Q&A

Q. Adding a Point Load to a Post-Tensioned Foundation

When making structural changes that involve adding a point load to a house built on a post-tensioned concrete slab, is it necessary to add a footing for a structural post? I'm concerned that cutting through the slab to pour a pad footing could sever one of the cables, but I don't want to assume that the slab can support a point load anywhere.

A. *Brian Allred, S.E., of Seneca Structural Engineering in Laguna Hills, Calif., responds:* A typical post-tensioned foundation is reinforced with high tensile-strength steel strands instead of conventional rebar or wire mesh. Once the slab is poured, the strands are tensioned to a predetermined level with a hydraulic jack to apply compressive force to the concrete, allowing it to bear heavy loads and resist cracking. In most single-family homes, these strands — or "tendons," as they're called — are spaced on a 3- or 4-foot grid and centered within the 5-inch-thick slab. Integral interior footings, or "ribs," are usually spaced about 12 feet apart in each direction, giving the underside of the slab a waffle-like configuration.

If the new post load can be located over an interior footing — which should be called out on the foundation plan — there's ordinarily no need for any other reinforcement. A typical interior footing should support a 10,000-pound load. Even between footings, a post-tensioned slab can safely bear about 1,000 pounds per inch of thickness, or about 5,000 pounds for a typical 5-inch-thick residential slab.

If more bearing is needed, it's possible to cut through the slab and pour a pad footing. But in doing so, it's important to avoid cutting through any tendons, since that will weaken the foundation. Because the tendons are under thousands of pounds of tension, cutting through one is also potentially hazardous. Tendon locations can be pinpointed with a high-strength metal detector or digital scanner. The tensioning force in the cables is transferred to the slab by way of steel fittings — which are ordinarily cast into the slab's exterior edges — so any retrofitted openings should be located several feet away. It's a good idea to consult a structural engineer if you'll be working anywhere near an edge.

As long as they are not cut or damaged, the tendons themselves can safely be exposed within an opening. They're typically enclosed in a plastic sleeve for protection and to keep the concrete from bonding to them. Once the opening for the new footing is complete, prepare the soil/subgrade as usual, install the rebar, and pour the concrete. Adding epoxy dowels and roughening the surface of the existing concrete will make for a stronger bond between the original slab and the new pour.

Q. Are Mountain-Climbing Harnesses Okay On Site?

I'm a long-time rock climber and carpenter, and I've been using climbing harnesses for job-site fall protection for many years. These kinds of harnesses are designed to protect the wearer in the event of a severe fall, and I've had a lot of practice using them. But with all the emphasis on fall protection lately, I'm wondering if their use in construction is accepted by OSHA.

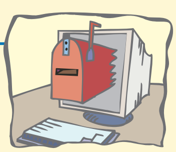
A. *Craig Firl, technical manager for fall-protection equipment manufacturer Capital Safety, responds:* The short answer is no, they're not. Unless the harness is compliant with OSHA and ANSI — and labeled accordingly — it should not be used on the job site.

There are a number of important design differences between a mountain-climbing harness — sometimes called a sit harness — and an industrial-type fall-arrest harness. Full-body harnesses for job-site use feature shoulder straps, leg straps, sub-pelvic support (which absorbs impact to the buttocks area), and a chest strap to restrain the worker.

Another key difference is that proper job-site harnesses have a dorsal (back) D-ring to which a personnel-rated fall-arrest connecting system is attached. This system consists of an energy-absorbing lanyard or self-retracting lifeline designed to limit forces on the body and reduce fall distances to just a few feet. In a mountaineering system, by contrast, the energy of a fall is absorbed by a "dynamic" rope, which stretches when under load.

GOT A QUESTION?

Send it to Q&A, *JLC*, 186 Allen Brook Lane, Williston, VT 05495; or e-mail to jlc-editorial@hanleywood.com.



Finally, a mountain-climbing harness may not be designed for 5,000 pounds of strength as required by OSHA — and even if it is, will lack the required agency approval. Use only the tools designed specifically for the job and you can't go wrong.

Q. When to Use a Heat-Pump Water Heater

A customer wants me to install one of the new heat-pump water heaters in the ground-floor utility room of a house built on a slab. I don't have any direct experience with them, but since they work by drawing heat from the surrounding air, won't any energy savings in the winter be at least partly offset by the cost of heating that indoor air to begin with? And could the outflow of cool air from the utility room cause comfort problems?

A. *Marc Rosenbaum, an energy consultant in West Tisbury, Mass., responds:* If the heat-pump water heater (HPWH) is operating with a coefficient of performance (COP) of 2 — meaning that it takes one unit of energy from the air for every unit of electrical energy it consumes — then half of the energy that goes into the water comes from the heated air in the living space. Whether this makes economic sense in a given situation will depend on where that energy came from in the first place. Here are some possible scenarios in heating-dominated climates:

1. The HPWH is in a basement with a gas furnace and leaky uninsulated ducts that keep the basement at 70°F. The HPWH is operating efficiently because it is taking heat from nice warm air, and that heat is only indirectly getting to the living space. This is probably a good application.

2. The HPWH is in the thermal envelope of a direct-gain passive-solar house with a wood-stove backup. Again, the heat pump is operating in a favorable temperature regime, and the source of the heat is either the sun or firewood. If the space would otherwise be overheated in winter — a common problem in passive-solar spaces on sunny winter days — incidental cooling may not be objectionable. This is a good application.

3. The HPWH is in the thermal envelope of an electrically heated house. Each unit of energy removed from the air is replaced by electric resistance heat. This would not be a good choice.

4. The HPWH is in the thermal envelope of a house heated with a minisplit heat pump that itself operates at a COP of 2.5. The COP of the HPWH is effectively reduced from 2 to 1.4 because the minisplit must work harder to offset the cooling effect of the HPWH. This improves to 1.7 if the house is in heating mode for six months of the year and the cooling effect of the heat pump is negligible or welcome during the remaining six months. In general, the more the climate shifts toward being cooling-dominated, the better the HPWH looks in this application.