ON THE HOUSE

Cracking Tiles

Q. *I have been called to inspect a shower with ceramic tile walls. The substrate is cementitious backerboard, and as far as I can tell, the tile was installed with thinset. There are hairline cracks running through the tiles on all three walls, both vertical and horizontal. There is a ceramic soap dish in the corner, and even it is cracked. It doesn't appear that there has been any movement in the floor or the walls. What could be causing the cracking?*

A. *Tile expert Michael Byrne responds:* Tiles generally crack for only two reasons: loss of bond or moving substrate. In this case, the substrate might be moving if the studs are spaced farther apart than 16 inches on-center, allowing that backerboard to flex.

Another possibility is that the backerboard was cracked prior to installation. Although cementitious backerboard often has minor cracks that don't cause problems, over-stressing the boards during delivery or installation can cause more serious cracks. If the backerboard was installed over a layer of drywall, then water penetration through tile joints or corners may have soaked and softened the drywall.

If the tiles have parted from the setting bed, they can break when someone applies pressure on the poorly supported tile. A tile can also crack if it is installed over two different substrate materials or an expansion joint. Tiles are strong only when they are cushioned in a bed of adhesive and surrounded by grout.

Solving the problem will require removing the tiles so that the substrate can be inspected.

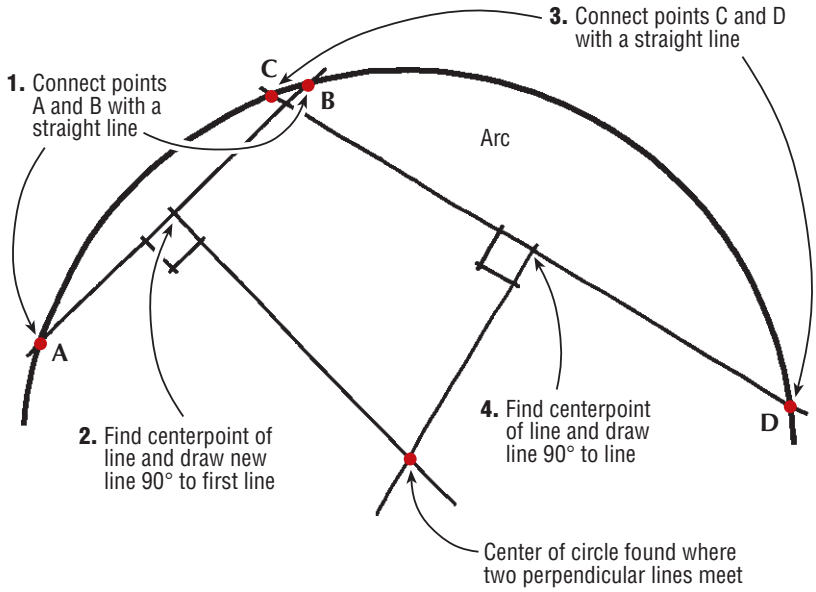
Finding the Center of a Circle

Q. *If I am presented with a portion of a circle (an arc), how can I determine the size (diameter) of the circle that the arc is part of?*

A. *Martin Holladay responds:* First, connect any two points of the arc with a straight line. Find the center of that line and draw a perpendicular line through the center point. Then do the same thing again elsewhere on the arc — connect two points with a straight line and draw a perpendicular line through the center of that line.

The point where the two perpendicular lines cross is the center of the circle.

Finding the Center of a Circle



Steel Stains on Wood Beams

Q. *I have some 8x16-inch Douglas fir beams that have black stains from the steel saddles. How can I remove the stains? Can I use a solution of oxalic acid crystals?*

A. *Henri de Marne responds:* First, you should find out what caused the steel saddles to stain the beams. Such stains are usually caused by water contact.

Since the steel saddles would not have stained the beams if they had been painted with a rust-inhibiting paint before installation, I assume the saddles were installed raw. You can use oxalic acid to remove the stains, but the work will be tricky because the acid solution should not come in contact with metal of any kind. You will have to mask the metal carefully before applying the acid solution to the beams.

You can buy oxalic acid crystals from a paint, hardware, or janitorial supply store. You won't need much. Dissolve the acid crystals in warm water in a glass or plastic container. The acid crystals should be mixed to saturation — that is, until some of the crystals will no longer dissolve.

