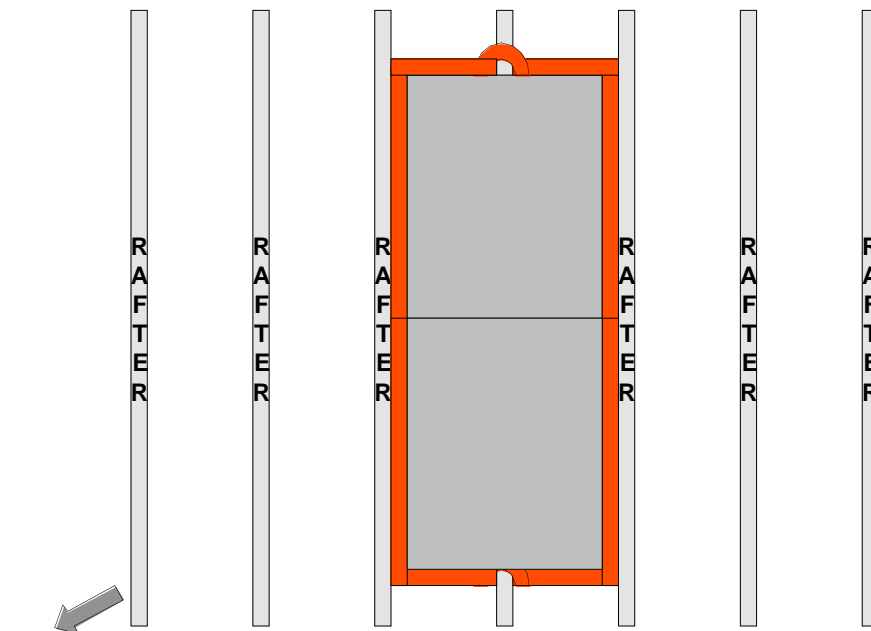
LADDER

Make the bottom cut, cutting towards your ladder. Start at the first “outside” rafter, roll over the second “center” rafter, and stop at the third “inside” rafter.



LADDER

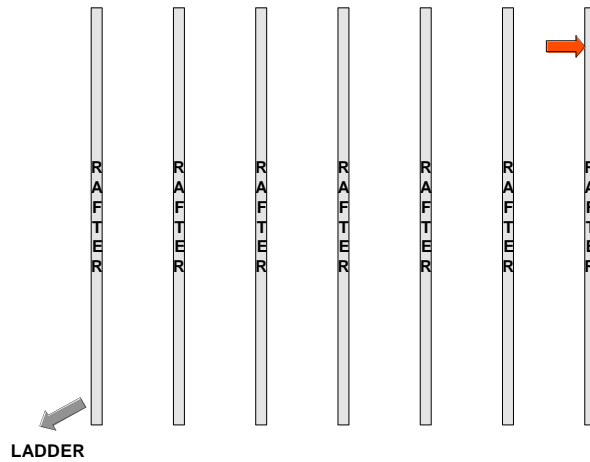
Make a parallel cut approximately 2 to 3 inches inside the third "inside" rafter.



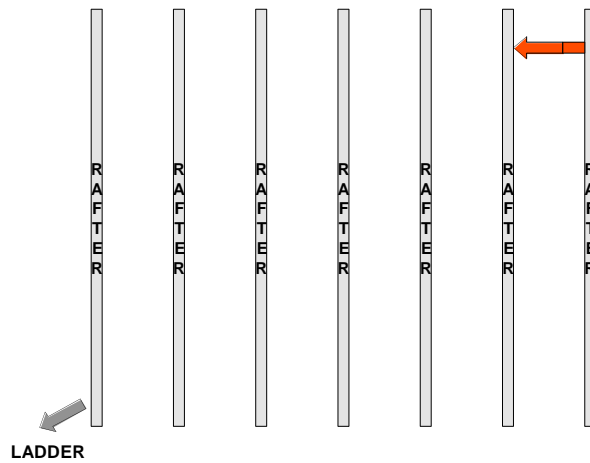
LADDER

Louver section.

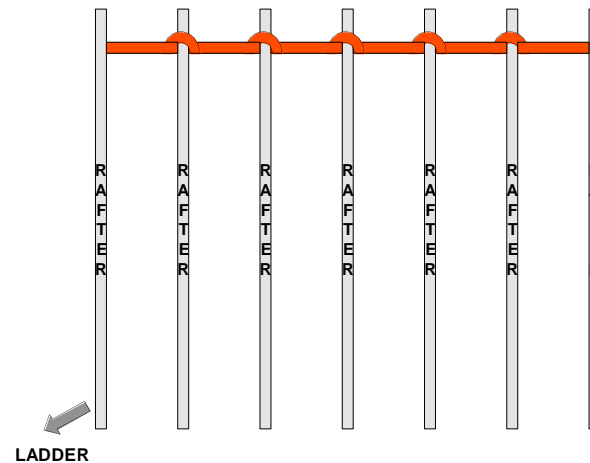
CENTER RAFTER LOUVER, AGAINST CONSTRUCTION



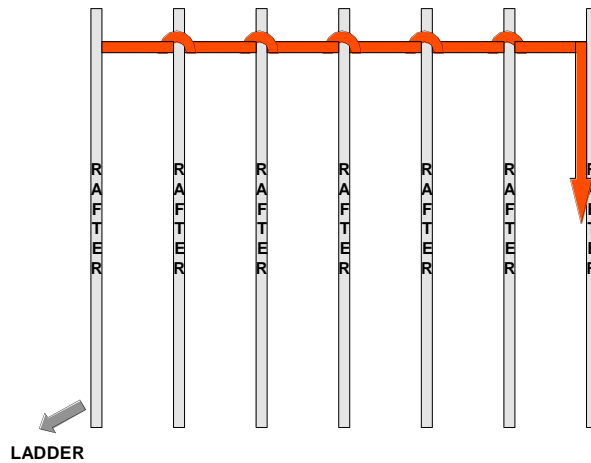
The head cut is started by first cutting away from your ladder to locate your first "outside" rafter.



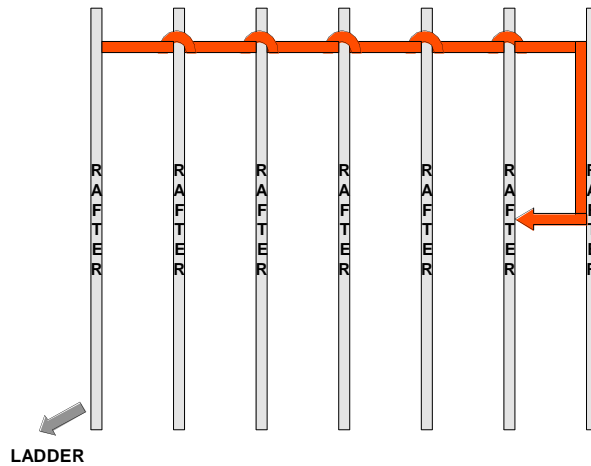
Reverse directions and cut back towards your ladder.



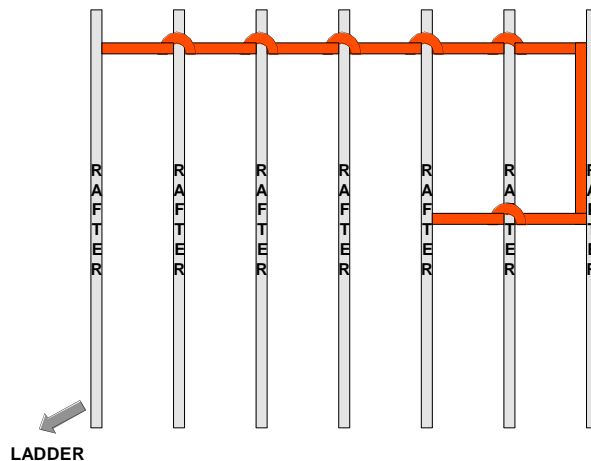
Roll rafters. Make "head cut" as long as intended hole.



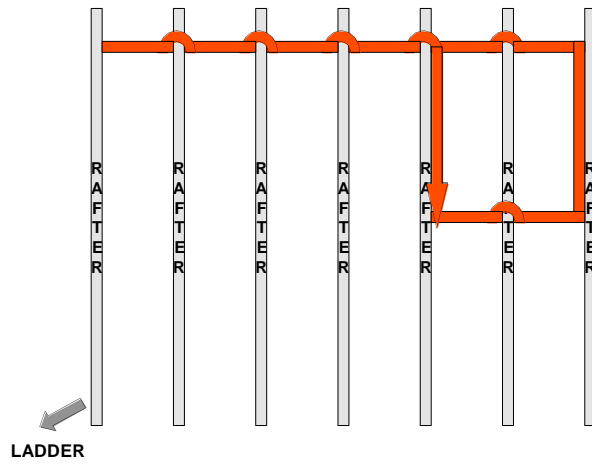
Move back to the first “outside” rafter and make a parallel cut approximately 2 to 3 inches inside the rafter. Make parallel cut approximately 3-½ feet long.



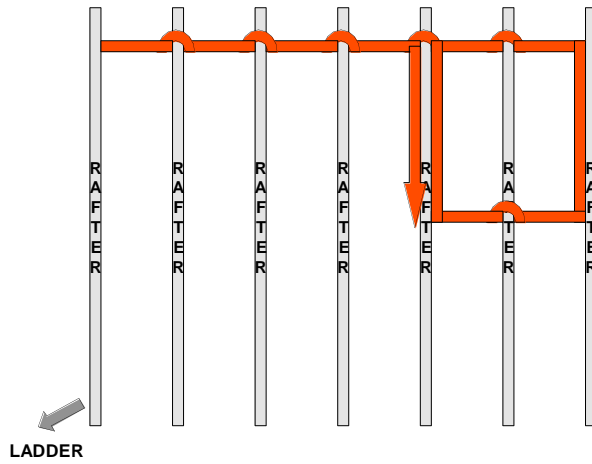
Make the bottom cut, cutting towards your ladder. Start at the first “outside” rafter.



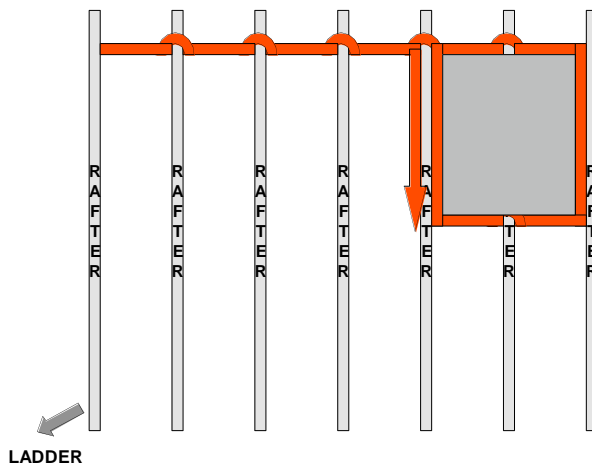
Roll over the second “center” rafter, and stop at the third “inside” rafter.



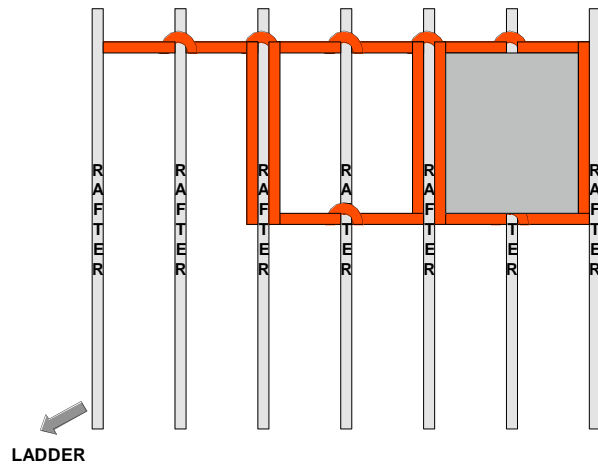
Make a parallel cut approximately 2 to 3 inches inside the third "inside" rafter.



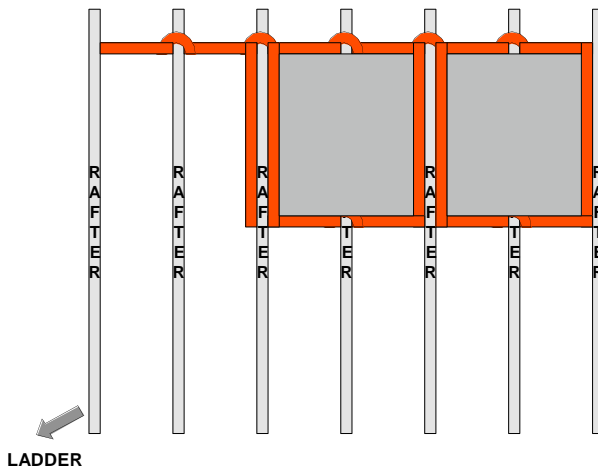
Make fifth cut.



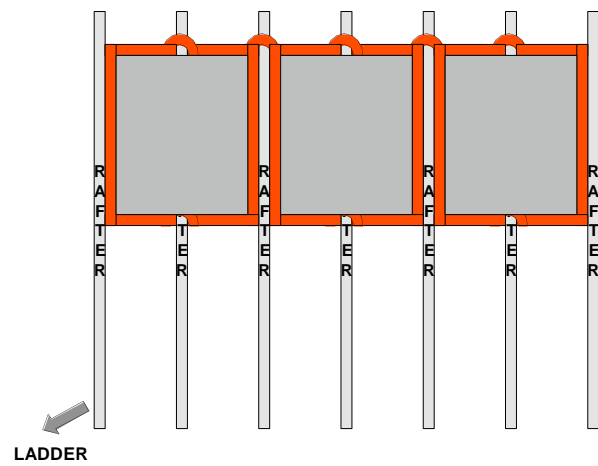
Louver section.



Make bottom, fourth, and fifth cuts.

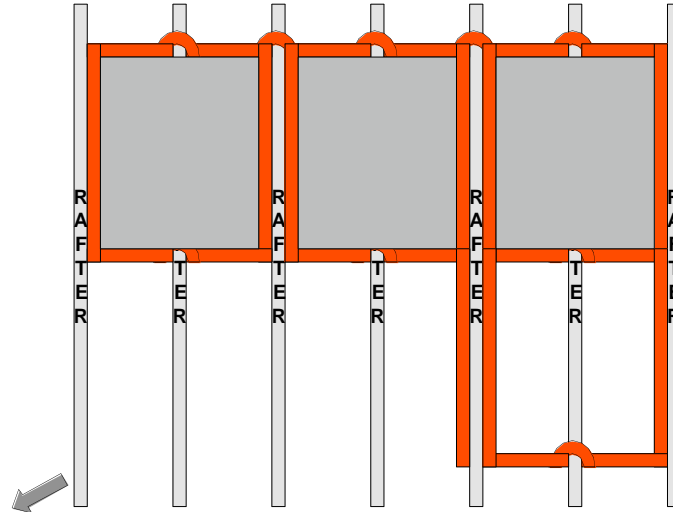


Louver section.



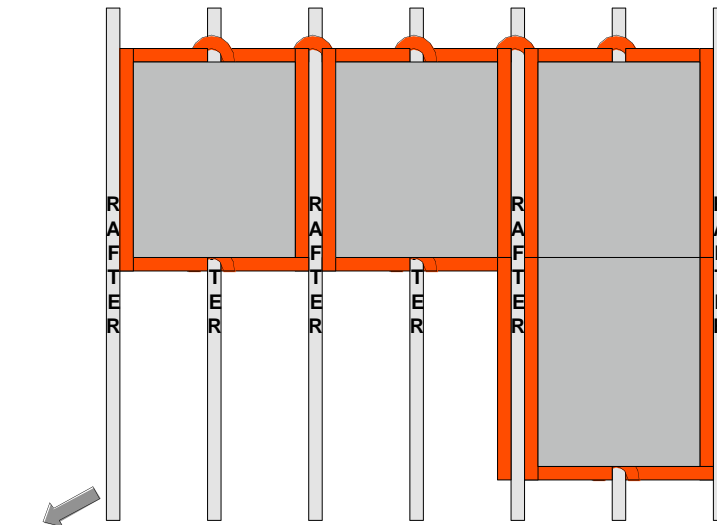
Make bottom and fourth cuts.
Then louver section.

