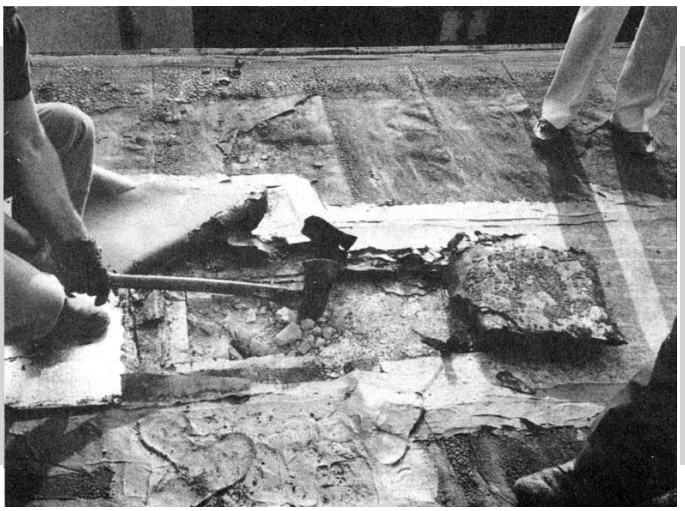
Roof Deck Renovations



Cutting through commercial roof decks often means working with unfamiliar materials. This worker is breaking up the gypsum fill on top of a concrete deck.

by Thomas Brown, Jr.

When you upgrade or renovate an existing building, you may have to cut through a commercial roof deck to add exhaust fans, skylights, vents, or curbs for rooftop hvac units. Cutting into a commercial deck can be trickier than cutting a skylight into a residential wood roof. In fact, precautions are needed when you cut into the roofing membrane and when you cut the structural deck itself.

Before taking any action, find out what type of roofing covers the deck you plan to penetrate. You need to know what's there so you can have the proper materials on hand to make the roof watertight after you make a test cut. Find out if the roof material is a specialty membrane covered by a manufacturer's warranty. If the roof is warranted (most single-ply roofing systems are), the manufacturer may have restrictions on who can cut the roof membrane and what materials are needed for repair. In some cases, it will be necessary to use a roofing contractor certified to work on that system. If you miss this important step, you could void the warranty. This can be an expensive mistake because it can affect how and when you get paid.

Once you've identified the membrane and decided how to handle its repair, you're ready to investigate the material beneath the roof membrane. To do that, you need to take a test cut (see "Non-Destructive Testing," in this article). You will cut out a small section of roof and take a core through all of the roof membranes and insulation (this could be several inches and many layers) down to the deck. Inspecting the layers is important because if the insulation is wet, it could be difficult to make your new penetration watertight. If the insulation is water-soaked, the roof may already be leaking into the building, or it may start leaking when put under pressure from the crew walking on the roof. If you discover wet insulation, notify the owner immediately, and in writing, to discuss what should be done before you proceed with the roof curb or penetration. Otherwise you could be hurt financially.

Understand the structural system and roofing membrane before cutting through a commercial roof deck

You are responsible for the watertightness of the roof, even if you found preexisting conditions that are beyond your control. Preexisting conditions become the contractor's responsibility unless otherwise stated in the initial contract.

Deck Materials

After you have cut through the membrane and insulating layers, you will be able to examine the structural deck, which may not be visible from inside the building. You must accurately identify the deck material before you bid the job, and certainly before you begin cutting.

There are nine general types of decks and variations in materials within each type. Only one, the wood-panel deck, bears any resemblance to decks found in residential work (see "Typical Roof Decks,"). Cutting through these decks, most of which are made from concrete and steel components, requires heavy-duty equipment and attention to safety.

If you are working in an occupied commercial building, you must pay attention to the safety of the occupants (and building contents) as well as to worker safety. Also, old buildings contain years of accumulated dust in the ceilings. You'll need to isolate the office space beneath your work area and protect the office by draping polyethylene from the deck to the floor. Clear the area below your cut; you might want to keep a person inside to make sure no one wanders into the area. Also, you may need to prop up a large cut-out from the inside. Many roof decks use different types of concrete, and the weight of the concrete can come down fast.

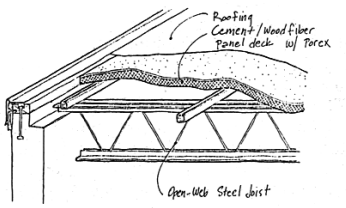
Cement-wood-fiber panel. These decks use treated wood fibers bonded together and compressed or molded into flat panels. The edges usually make a tongue and groove configuration for a tight fit. These are installed directly on joists or on panels suitable for use as subpurlins. These panels have acoustical and thermal benefits and are generally visible from inside the building. These wood decks are easy to cut with a hole saw, skill saw, or reciprocating saw – anything that will penetrate the 2-inch-thick wood panel. Once the hole has been cut, the flange of the new penetration will have to be anchored to the deck with a toggle-bolt device to get an adequate hold on this deck system. A lag screw can pull out.

