

## Focus

### Education, Health Care & Government

#### Concrete weighs down hospitals

Most new technologies are ultra slim, lightweight and shiny. In the medical building industry, it's quite the opposite. Today you will find extremely dense concrete as the latest development in medical building design.

A catalyst for this switch in materials is the combination of having a "one-stop shop" medical facility, meaning the doctor's office, testing labs and invasive procedure capabilities are all in one facility. One of the main concerns with housing all these services in one space, notably apparatus like x-ray machines, computerized tomography scanners and other medical devices that produce radioactive waves, is safely containing the radioactivity produced by such equipment.

The trend to include more medical testing facilities within medical office buildings has led to the demand for new solutions to safely house radioactive equipment. Physicists drive these requirements for building a "protected" vault. When concrete is used, higher density equals less concrete.

A certified medical or health physicist is required to perform the calculations necessary for appropriately shielding employees and the general public from radiation exposure. Often, the minimum guidelines are determined using the standard methodology of the National Council on Radiation Protection and Measurements. Each state has their own set of requirements that must be addressed, such as specific persons qualified to perform the calculations and licensing laws for design approval. Steel, granular fill, steel plates, wood and other materials have commonly been used in designs for structural shielding. Today, more and more medical facility designers are turning to high-density concrete for its abilities to create a concrete biological shield.

At the request of Calcon Constructors, Inc., we tested a concrete mix for high-density walls in 2002 for the Sky Ridge Medical Center in Lone Tree. In addition to offering full diagnostic and imaging services, Sky Ridge also has a cancer center that includes a linear accelerator, a piece of equipment that emits high-energy radiation for an intense cancer treatment.



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Typically, the vaults for linear accelerators are located adjacent to a building so as to provide the room necessary to create thick walls to block the radiation, while also providing some distance from neighboring facilities and its occupants. In this case, the vault was located with occupants above and adjacent to it, limiting the depth allowed to place the required amount of shielding to about five feet. Our firm designed a concrete mix with a density of 230 pounds per cubic foot to meet these terms. (Normal concrete weighs approximately 140 pounds per cubic foot.) A major benefit to using concrete is its ability to block both photons and neutrons because of its water content.

"With the testing done by physicists and their calculations for the density of material required to block a given amount of radiation, we knew what we were able to achieve prior to construction," said Chris Murdy, project manager/estimator at Calcon Constructors. "After running a cost analysis, the high-density concrete was significantly less expensive than steel plate or lead brick and offered a less complex process to implement."

As part of the Rose Medical Center in Denver expansion plans, a 130,000-square-foot medical office building will be built for surgical, orthopedic, imaging, oncology, women's and cardiovascular services. We are working on another 290-pound-per-cubic-foot mix for Calcon Constructors for this project. The aggregate shipped from out-of-state for this dense mix contains steel, providing for the higher density.

In a world of technological advances, there are many related facets that have to advance as well. Projects like Sky Ridge and Rose are helping the concrete industry do just that while also looking out for our well being.