EXPANDED CENTER RAFTER LOUVER, AGAINST CONSTRUCTION



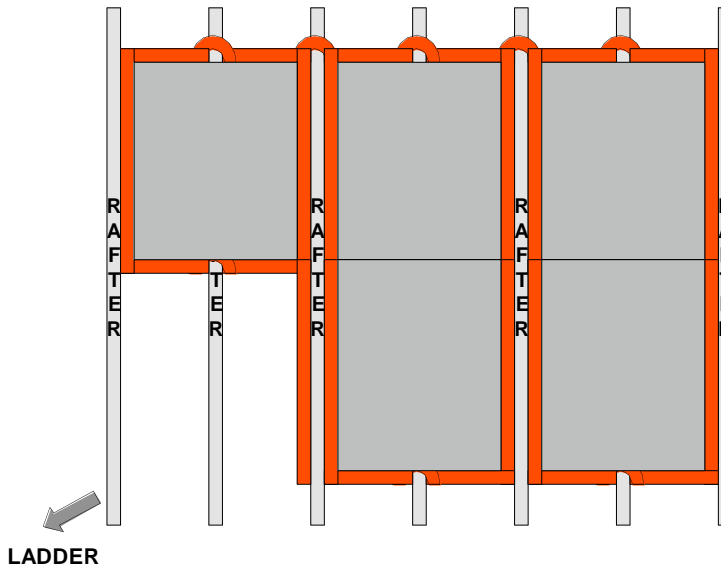
LADDER

Move back to the first "outside" rafter and make a parallel cut approximately 2 to 3 inches inside the rafter. Make parallel cut approximately 3-½ feet long. Make the bottom cut, cutting towards your ladder. Start at the outside rafter. Roll over the center rafter, and stop at the third "inside" rafter. Make fifth cut.

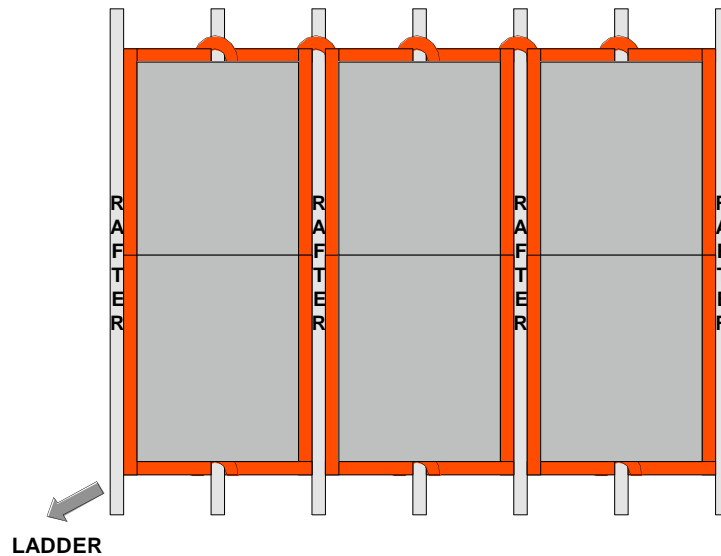


LADDER

Louver section.

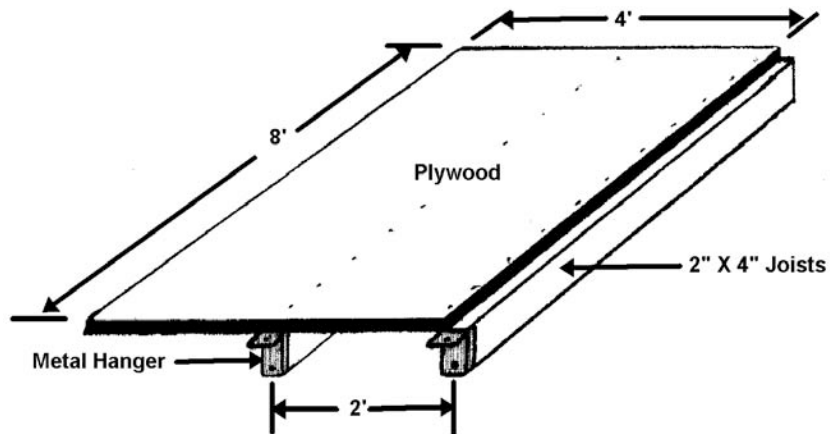
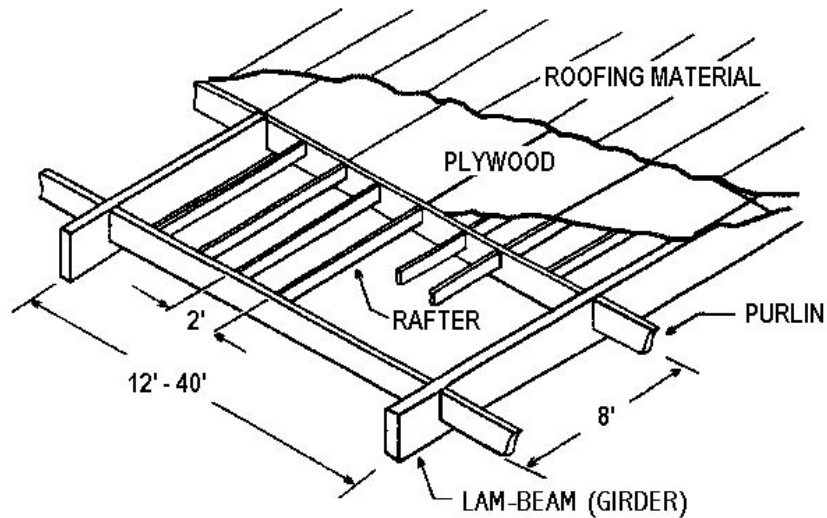


Make the bottom cut, cutting towards your ladder. Roll over the center rafter, and stop at the third rafter. Make fourth and fifth cuts. Then lower section.



Make the bottom cut, cutting towards your ladder. Roll over the center rafter and stop at the third rafter. Make fourth cut. Then lower section.

PANELIZED ROOF CUTTING TECHNIQUES



DROP METHOD (OFFENSIVE)

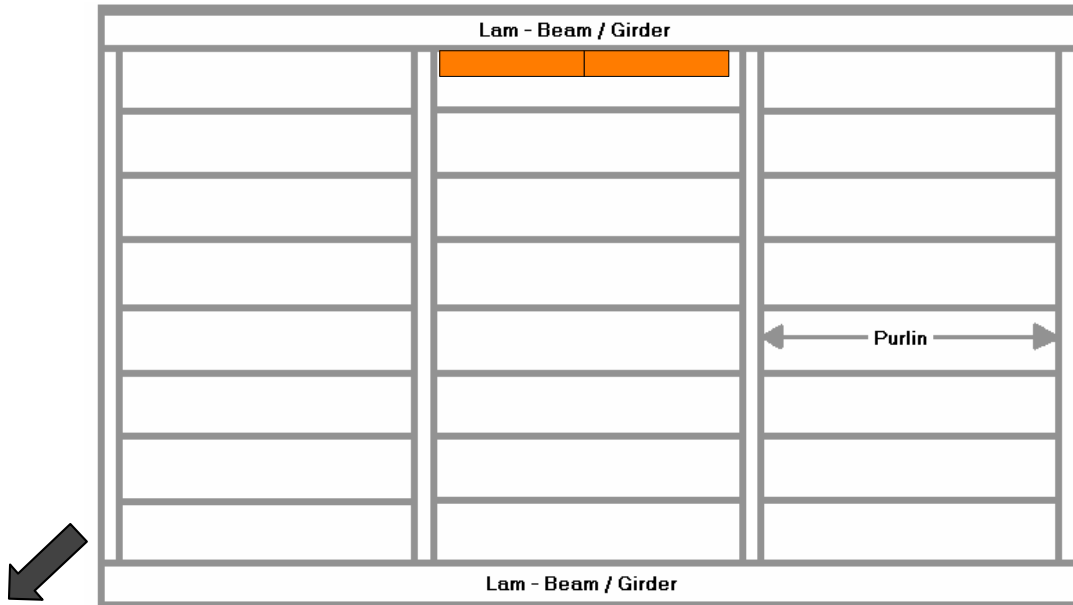
PULL BACK METHOD (OFFENSIVE)

OFFENSIVE LOUVER (OFFENSIVE)

LOUVER OFF A LAM BEAM / MAIN BEAM (DEFENSIVE)

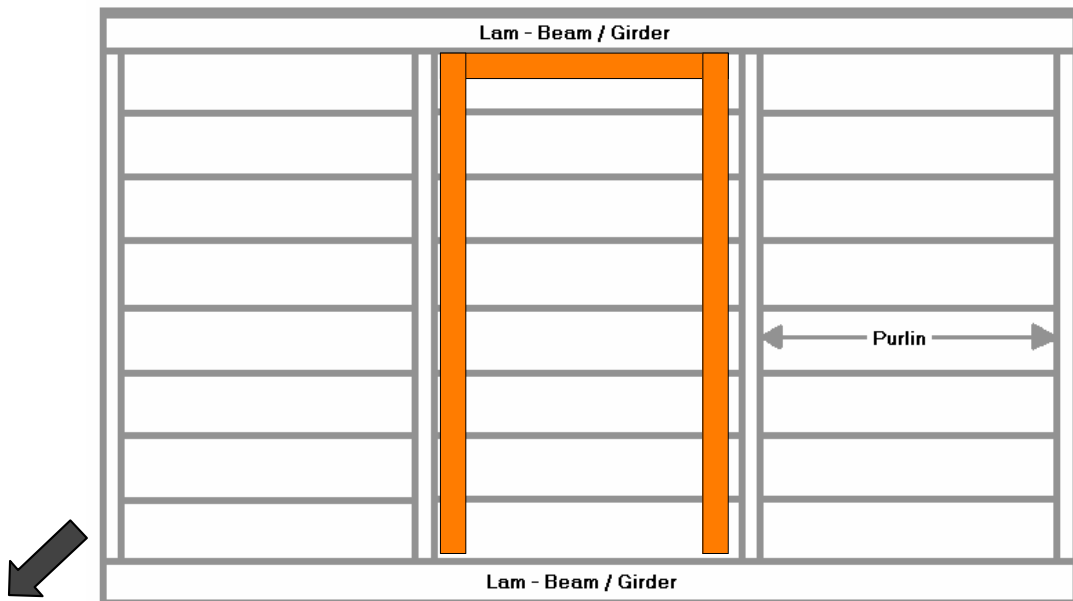
LOUVER OFF A PURLIN (DEFENSIVE)

DROP METHOD (OFFENSIVE)



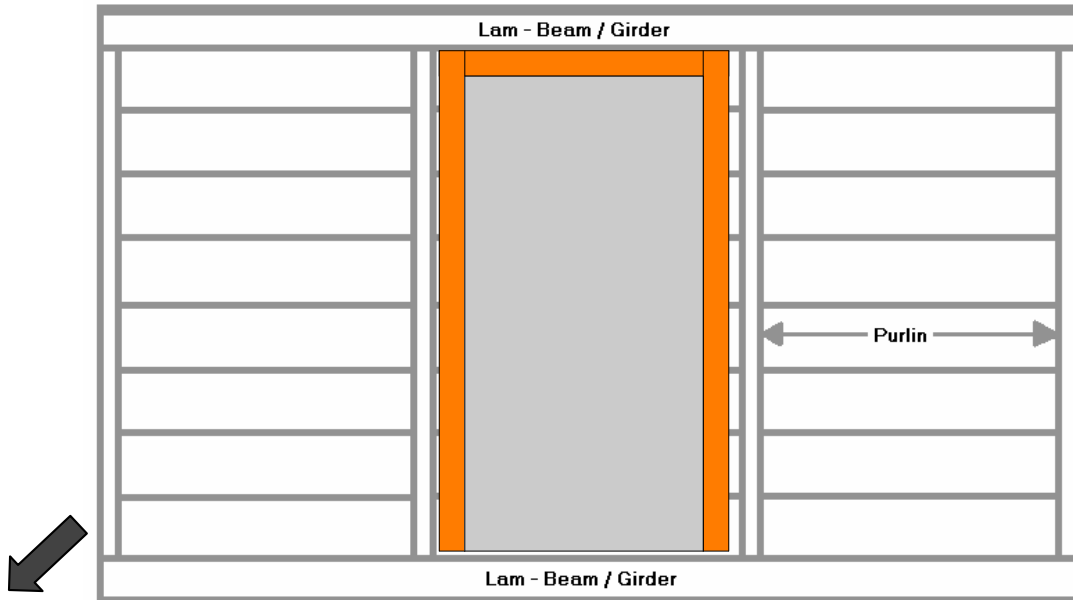
LADDER

While standing on purlins, the first cut is made parallel to the lam-beam, stopping at the purlins.



LADDER

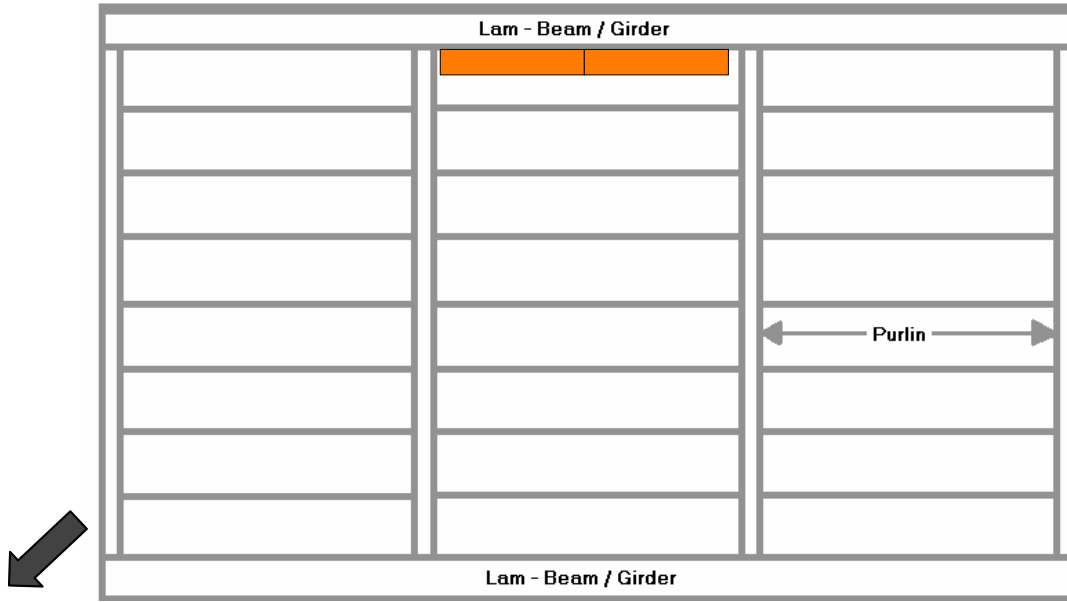
Cut inside and parallel to the purlins. Cut completely through plywood and 2" x 4" rafters. Cutters must work together. Cut 4 to 6 inches inside of the purlins to avoid hitting metal hangers.