Lightweight, insulating concrete. This cementitious deck insulation and roofing substrate is produced by combining lightweight insulating aggregates, such as perlite, with portland cement and water. The material is installed over galvanized-corrugated metal forms, a vault-T form-board system, or a precast concrete substrate. With this system, avoid cutting too much of the width of the deck, or you may make it structurally unsound. If large cut-outs are required, you'll need a structural engineer. An engineer takes professional responsibility for the size of the hole, the spacing of supports, and the weight of the equipment.

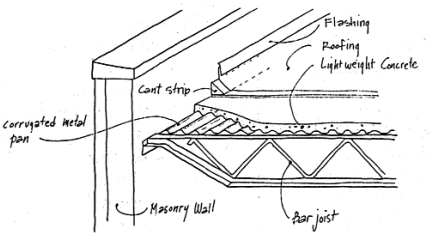
The cement layer, added to provide slope, can be cut down to the structural deck with a gas-fired concrete saw (see Figure 1). The thickness may vary if this material has been used to put slope onto the concrete slab or metal deck. In one place the roof section at the drain may be 2 inches thick and in another, 6 inches. The material can be broken up with a 2 to 3 pound sledge hammer once the area to be taken out

Typical Roof Decks

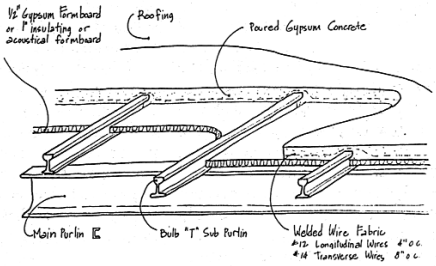
Note: Materials may vary slightly within each category.



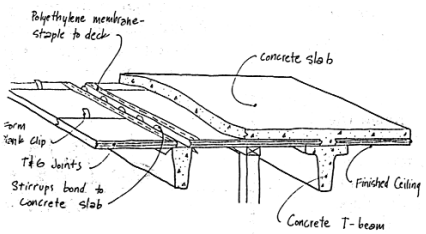
Cement/wood fiber panel. *Panels made of wood fiber cut easily and are visible from inside. Use toggle bolts to hold new flashings.*



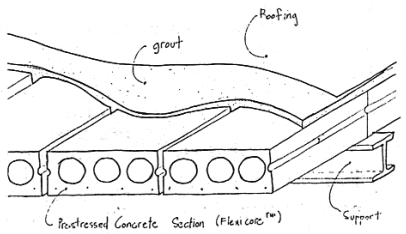
Lightweight insulating concrete. *Lightweight, perlite concrete goes down over corrugated forms. Consult an engineer on large holes.*



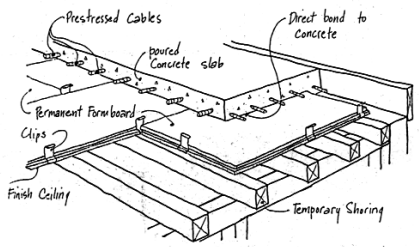
Poured gypsum concrete. *Form boards provide the interior finish. Have extra pieces on hand to patch interiors.*



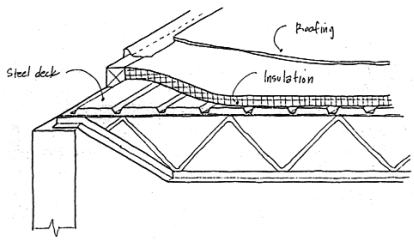
Precast concrete panel. *Cut-outs in concrete roof deck panels are made with a concrete saw. Look out below! This material is heavy.*



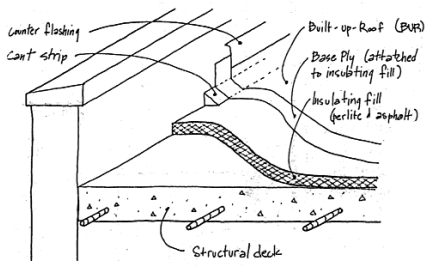
Prestressed concrete. *Watch out for the embedded reinforcing in prestressed decks. If you release the tension in the rod by cutting it, the cables may whip out of the concrete.*



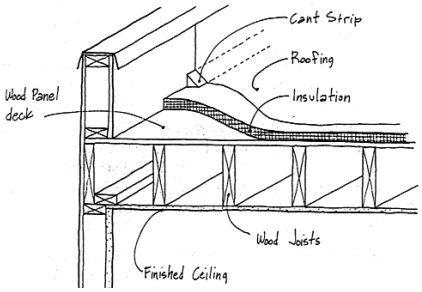
Reinforced concrete. *Cut with a concrete saw, but watch out for embedded wires and rods. These may or may not be prestressed.*