Carefully apply the solution to the stained area with a small brush, without letting any drip. Removing the stains may require more than one appli-

cation. Use extreme caution; oxalic acid is a very potent chemical. Wear rubber gloves, and skin and eye protection.

Once the stains are gone, wipe the treated areas with a sponge or clean cloth dampened with white vinegar in order to remove any crystal residue.

Air Quality Problem

Q. *I have been called to solve an air-quality problem at a house with air-lock entries. The house has hydronic heat. The vestibules have no mechanical ventilation, and the air quality is poor. What type of ventilation do you suggest for these very small rooms?*

A. *Ventilation consultant Andy Shapiro responds:* In general, opening and closing the doors provides enough ventilation for vestibules. My guess is that there is a source of odor in these vestibules that is leading to the air-quality complaints. Could the problem be caused by the smell of boots taken off and left in the mudroom? Mold from excess moisture from some source? Off-gassing of materials or finishes?

The first approach with any indoor air-quality problem is to identify the pollution source. After the source has been reduced as much as is practical, ventilation can be used if necessary to dilute the remaining, hopefully low, concentration of offending air.

If the house has a whole-house ducted ventilation system, such as a heat-recovery ventilation system, and the source of the smell cannot be reduced to acceptable levels, then a small exhaust from the vestibule could be connected to the whole-house system. But first, find the source.

Strength of Built-Up Versus Solid Lumber Columns

Q. *When I need a 6x6 deck post, I usually assemble a built-up column from three 2x6s. Is this kind of post equal in strength to a 6x6?*

A. *Frank Woeste, P.E., professor of wood construction and engineering at Virginia Tech, responds:* The built-up post you describe may be as strong as the 6x6, depending upon the grade and species of the lumber, and how the 2x6s are nailed together. Assuming the post and 2x6s are No. 2 Southern Pine, the nailing used to laminate the three 2x6s is the main issue in determining if three pieces of 2x6 will replace the 6x6 post.

When the deck column is loaded, the nails or screws slip or give slightly, allowing the column to start bowing. If the nailing is inadequate, the bowing will continue and the capacity of the deck column is reduced. Even when such a column is assembled in accordance with rigorous National Design Specification for Wood Construction (NDS) provisions (using 30d common nails 8 inches on center and staggered $2^1/_2$ inches), its bearing capacity is reduced 40% from a solid-sawn column of the same size ($4^1/_2$ x $5^1/_2$ inches) having identical lumber properties.

In summary, substituting a post made of laminated 2-by material for a solid-sawn post in a free-standing application (such as a deck post) is not recommended without an in-depth analysis based on the NDS column provisions.

Makeup Air for Fireplaces and Exhaust Fans

Q. *In a house I am building, I need to provide adequate makeup air for a fireplace and a 600-cfm cooktop exhaust fan. How do I size a passive duct to introduce exterior makeup air into the house?*

A.. *Pat Huelman, cold climate housing coordinator at the University of Minnesota, responds:* Whether or not the fireplace or exhaust fan will cause problems depends on several factors. The most important factors are the leakage characteristics of the house, the type of combustion devices used for space and water heating, the location and type of fireplace and chimney, and the presence of other exhaust devices such as a clothes dryer, central vacuum, or bath fans.

The quantity of combustion and dilution air needed by a fireplace varies, depending on the type of fireplace, the type of chimney, and the size and burning phase of the fire. The amount might be as little as 100 or 200 cubic feet per minute (cfm) at the start-up or burn-down of a small fire in a fireplace with glass doors, or as much as 800 cfm or more for a large fire in an open fireplace.

If the house is very leaky, drawing that much air may cause only a small negative pressure. But if the house is tighter, pulling that much air may cause a very large negative pressure. Although negative pressure can interfere with the combustion of the fireplace, in many cases it simply limits the magnitude of the fire, somewhat like a wood-burning stove with good air control.

Negative pressure can certainly interfere with atmospherically vented furnaces, boilers, or water heaters, potentially causing spillage of flue gases. That's why you would be well advised to choose sealed-combustion appliances. Also, excessive soil gas and/or garage gases could be drawn into the home when the fireplace is in use.