LADDER

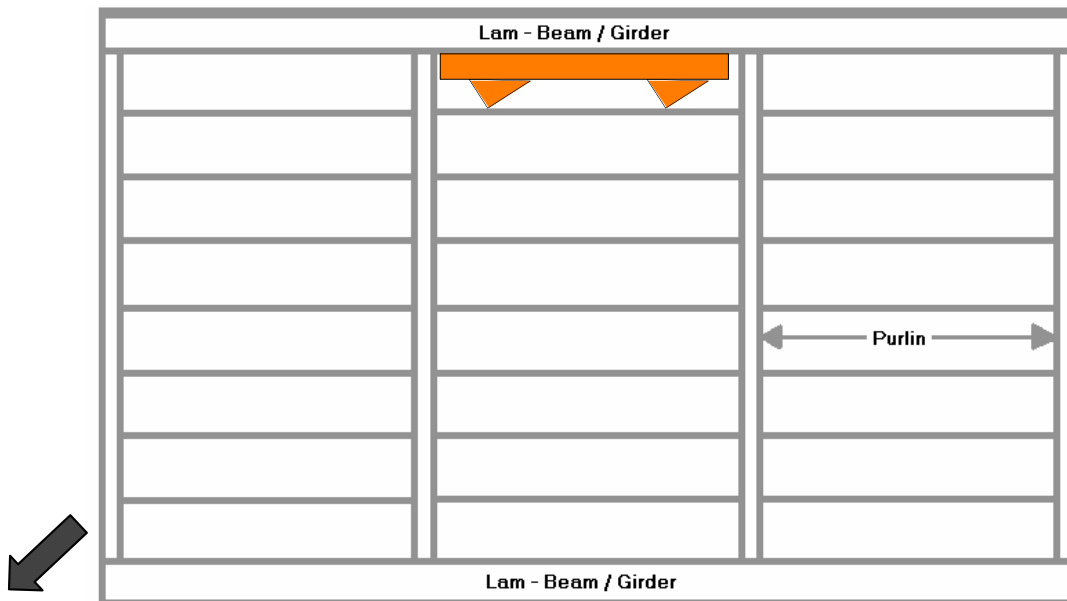
Cut from lam-beam to lam-beam. Always cut back toward your ladder.

PULL BACK METHOD (OFFENSIVE)



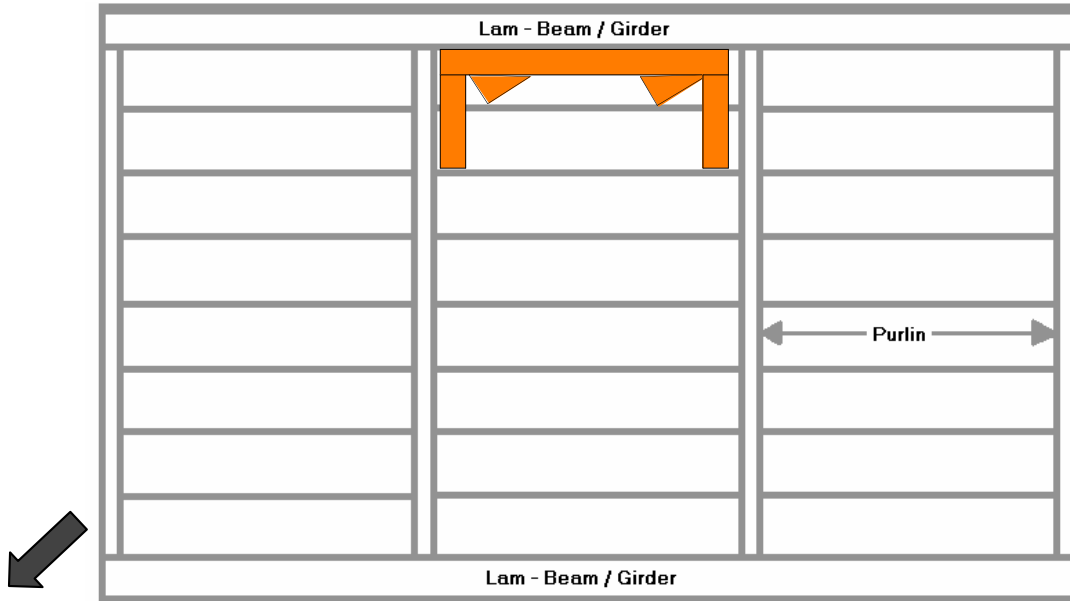
LADDER

Standing on purlins, the first cut is made parallel to lam-beam, stopping at purlins.



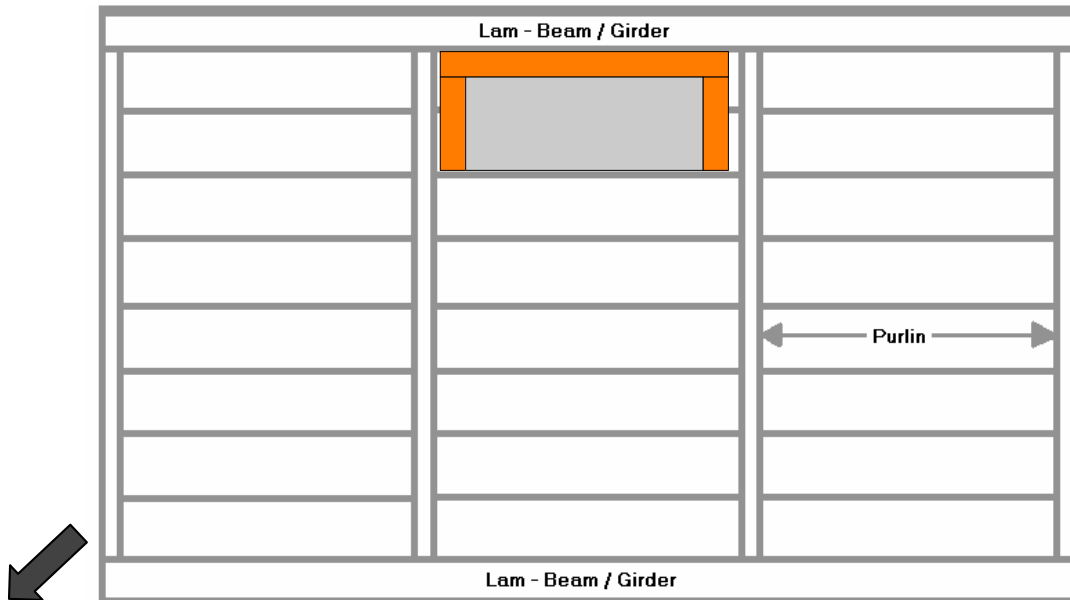
LADDER

Cut small triangles through roof decking. Insert rubbish hooks into triangles. Rubbish hooks are used to pull back roofing and decking materials.



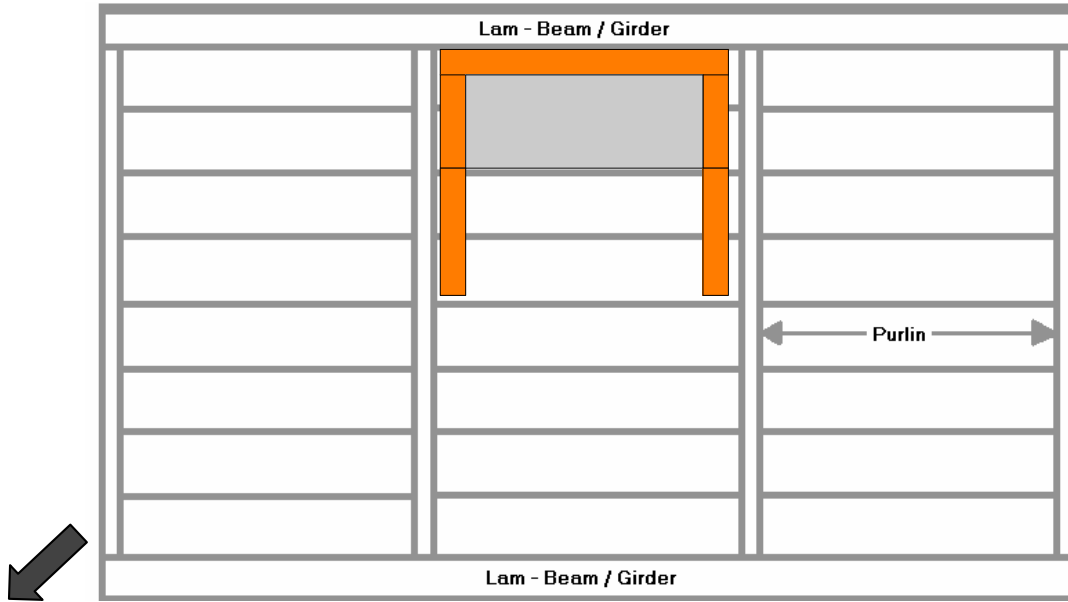
LADDER

Cut completely through the first rafter, and stop at the second rafter.



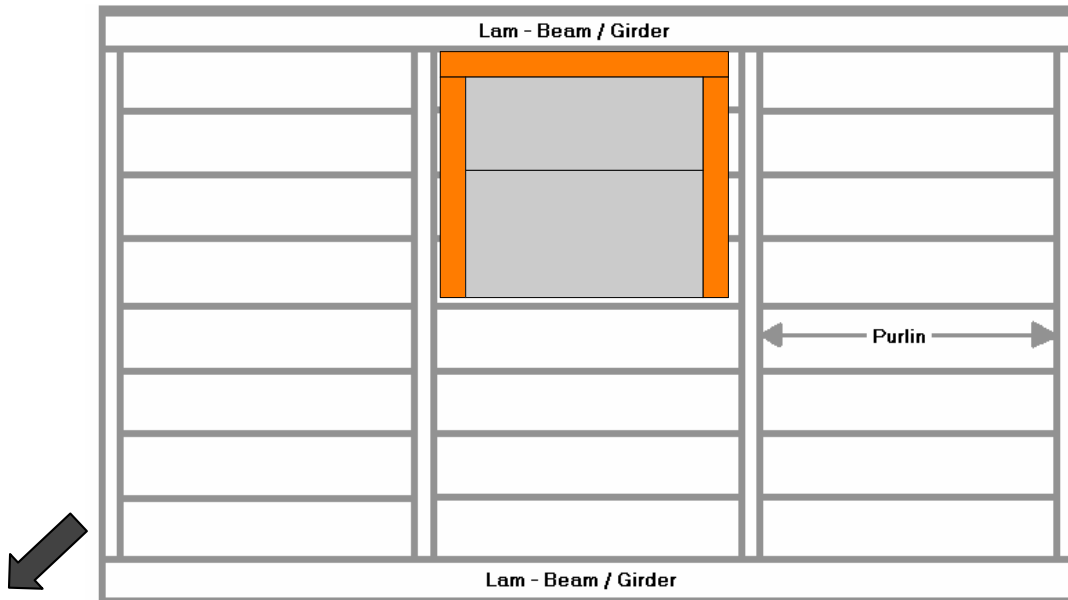
LADDER

Pullers pull back 4' x 8' panel with rubbish hooks. Panel will break at plywood seam.



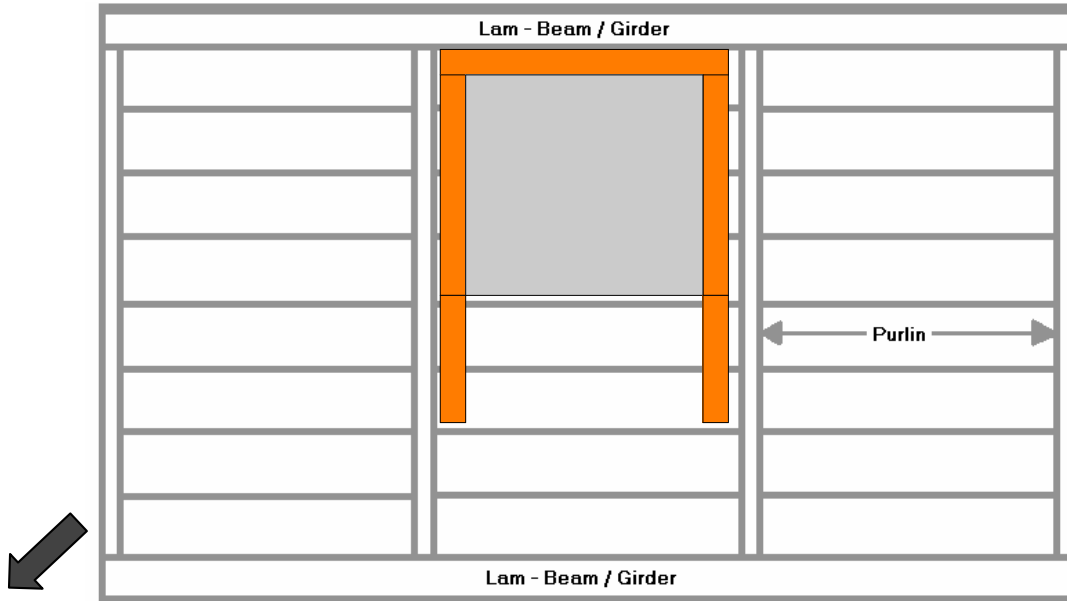
LADDER

Pullers insert rubbish hooks over exposed rafter. Cutters cut completely through two rafters. Stop at third rafter.



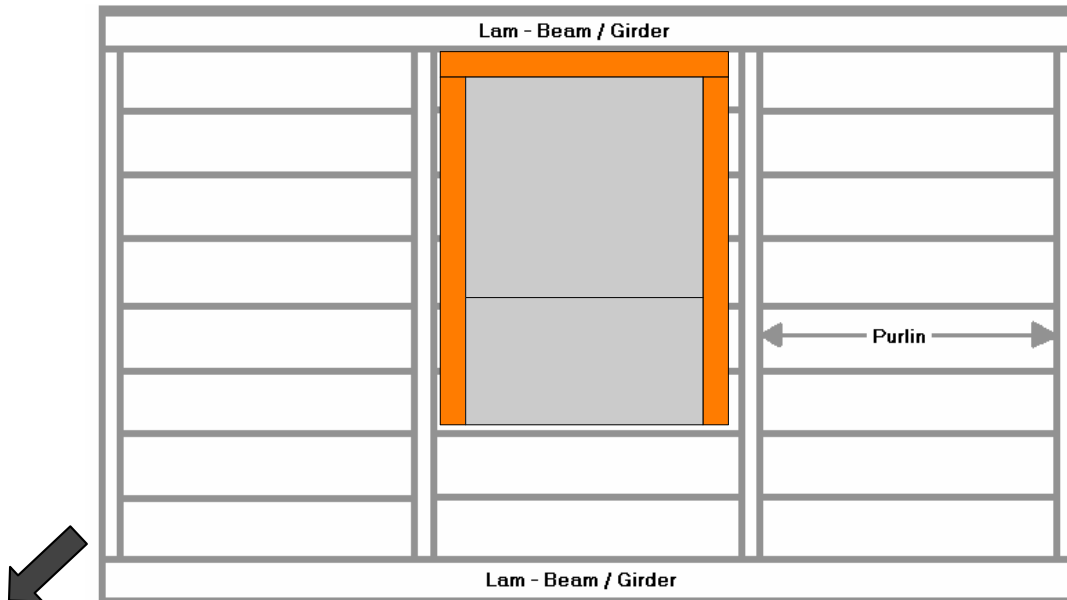
LADDER

Pullers pull back 4' x 8' panel with rubbish hooks. Panel will break at plywood seam.