Steel. *Cut steel decks with a torch, or saw with a metal blade, but watch carefully for sparks and fire below.*



Thermosetting insulating fill. *Make sure you don't change the roof slope when you cut through this deck. Patch in with tapered insulation.*



Wood plank or panel. *Frame around openings in wood decks with headers or beams.*

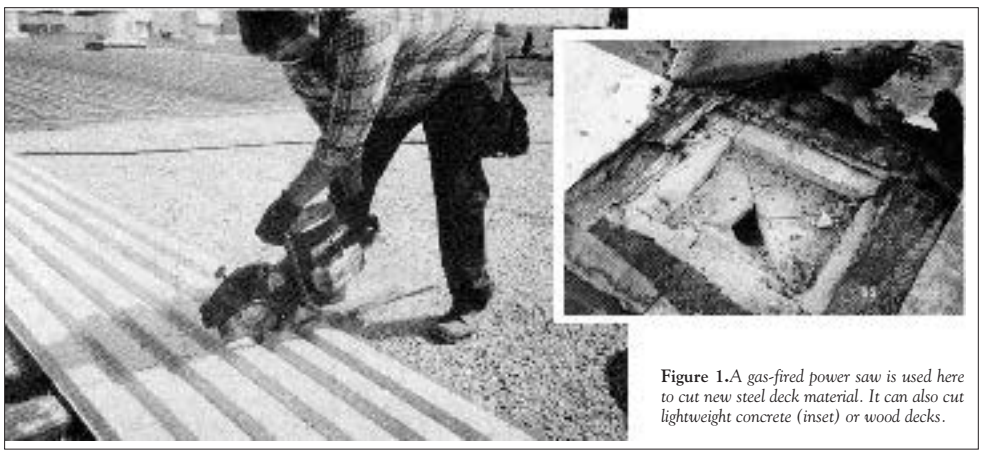


Figure 1. *A gas-fired power saw is used here to cut new steel deck material. It can also cut lightweight concrete (inset) or wood decks.*

has been identified. The structural deck will have to be cut separately, depending on whether the deck is metal or concrete.

Poured gypsum concrete. In this deck system, gypsum concrete is mixed with wood fibers, mineral aggregate, and water, and it is poured into form boards supported by steel subpurlins or bulb T's. The form boards remain in place after the installation of the deck to provide a finished underside. Different types of form boards are available to provide the desired interior finish, and this finish should be considered when

Position your cut or install new equipment to do the least damage to the structure.

roof penetrations are needed. Make sure the right interior finish is available. Also, be sure the size of the opening doesn't consume too much of the area of the roof panel. Again, a weakened panel may not be able to support the new roof-mounted equipment, and wet gypsum that is mushy certainly will not.

A gas saw can be used to cut the gypsum deck, and the form board will hold the loose material in place. You'll still need interior protection because the form board can pull out of the bulb T that holds it in place.

Precast concrete panel. Concrete roof deck panels are manufactured in different shapes - plain slabs, channel slabs, tongue and groove planks, and single- or double-Ts. They're supported by structural steel beams, precast concrete beams, or load-bearing walls. Holes in these decks must be made with a concrete saw. Be careful about the size of the hole. Because the material is so heavy, protect the interior so the cut-out doesn't fall on people working below. When cutting the precast panel, protect the interior. Chunks of this material can easily slip inside the building.

Prestressed concrete. Prestressed roof decks are usually made of concrete units that are prestressed with an integral steel rod. This prestressing generally results in a camber (or upward deflection) occurring in the center of the span of a panel. Take precautions because you do not want to cut the prestressed steel tenon. The tenon is under pressure, and if it is cut accidentally, it may actually recoil, ripping out part of the deck. The whiplash of a steel tenon can be dangerous for workers. Use a concrete saw, and protect the interior below. Original drawings and an engineer's approval are a must.

Reinforced concrete. Steel bars or welded steel mesh are sometimes used to reinforce concrete as it is poured in place. This is followed by a power troweling to give a smooth surface. The deck can be cut with a power concrete saw. Follow the general precautions for interior and structural considerations.

Steel. Perhaps the most popular roof decks in the Midwest, steel decks are constructed from cold-rolled steel sheets or panels with ribs formed in each panel to provide strength and rigidity. There are three types:

- Narrow rib, type A
- Intermediate-rib, type F
- Wide-rib, type B.

The gauge (18 to 22) and depth of the rib determine the maximum span for this deck. You can cut this deck with a power saw and special metal blade or cutting torches. Sizable curb holes may require added metal or angle-iron bracing from the underside to provide the proper structural support. Whether you're using a saw (sparks) or a torch, you'll also need to have someone inside the building watching for fire.