A. Makeup Air Required for a Fireplace

House Tightness	Blower Door (cfm @ 50 Pa)	Combustion Air Opening for: 200 cfm	500 cfm	800 cfm
Very Tight	600	28 sq. in.	154 sq. in.	280 sq. in.
Pretty Tight	1,200	None	98 sq. in.	224 sq. in.
Kind of Tight	1,800	None	41 sq. in.	168 sq. in.
Typical	2,400	None	None	111 sq. in.
Loose	3,000	None	None	54 sq. in.
Very Loose	3,600	None	None	None

Let's assume for a minute that you want to limit the negative pressure caused by the fireplace to 5 pascals. The first table shows the size of combustion air opening needed, assuming three levels of combustion and dilution air requirements (see Chart A).

If your house is very leaky, existing leaks may provide adequate combustion and dilution air for your fireplace. If your house is very tight, you will need a very large passive air opening.

Now let's focus on the 600-cfm cooktop exhaust fan. If we know the cfm @ 50 pascals of the home using a blower door, we can easily predict the negative pressure due to the operation of this fan (Chart B).

A negative pressure of 3 or 4 pascals — which this exhaust fan can cause, even in a very leaky house — can pull the products of combustion down a fireplace chimney. This is especially likely during the start-up or burn-down phases of a fire. The simplest solution to this problem is never to use the cooktop exhaust fan when the fireplace is being used.

However, remember that this same negative pressure could cause spillage of combustion gases from an atmospherically vented space or from water heating equipment. With this type of exhaust device, sealed combustion equipment would be advised for space and water heating.

If you decide that these approaches are impractical, you can try to size a makeup air inlet for the cooktop exhaust fan. Let's assume a 20-foot smooth duct with three 90-degree elbows and a screened hood. Let's also assume that the fireplace (or water heater) can tolerate 3 pascals. Assuming no house leakage, you would need an opening of approximately 325 square inches, or the equivalent of a 20-inch diameter duct. If we know the house leakage as measured by a blower door, we could use Chart C to size the makeup air opening.

If the cooktop exhaust fan will be used while the fireplace is in operation or with atmospherically vented space and water heating, you should install a makeup air fan.

B. Negative Pressure Caused by a 600-cfm Exhaust Fan

House Tightness	Blower Door (cfm @ 50 Pa)	Predicted Negative Pressure Due to 600-cfm Exhaust Fan
Very Tight	600	50 pascals
Pretty Tight	1,200	17 pascals
Kind of Tight	1,800	9 pascals
Typical	2,400	6 pascals
Loose	3,000	4 pascals
Very Loose	3,600	3 pascals

C. Makeup Air Required for a 600-cfm Exhaust Fan

House Tightness	Blower Door (cfm @ 50 Pa)	Makeup Air Duct Required
Very tight	600	17-inch diameter
Pretty tight	1,200	16-inch diameter
Kind of tight	1,800	14-inch diameter
Typical	2,400	12-inch diameter
Loose	3,000	10-inch diameter
Very loose	3,600	5-inch diameter

Now, if that isn't complicated enough, there is one last nagging issue. When the cooktop exhaust fan is used when the fireplace is not, the makeup air often comes down the fireplace chimney, commonly leading to homeowner complaints about a sooty odor in the house. Unfortunately, it is very difficult to seal the chimney completely.

In conclusion, a fireplace and a large cooktop exhaust fan just don't belong together in the modern house. The fireplace by itself can be handled by selecting sealed combustion equipment for space and water heating and introducing the necessary combustion and dilution air, especially for tighter homes and during the critical start-up and burn-down phases. The cooktop exhaust fan can likewise be handled by itself with proper selection of combustion equipment and some provision for makeup air. It is very difficult or impossible, though, to handle combustion and makeup air requirements when a house has both a fireplace and a cooktop exhaust fan. If both are an inextricable part of your plans, I would recommend a different type of hearth product and a kitchen cooktop or exhaust fan with much smaller cfm requirements.

GOT A QUESTION? Send it to On the House, *JLC*, 186 Allen Brook Ln., Williston, VT 05495; or e-mail to *jlc@bginet.com*.