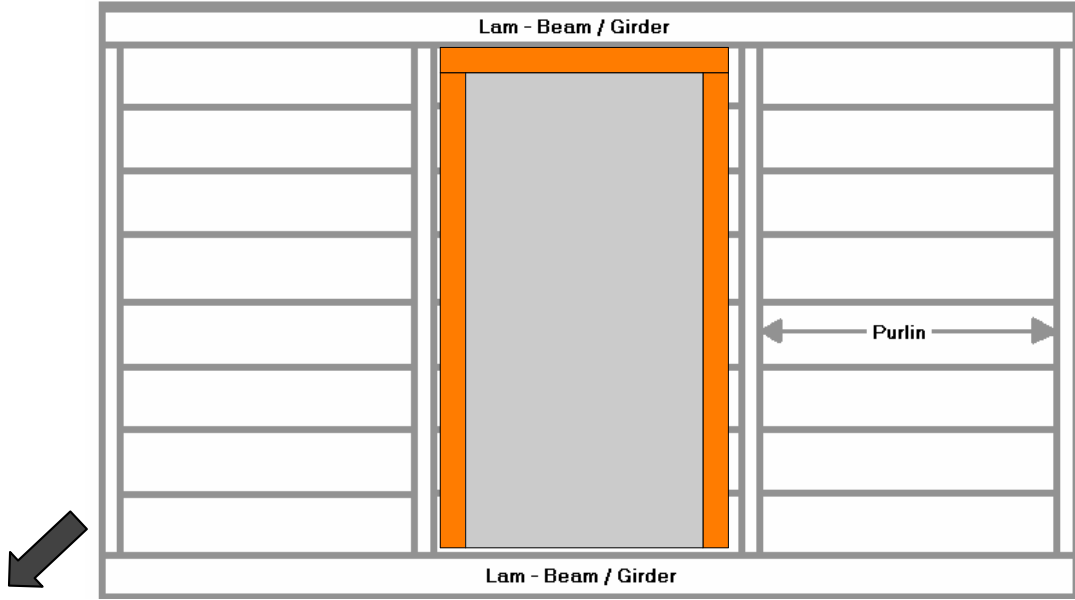
LADDER

Pullers insert rubbish hooks over exposed rafter. Cutters cut completely through two rafters. Stop at third rafter.



LADDER

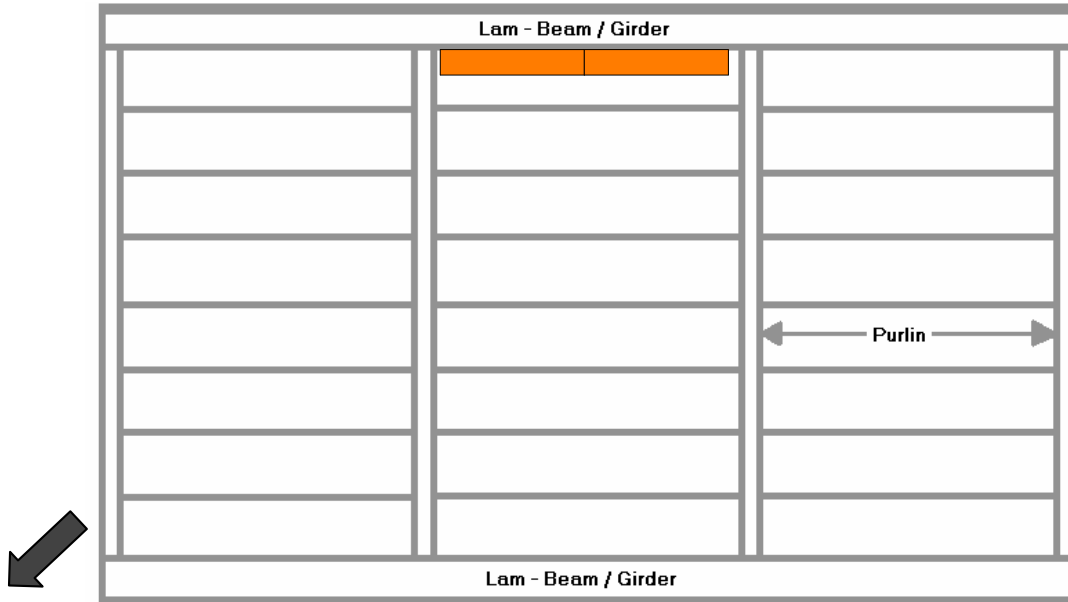
Pullers pull back 4' x 8' panel with rubbish hooks. Panel will break at plywood seam.



LADDER

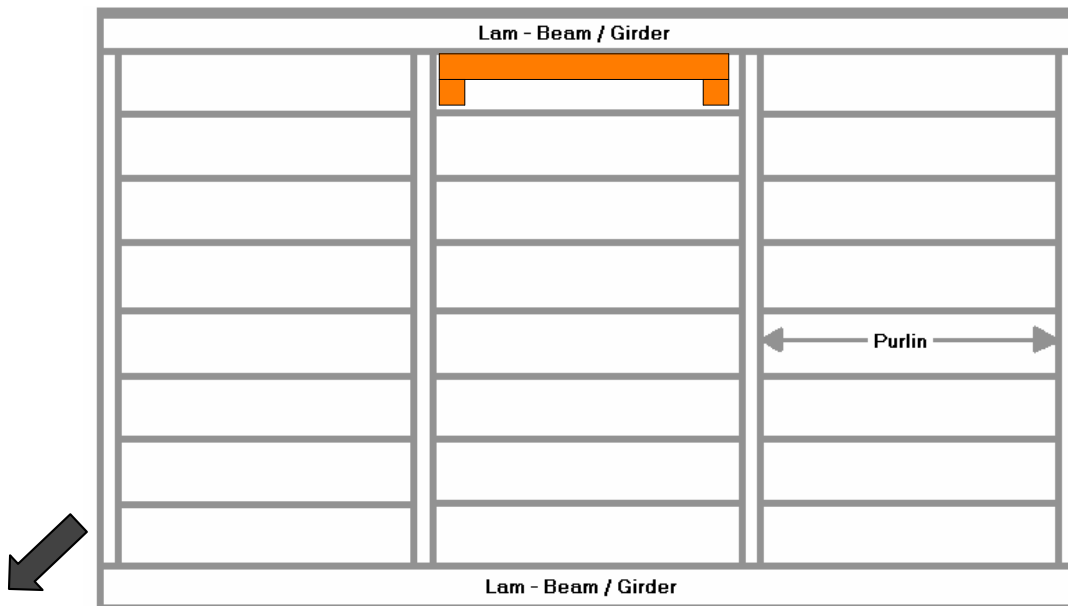
Complete pull back from lam-beam to lam-beam.

OFFENSIVE LOUVER



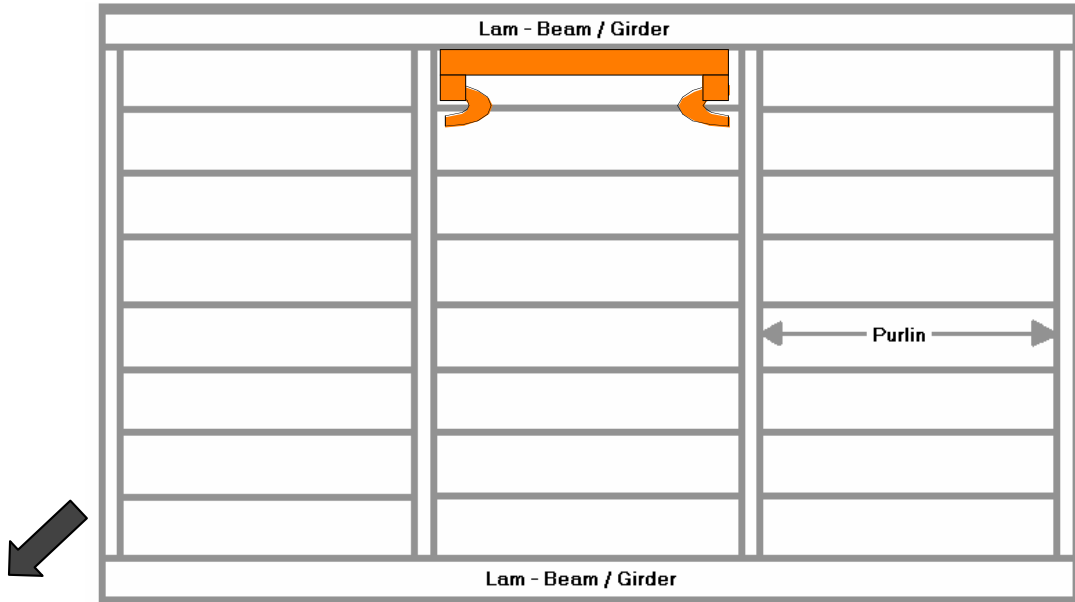
LADDER

While standing on purlins, the first cut is made parallel to lam-beam, stopping at purlins.

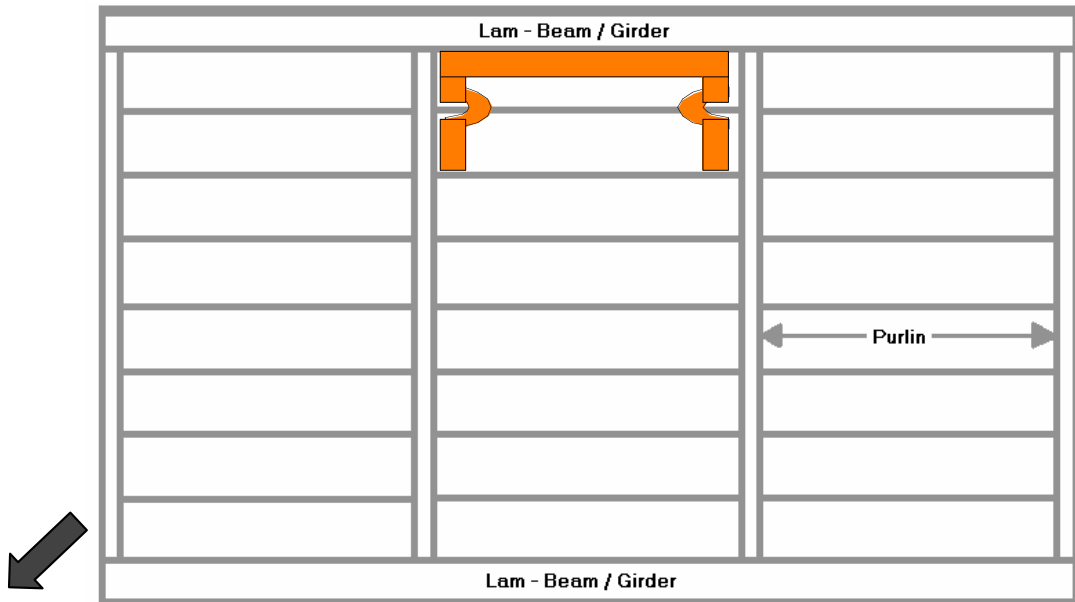


LADDER

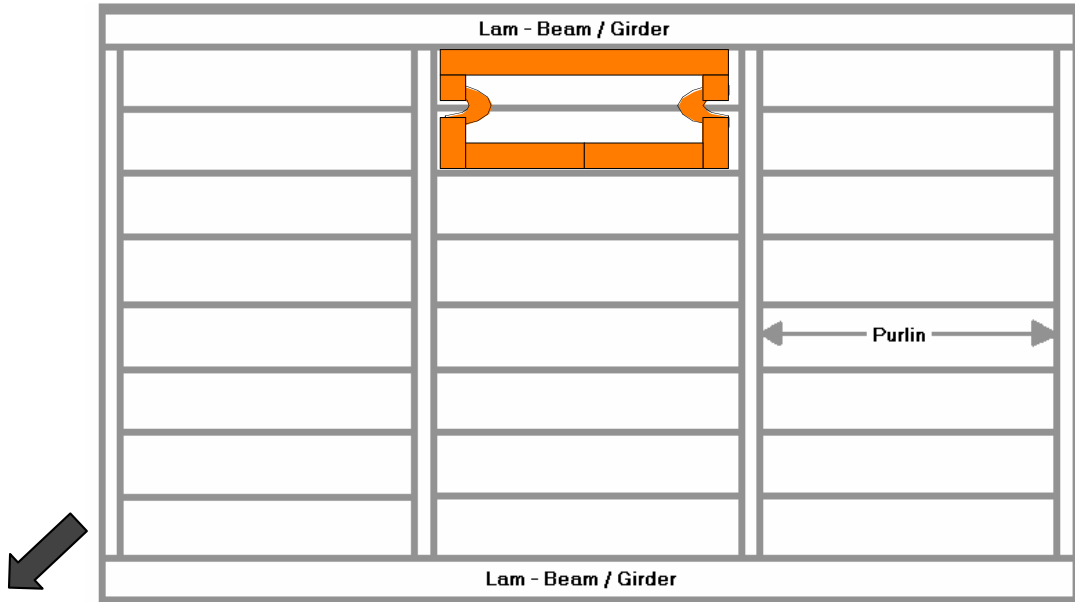
Cut parallel to purlins; locate center rafter.



Roll center rafter.

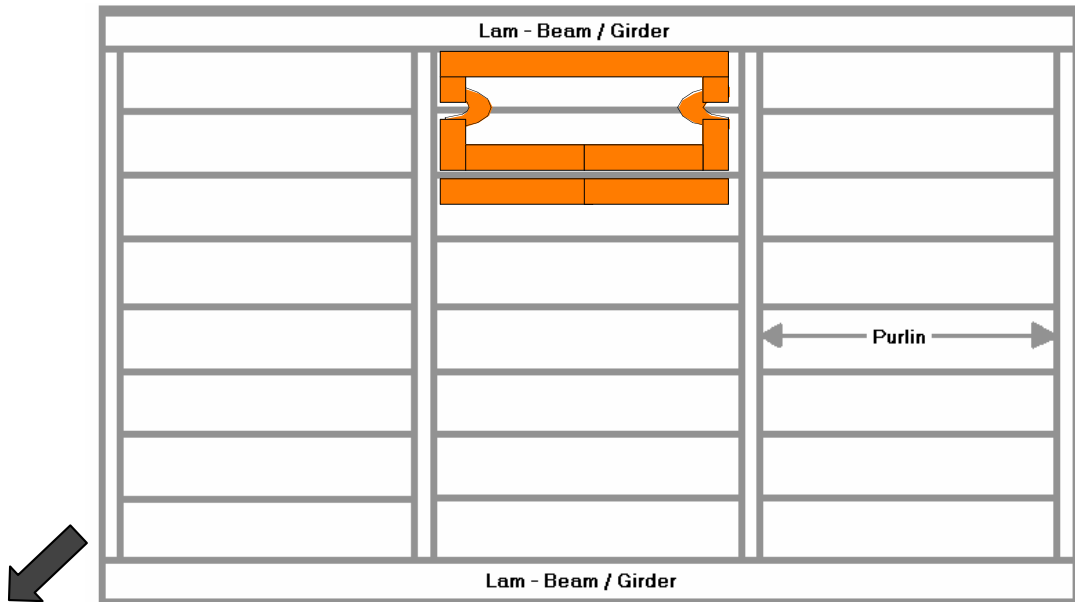


Stop at third rafter.



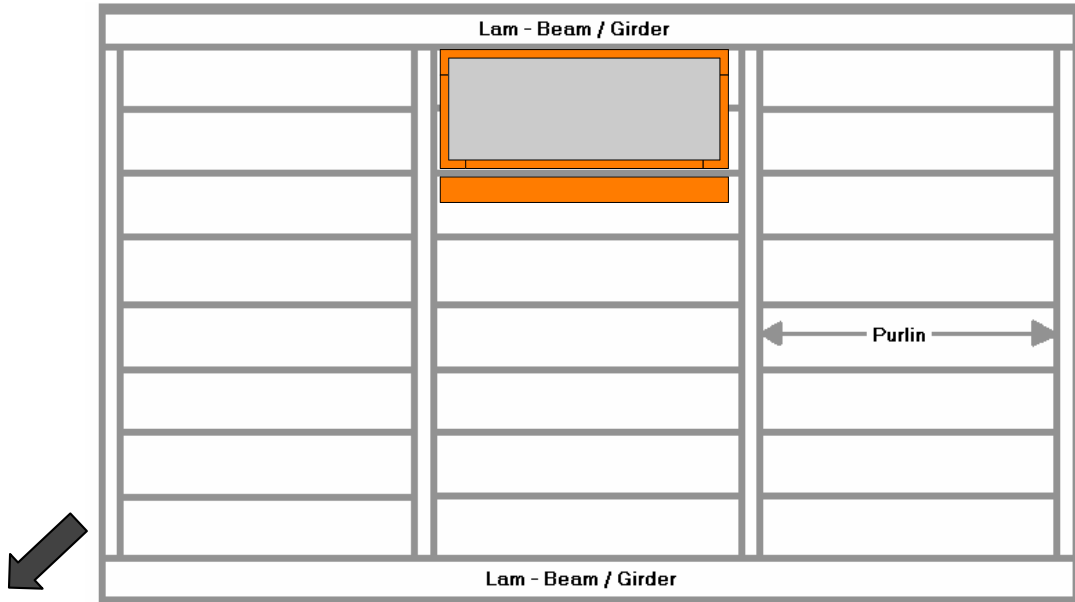
LADDER

Cut inside of third rafter.