Thermo-setting insulating fill. A nonstructural material of perlite and asphalt, this material is installed somewhat like highway asphalt. After mixing, it is rolled onto a structural steel or concrete deck. If you cut through the fill, make sure that your cuts (or patches) don't change the roof slope. Tapered insulation can be pieced in to fill any gaps and to restore the slope. Follow normal safety precautions.

Wood plank or panel. These come in different sizes and thicknesses, and were popular in the early 1900s. When making cuts, be sure you frame the opening with additional structural members, such as headers or beams, to hold up the new equipment. Wood plank decks can be tongue and groove, plywood, or waferboard.

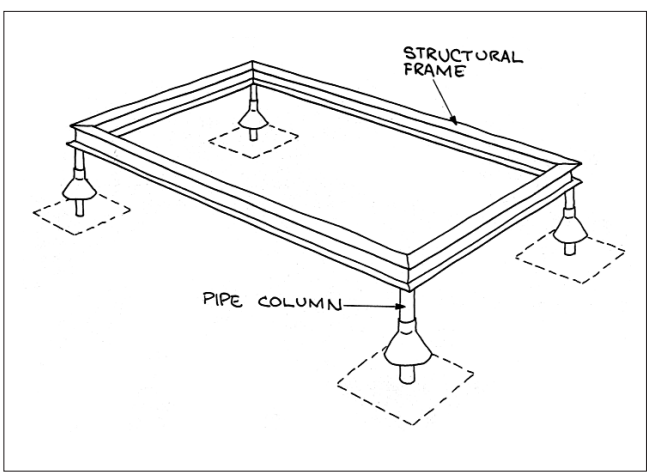


Figure 2. *The NRCA recommends a stand be used to mount roof-top equipment. The stand allows roofers to make repairs and reroof without having to extend ductwork later on.*

A Few Pointers

The reason for investigating the deck material is to position your cut or install new equipment to do the least damage to the structure. But other structural considerations are also important. If you are installing rooftop hvac units, you should find out how much the equipment weighs. If you're working on a small commercial building and you need to install an air conditioner, chances are the unit won't weigh enough to warrant calling a structural engineer. When you're done with your installation, however, check the roof to make sure the unit is not causing the structural deck to deflect. This increases the chance of water ponding on the roof. If you're installing a heavy air filtration system on the roof, you should work with a structural engineer to ensure the unit is properly positioned and supported.

If you're doing a small commercial job, use some common sense about positioning the units and protecting the integrity of the roof. Rooftop equipment should be mounted using guidelines of the National Roofing Contractors Association (NRCA, 8600 Bryn Mawr Ave., Chicago, IL 60631; 312/693-0700. These are based on the height and width of the unit, and they're designed to make later repair or reroofing easier (see Figure 2). Non-roofing contractors will often place the equipment on I-beams or treated 4x4s placed perpendicular to the support beams. These "sleepers" cause problems and cost money later on when reroofing. The units have to be disconnected and the ductwork extended.

Whatever roofing and deck systems you encounter, take the time to locate exactly where that roof penetration should be made. We've made a lot of penetrations that ended up in the wrong location. More than once, we've had to go back to a job to make additional cuts to finally get the proper location that the owner desires. The smart thing is to get the location right the first time by drilling a hole and inserting a long nail or a steel rod from the inside. Check the measurements carefully before making that cut, and you'll save yourself a lot of time and money. ■

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Non-Destructive Testing

When you do your investigation work prior to making a bid, don't assume that you'll get the job, or even that the job will be done. Instead, be as careful as possible while taking a test patch of the roof. If you're working on a tar-and-gravel roof (70% of roofing in the U.S.), scrape back the gravel and expose the roofing felt. Use a utility knife to cut a triangle; 12 inches on each side. Then use your hand or the knife to pull back any insulation. It doesn't matter if the insulation crumbles. You can't really get it out intact anyway. But save all of it, because it's going to go back.

When you've gotten down to the deck, you'll be able to inspect it to see what kind of deck you're working with. With the deck exposed, measure the depth of the insulation, and the depth of any materials on top of the insulation. You'll need to know how high to build curbs, and you'll need to know the length of fasteners needed to secure the curbs. Also, it you're going to reroof over the existing roof, you'll need to decide whether to install new insulation, and if so, how long the fasteners should be. Take a look at the building from the inside too to avoid surprises.

Put back the patch carefully because if you don't, you'll be blamed for leaks. Stuff the insulation back on top of the deck, packing it into the hole. Then put back the roofing felt. Lay a bead of asphalt roofing cement on both sides of the cut all around the triangle. Then lay fiberglass tape in the asphalt and bed it down. Coat the tape with asphalt, and pile the gravel on. Follow the procedure carefully, and you'll have an investigative hole that won't leak.

– Marylee MacDonald