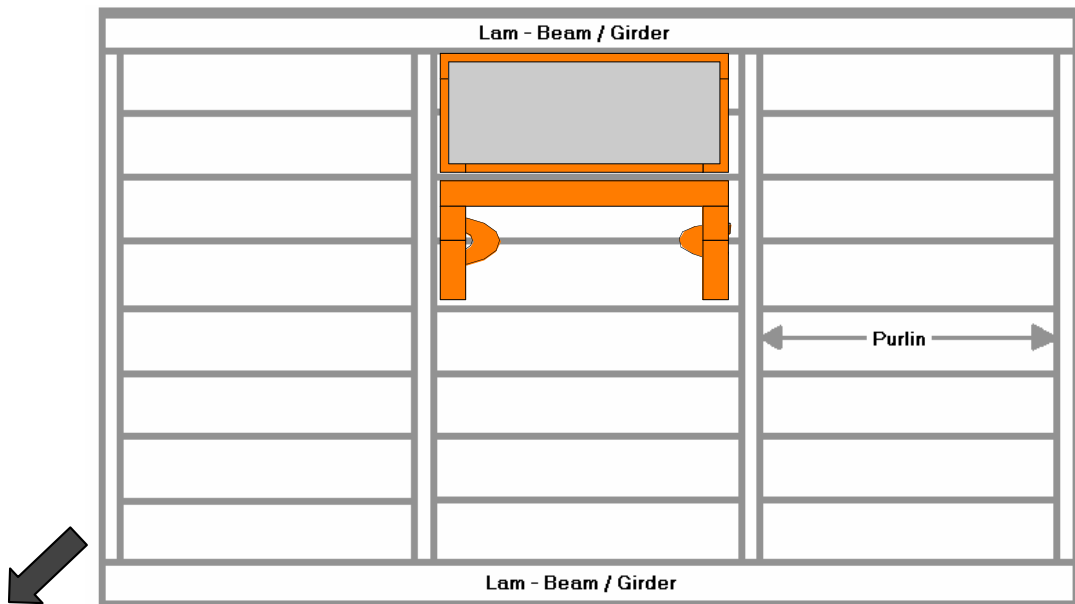
LADDER

Cut outside of third rafter.



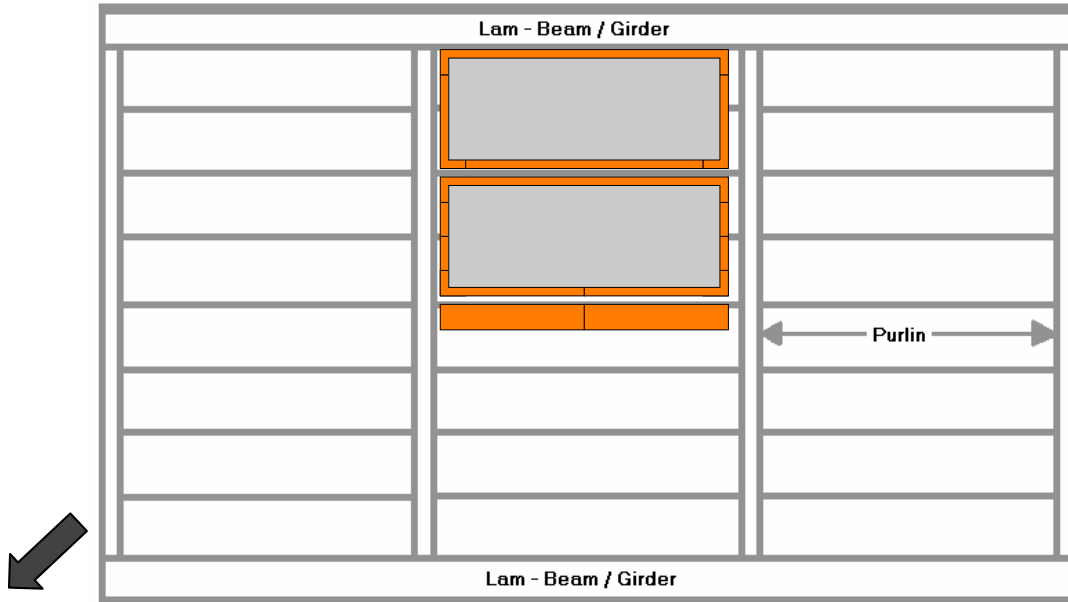
LADDER

Louver section.



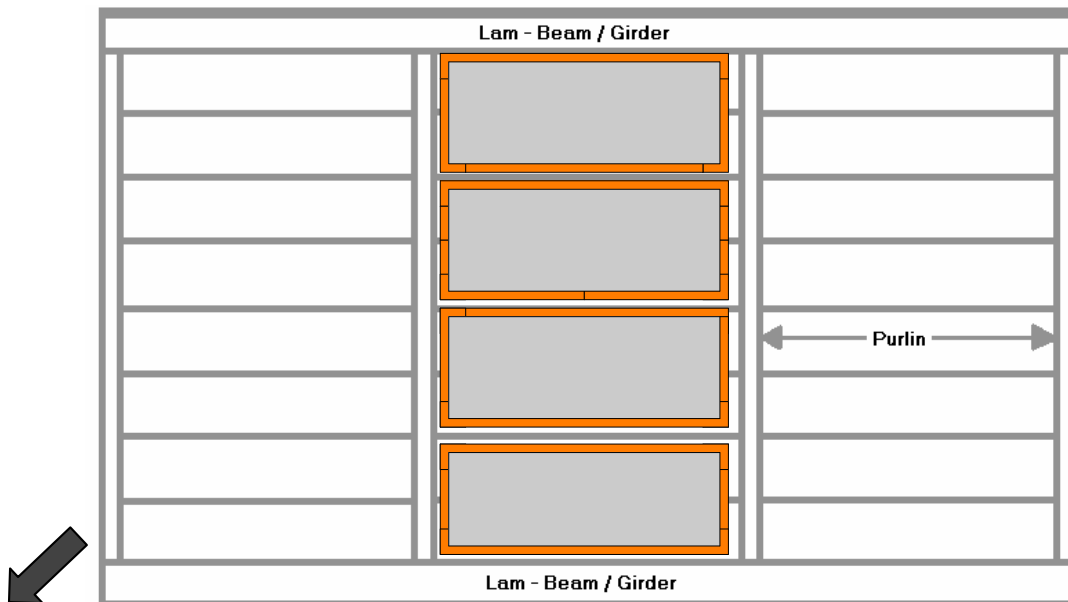
LADDER

Cut parallel to purlins, roll center rafter, and stop at third rafter.



LADDER

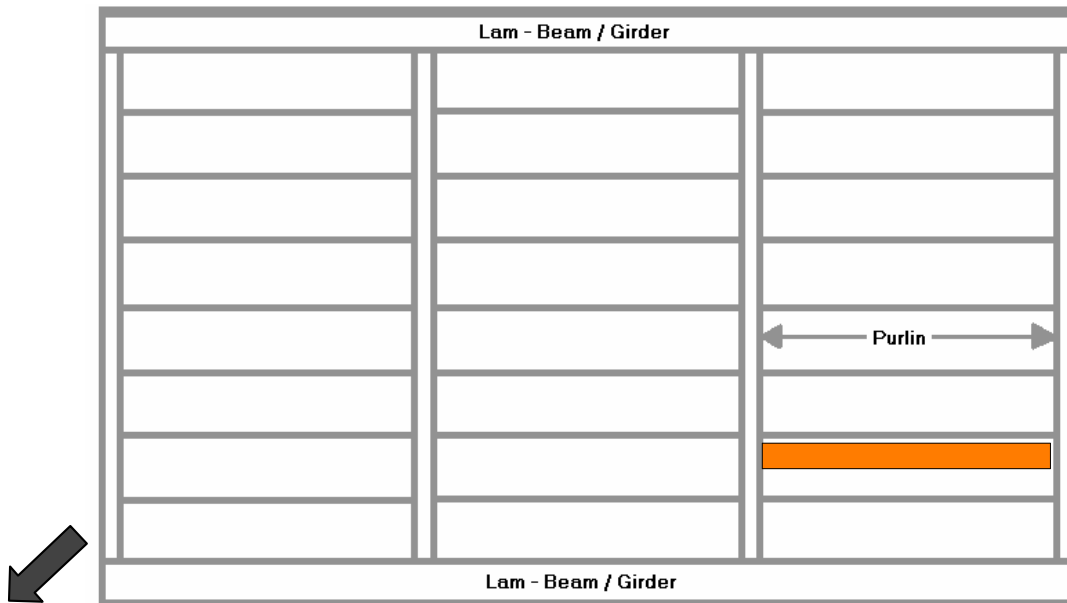
Cut on both sides of third rafter (fourth and fifth cuts). Then lower section.



LADDER

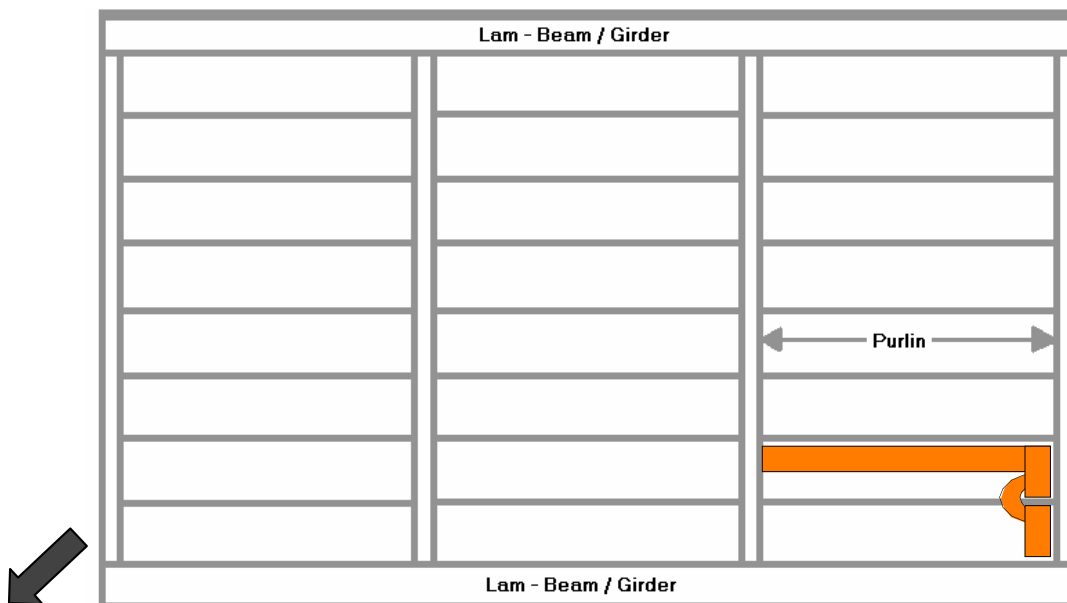
Continue offensive louver from lam-beam to lam-beam.

**LOUVER OFF A LAM-BEAM / MAIN BEAM
(DEFENSIVE)**



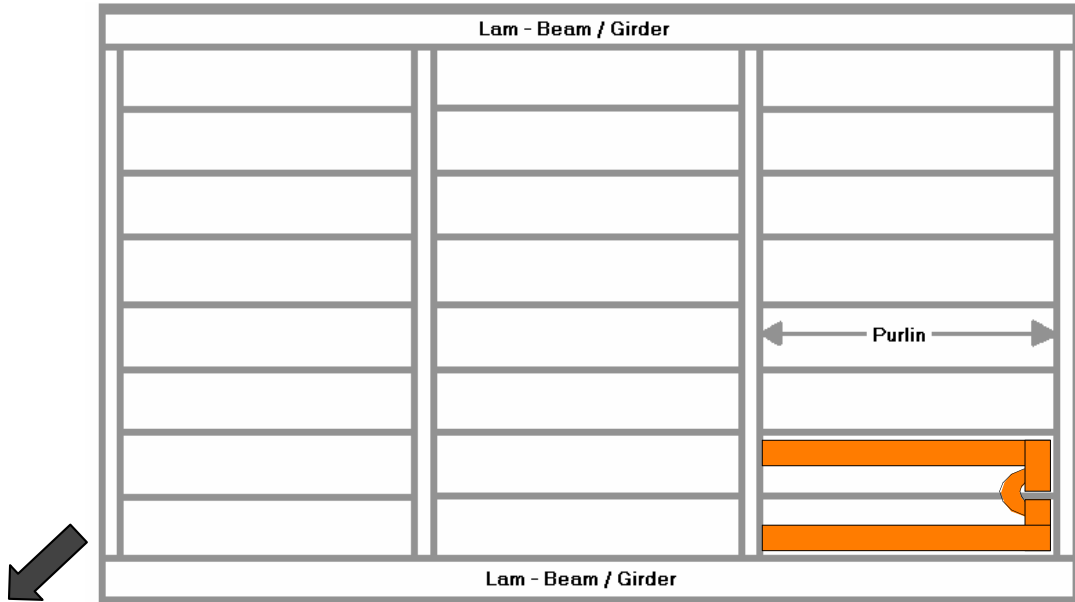
LADDER

While standing on a lam-beam, reach out approximately 3-½ feet, and make first cut parallel to rafters from purlin to purlin.



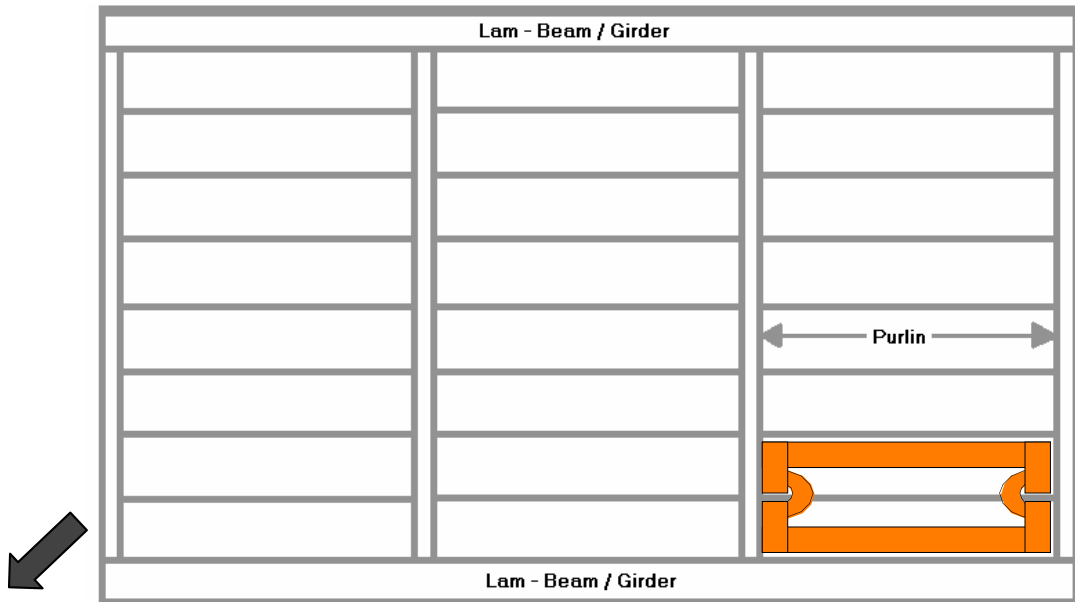
LADDER

Cut parallel to outside purlin, roll center rafter, and stop at lam-beam.



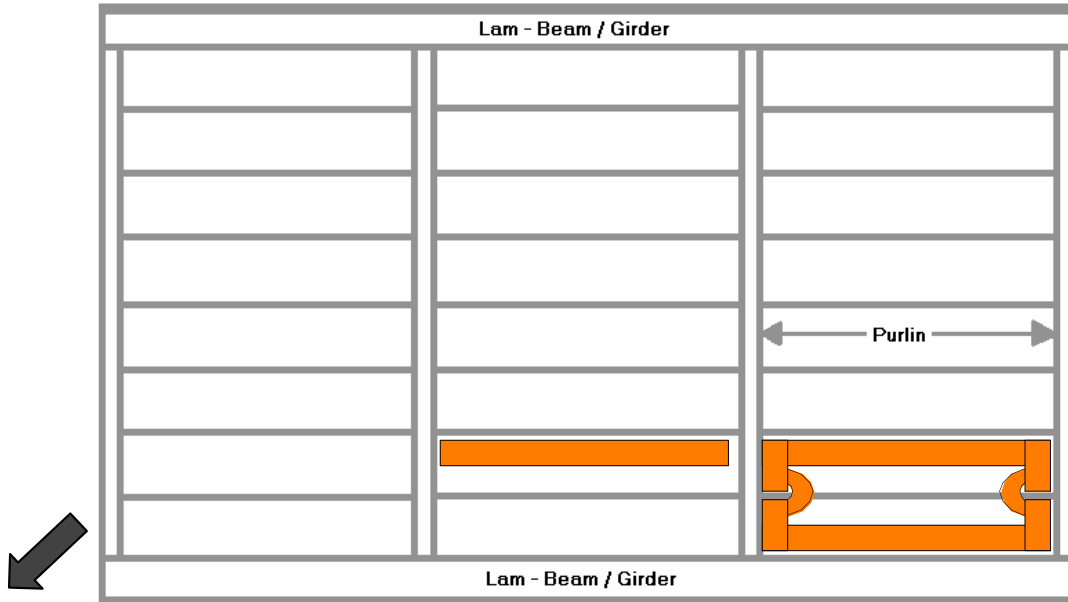
LADDER

Cut parallel to lam-beam, from purlin to purlin.



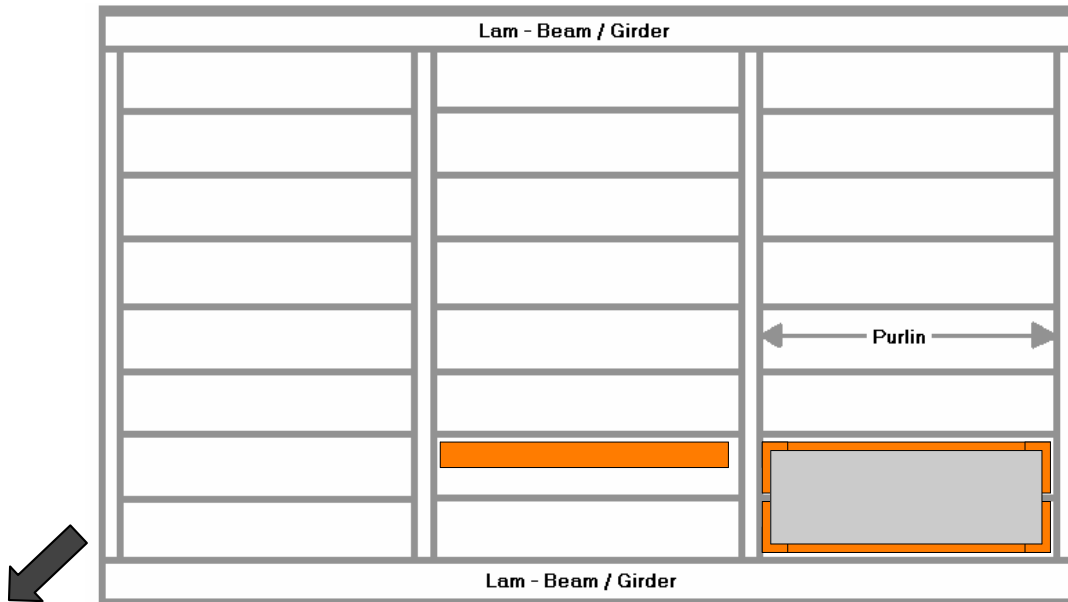
LADDER

Make fourth cut parallel to inside purlin, roll center rafter, and stop at lam-beam.



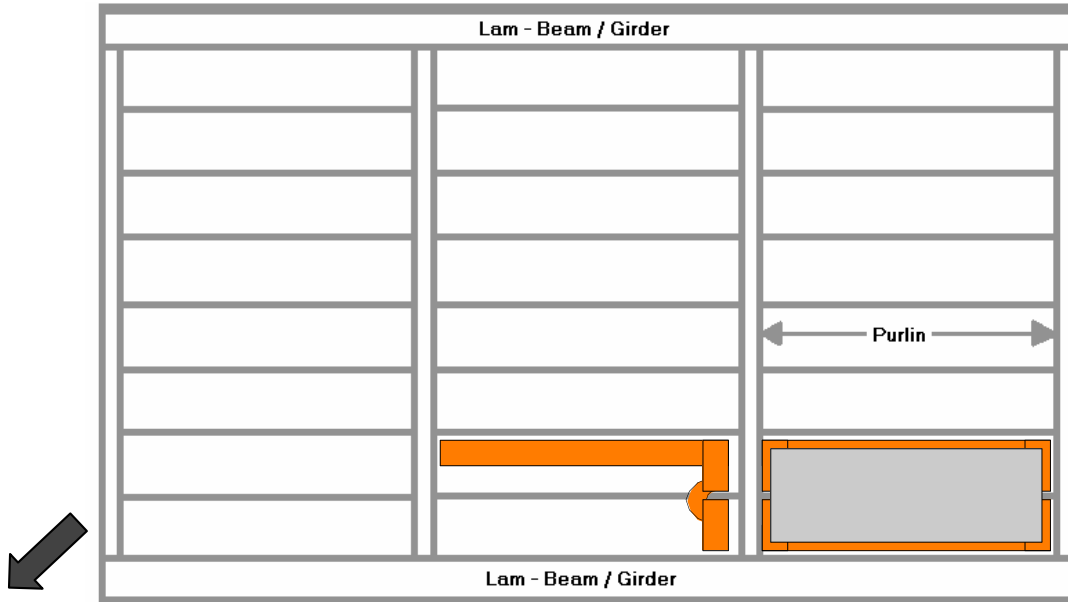
LADDER

Because of work area limitations (standing on a lam-beam), cutter and puller exchange tools. Before louvering section, make outside cut. Cut from purlin to purlin.



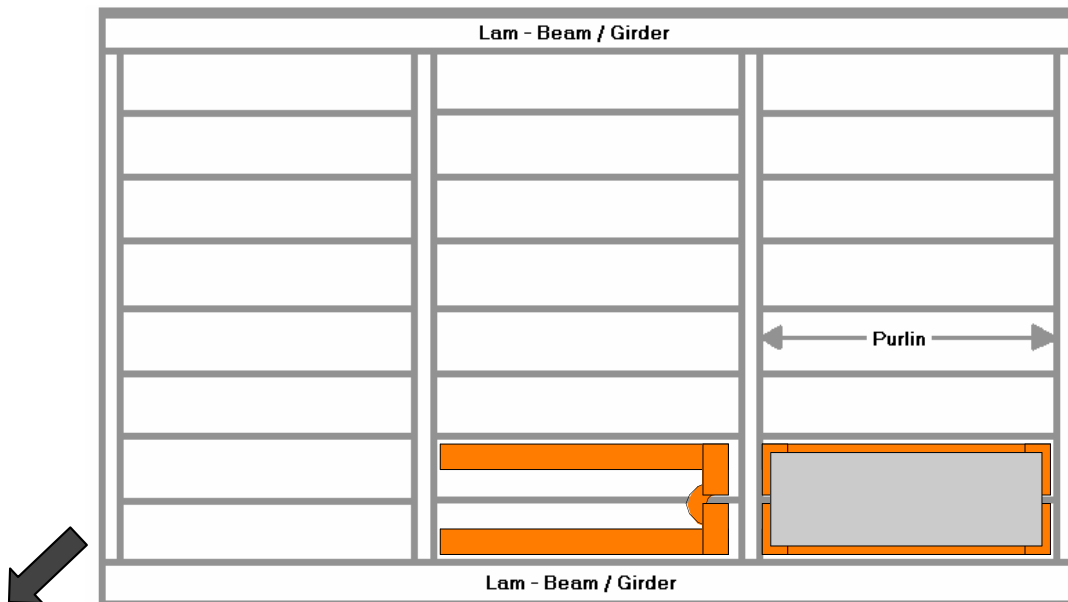
LADDER

Louver section.



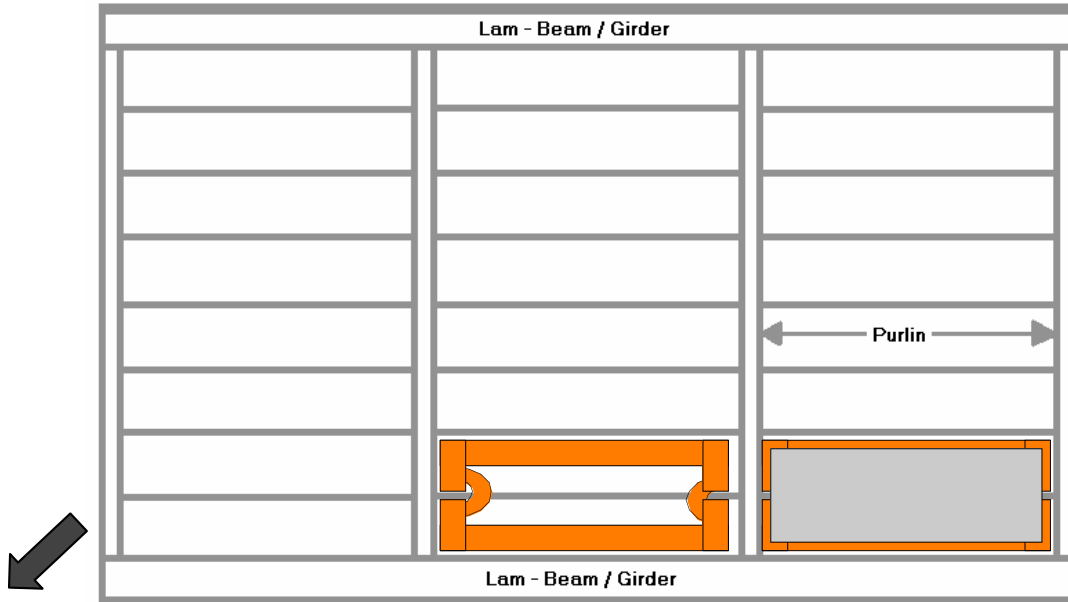
LADDER

Exchange tools, make second cut parallel to outside purlin, roll center rafter, and stop at lam-beam.



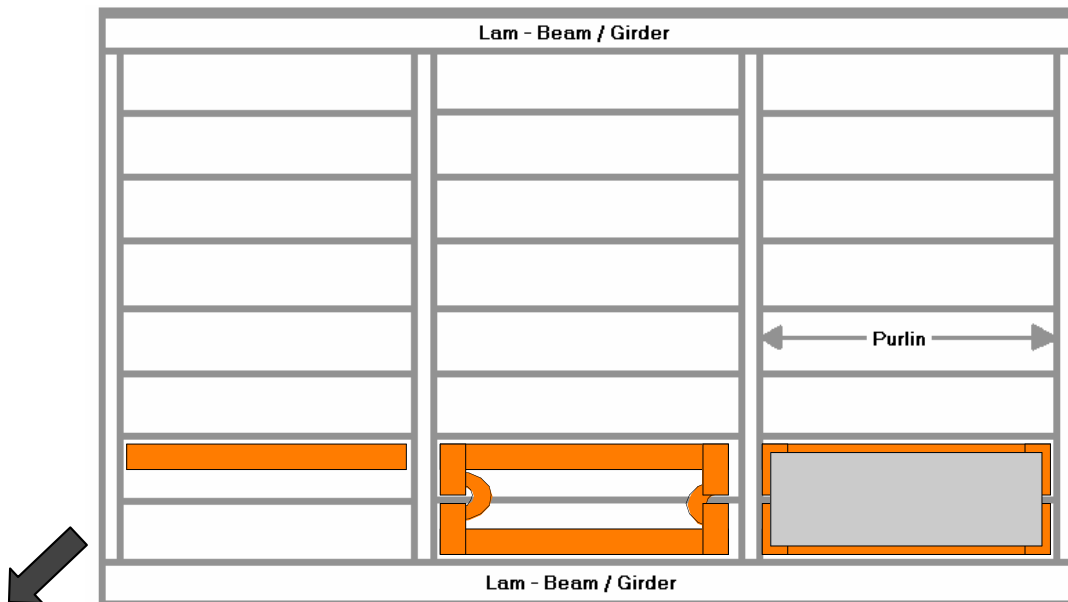
LADDER

Cut parallel to lam-beam from purlin to purlin.



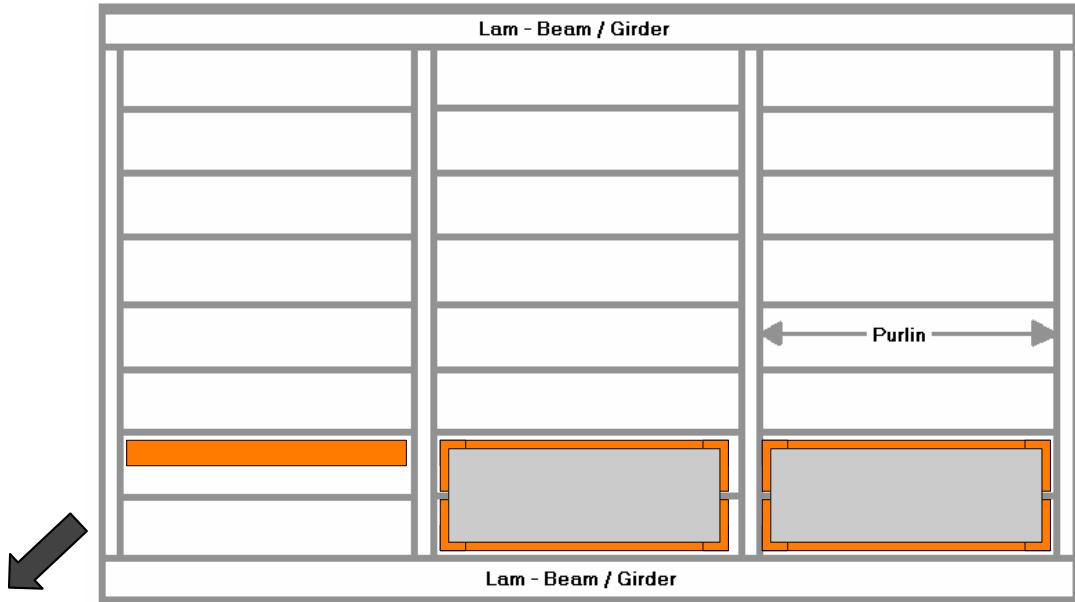
LADDER

Make fourth cut, roll center rafter, and stop at lam-beam.



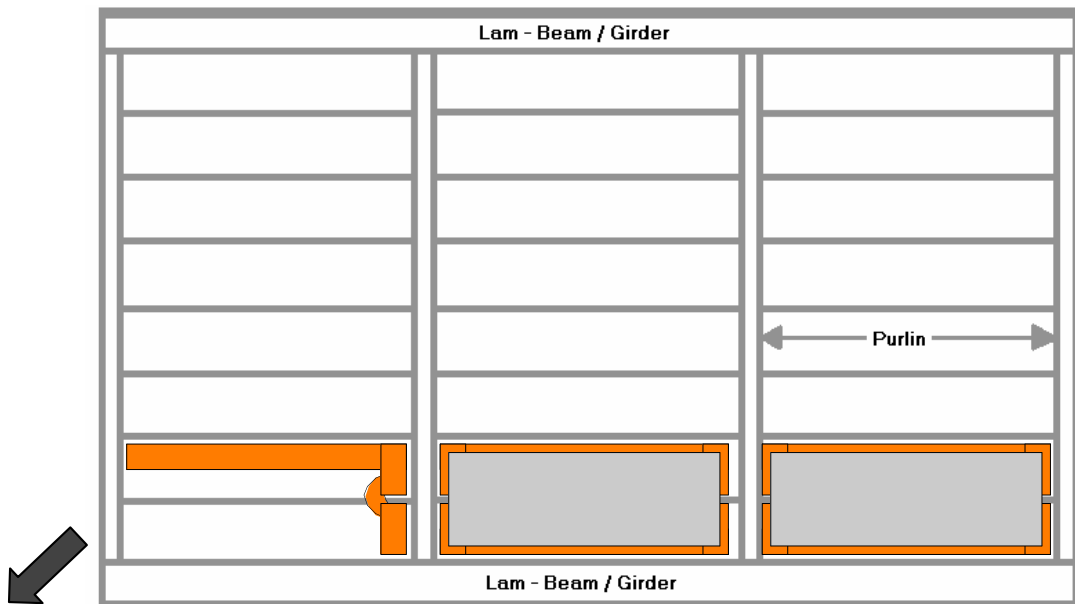
LADDER

Cutter and puller exchange tools. Make outside cut. Cut from purlin to purlin.



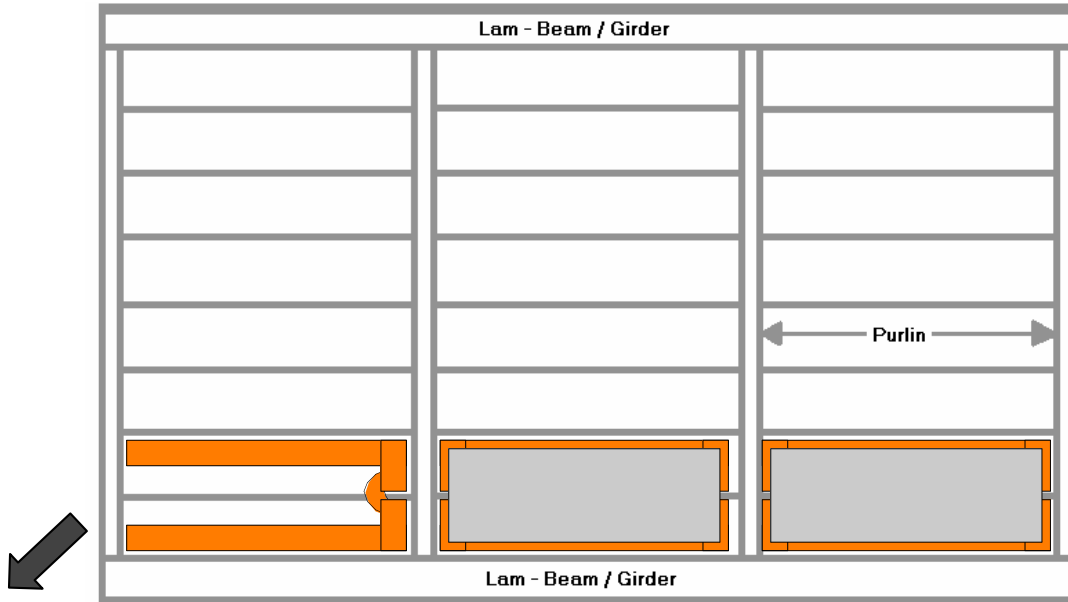
LADDER

Louver section.



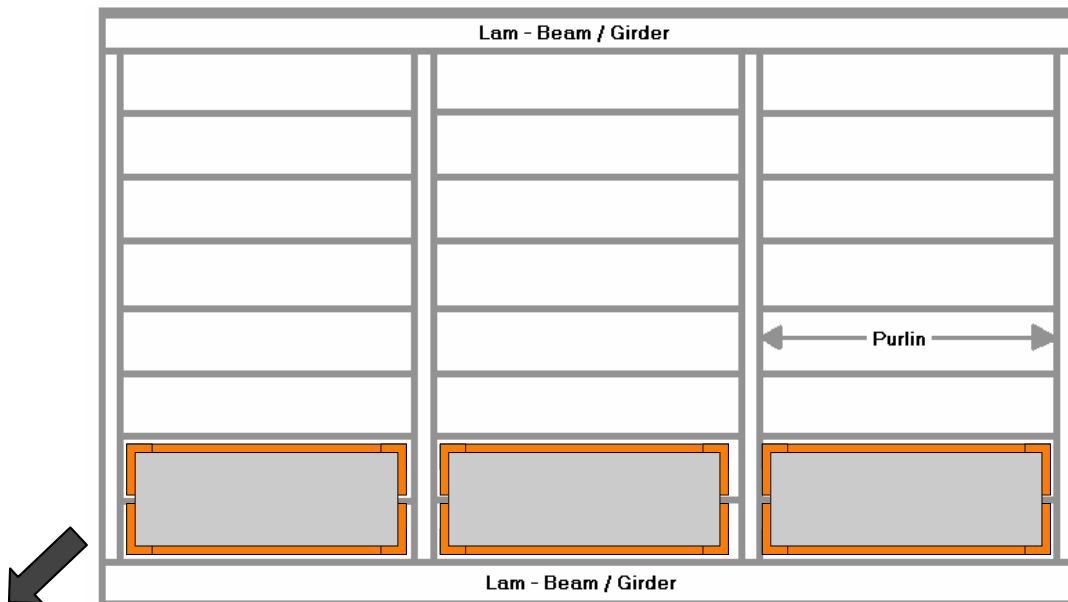
LADDER

Exchange tools, make second cut parallel to outside purlin, roll center rafter, and stop at lam-beam.



LADDER

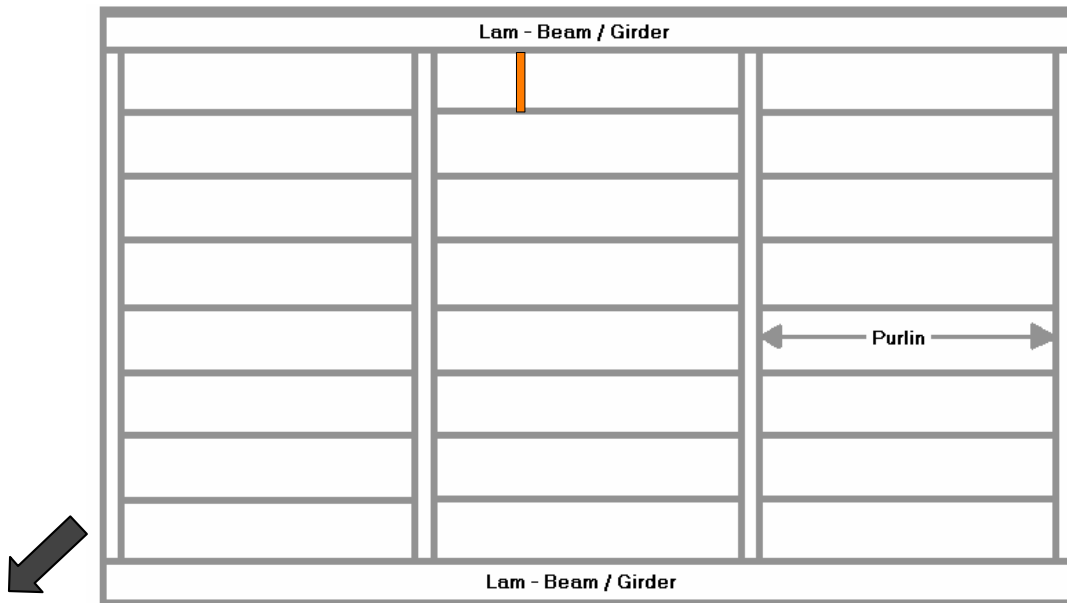
Cut parallel to lam-beam, from purlin to purlin.



LADDER

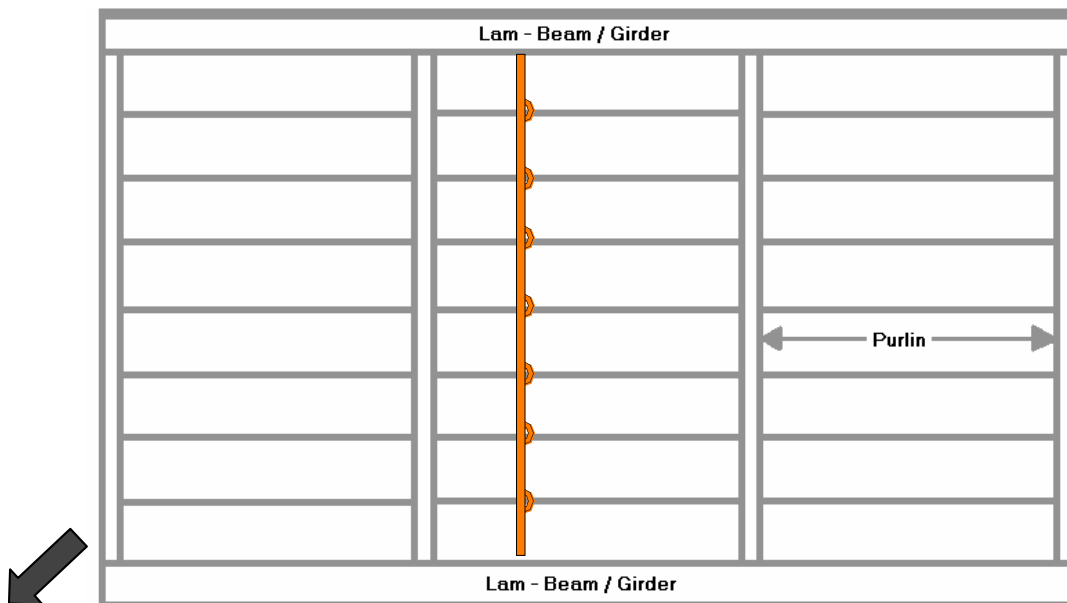
Make fourth cut, roll center rafter, and stop at lam-beam. Then louver section.
Cut strip from parapet to parapet.

LOUVER OFF A PURLIN (DEFENSIVE)



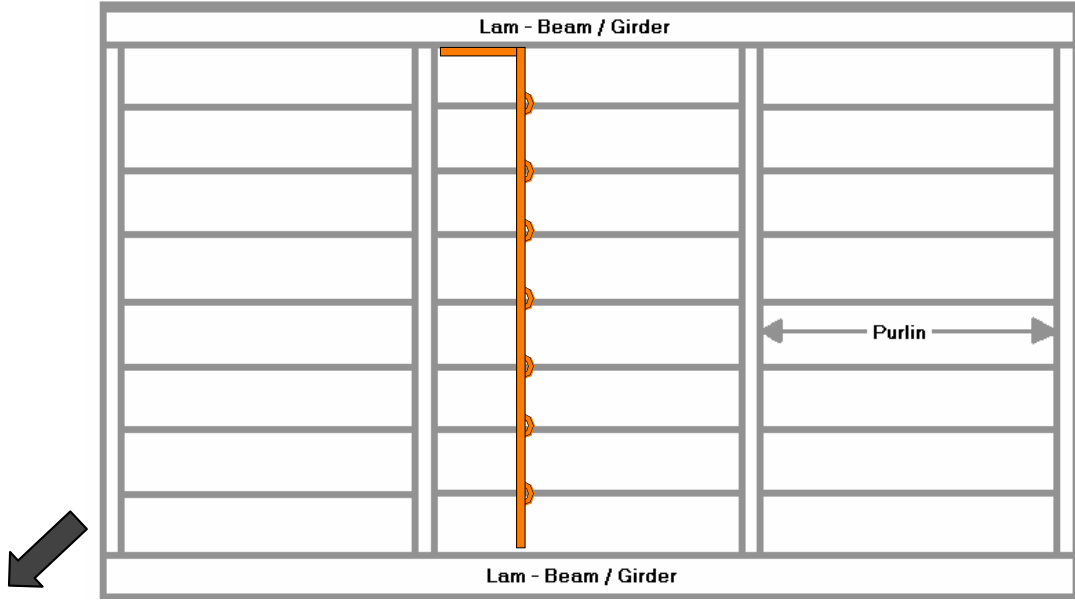
LADDER

While standing on a purlin, start "skim cut." Reach out as far as you comfortably can, approximately 3-½ feet. Start at outside lam-beam.



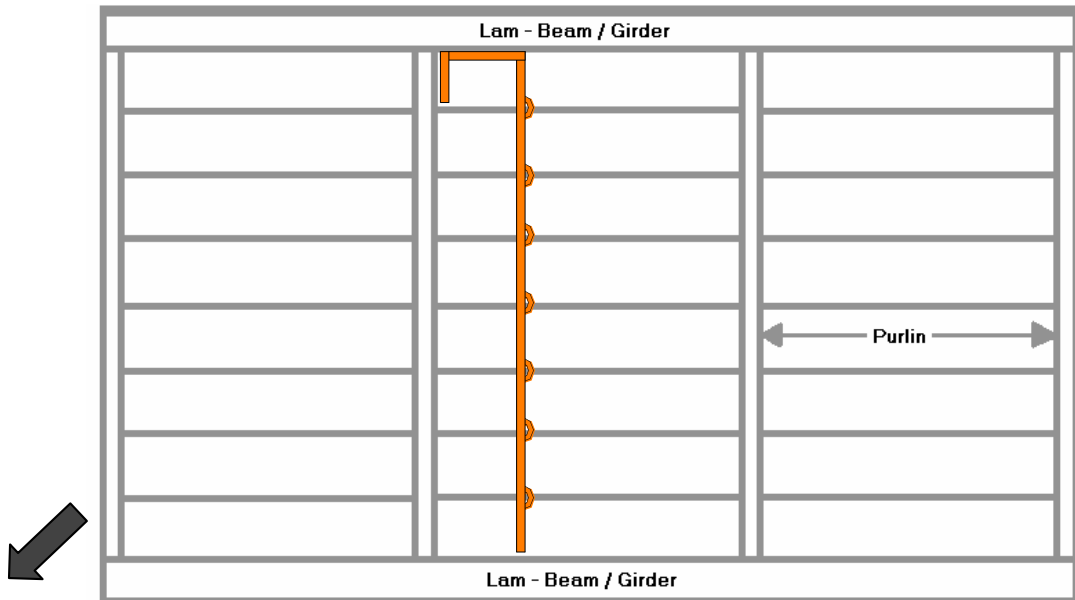
LADDER

"Skim cut" over rafters from lam-beam to lam-beam.



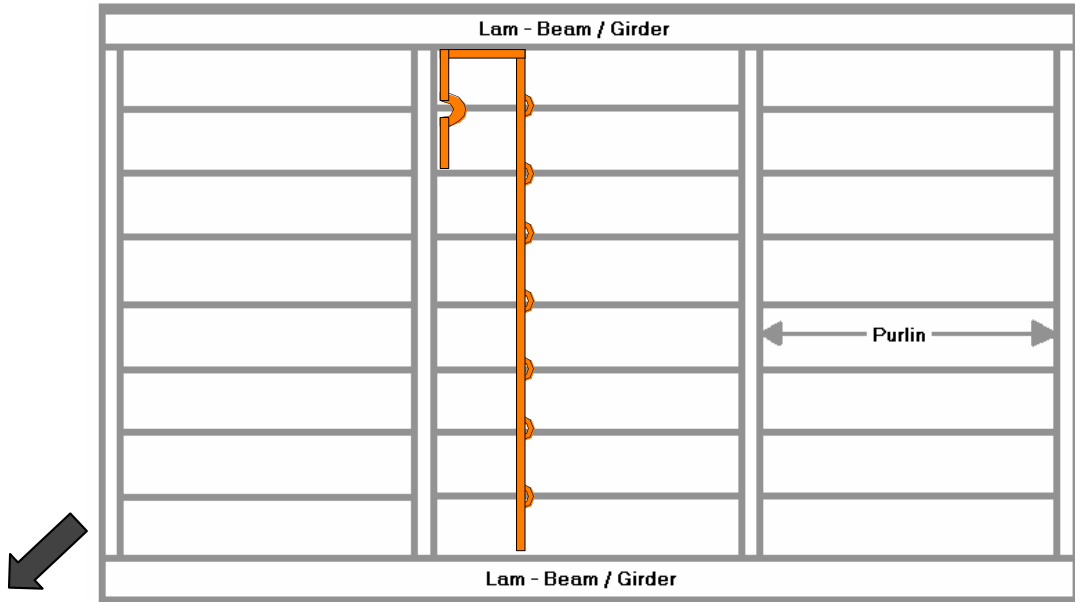
LADDER

Cut parallel to lam-beam and stop at purlin.



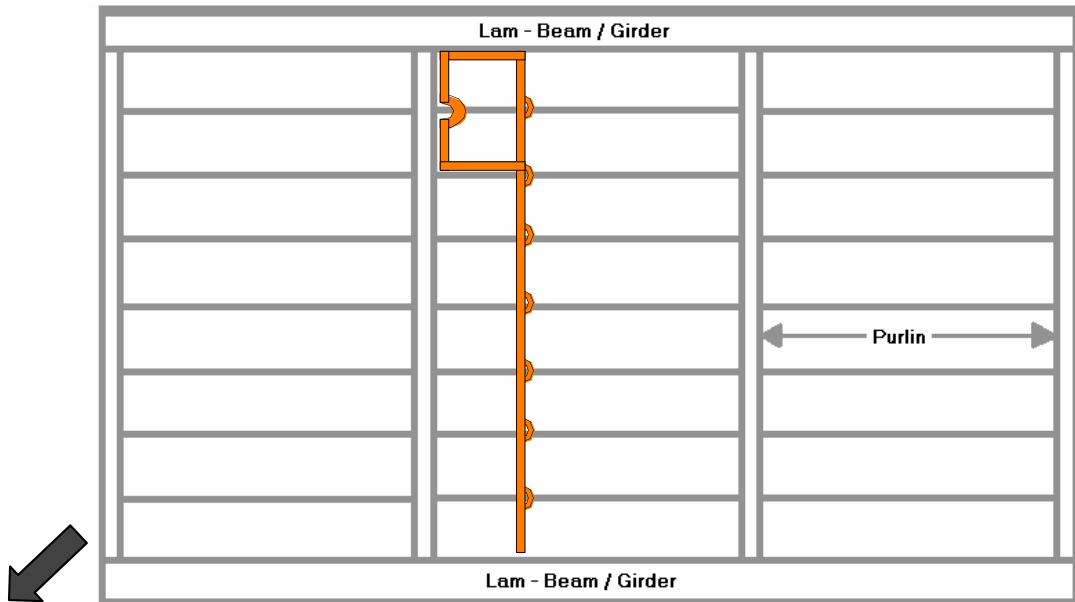
LADDER

Cut parallel to purlin; locate center rafter.



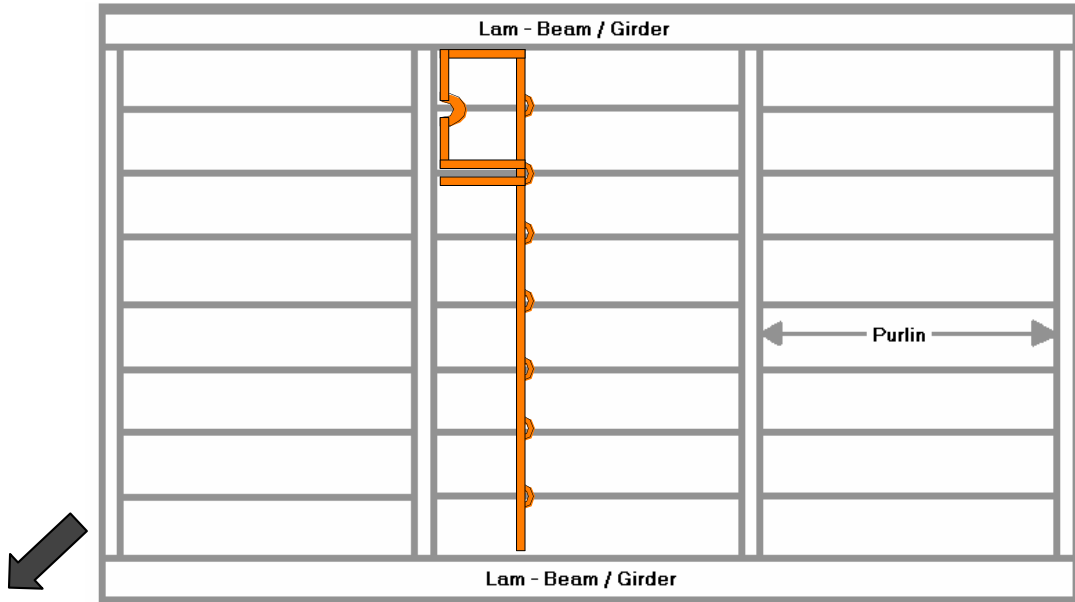
LADDER

Roll center rafter and stop at third rafter.



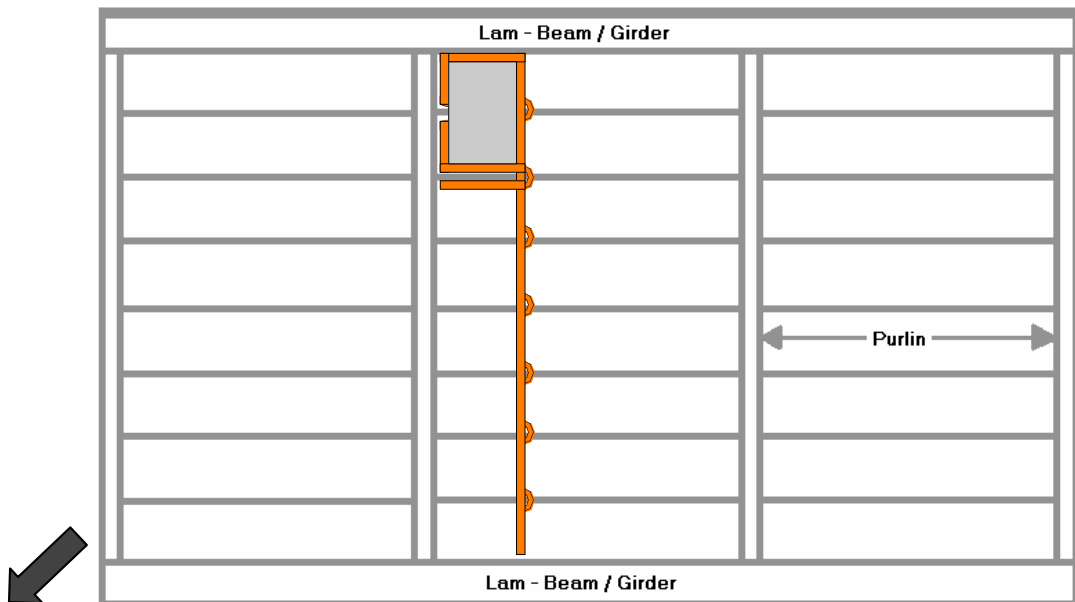
LADDER

Make fourth cut inside of third rafter.



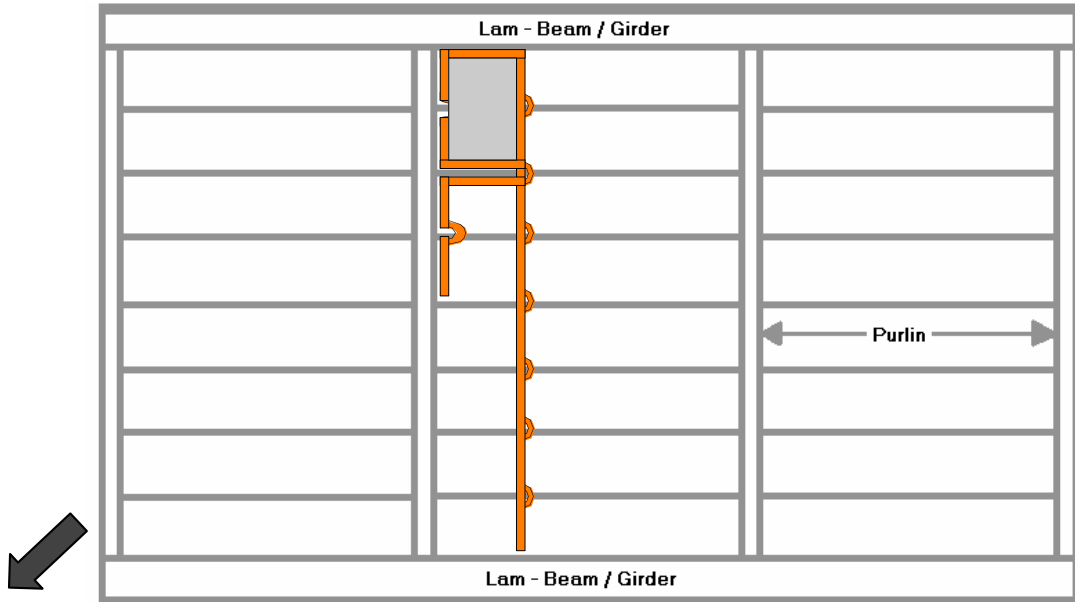
LADDER

Make fifth cut outside of third rafter.



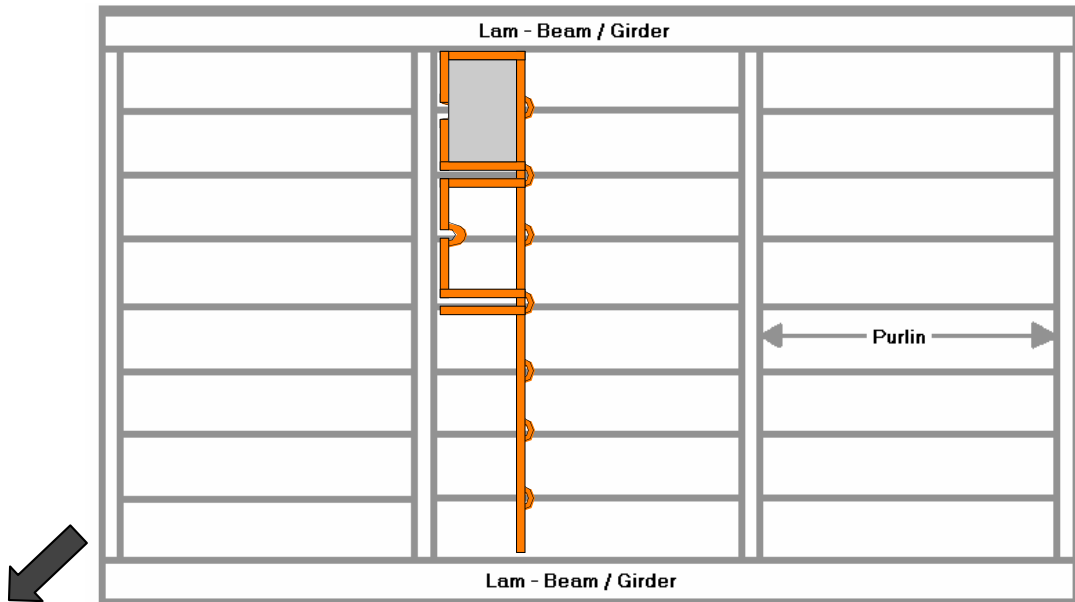
LADDER

After fifth cut, louver section.



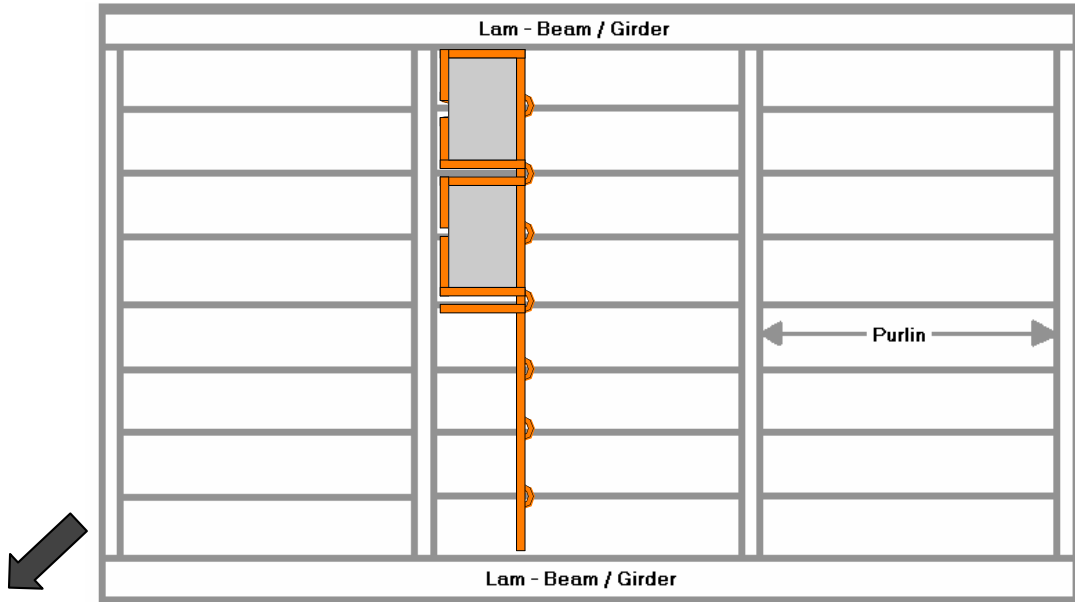
LADDER

Cut parallel to purlin, roll center rafter, and stop at third rafter.



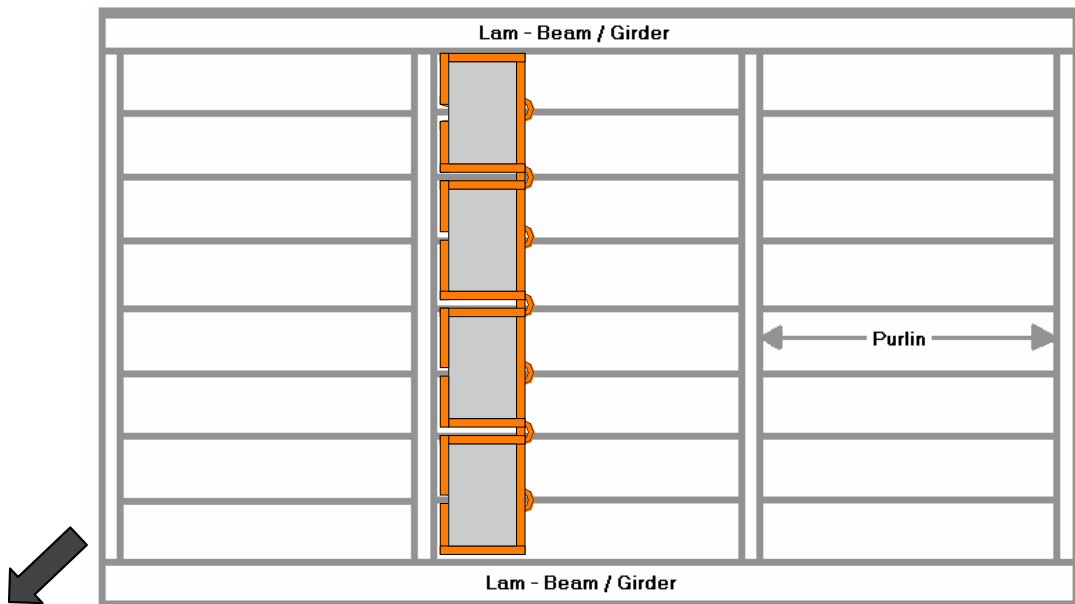
LADDER

Make fourth and fifth cuts parallel to third rafter.



LADDER

After fifth cut, louver section.



LADDER

Cut strip in sections, from lam-beam to lam-beam.