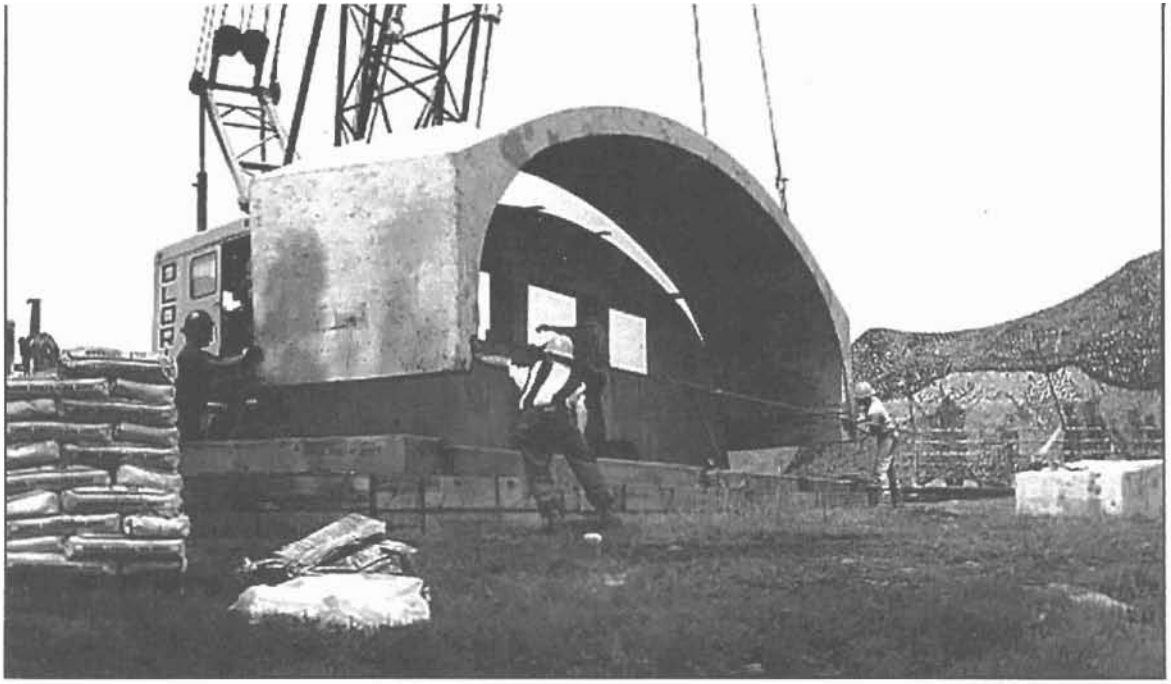

Precast Demolitions Training Range Bunkers

By Gerald L. Knapp and First Lieutenant Adrian Donahoe

Today's Army continually changes its training to fight different types of conflicts. Adjusting training is relatively easy, but adjusting training sites is not. It is difficult to move existing ranges, establish new ranges in a cost-effective way, identify range fans and safety or buffer areas, build new support facilities, and redefine impact areas while maintaining good environmental stewardship. Units must often adjust to the loss of training areas and the proverbial "doing more with less" situations. This article describes how the United States Military Academy successfully designed and installed a new demolitions training range bunker using state-of-the-art concrete technology.

Mission

The planning process for 1996 cadet field training revealed the need for more light infantry training and a larger training area. Since acquiring more land was not an option, we decided to maximize the use of existing training areas.

The demolitions range occupied prime areas needed for light infantry training. Range control personnel selected an alternate site adjacent to the existing artillery impact area and moved the demolitions range there. The impact area provides a safety zone around the new demolitions training site, which is an added benefit.

Overall design of the demolitions range was driven by the requirement to allow cadets to witness detonation of the demolitions charges they prepared. Since this was the third site for the demolitions range in five years, ease of construction and portability were primary issues.

While reviewing sales literature for precast concrete bridge spans for use in our range and training complex, we discussed whether these spans might also provide overhead cover protection for the range. We contacted the manufacturer, who indicated that a concrete precast bridge span had never been used for a bunker. We reviewed the construction details of the proposed unit and decided it would meet our needs. The manufacturer sent shop drawings, which were presented to members of the U.S. Military Academy Range Review Board. This group of trainers, range control managers, the Director of Housing and Public Works, and environmentalists routinely meet to plan and track range improvements. They approved our plan as presented.

Specifications

The bunker is made from four precast concrete pieces. The floor is two panels, each 9 inches thick, 21 feet long, 6 feet 6 inches wide, and weighing 7.8 tons. The panels are reinforced with Number 6 and Number 4 rebar. They are joined with a keyway filled with fast-setting construction grout.

A completed bunker built with precast concrete.

The 10-inch-thick reinforced end wall is 37 feet long and weighs 14 tons. It has three windows that are 6 feet long, 2 feet 6 inches high, and 2 inches thick. They are multilayered (laminated glass, polycarbonate, and lexan) and bullet-resistant to meet Army specifications. These are basic embassy windows that will resist 15 minutes of forced entry and impacts from three 7.62-millimeter rounds in an 8-inch circle. This is more than sufficient to stop fragments that may result from demolitons training. A replaceable scar shield of 1/4-inch Plexiglas protects both sides of the windows from vandalism and fragments.

A bridge span that is 38 feet long, 9 feet high at the apex, and 6 feet 6 inches deep provides overhead cover. It weighs 25 tons and is connected to the end wall at six points with 6-inch by 6-inch angle iron bolted to drop-in anchors installed during casting.

Construction

To prepare the bunker site, an engineer platoon removed existing mortar pits, moved a set of bleachers, removed the existing range tower, and hauled suitable fill for the walls of the demolitions pit.

The foundation has a 12-inch-high base of 3/4-inch stone to ensure good drainage around the bunker. The base is held in place by a curb made of 2 by 10 lumber and rebar. This is strengthened by backfilling around the curb with more stone.

The bunker arrived on three flatbed trucks at 1000 hours and was in place by 1800 hours. The following day the engineer platoon grouted the joints between the span and the base and caulked the arch/ end wall joint.

Personnel from the Directorate of Housing and Public Works installed the windows, which were mounted with 3-inch angle iron on both sides. They used sheet steel to shim the windows and fill the voids around them.

Cost Effectiveness

The total cost for the project was approximately $30K (see table). This sounds expensive for a bunker, but it is portable. If the demolitions site is moved, the bunker can go with it. It has an expected life span of at least 20 years.

Moving the "portable bunker" will be relatively easy. It requires fracturing the grout, unbolting the 6-inch angle iron connectors, removing the windows, and transporting the bunker to the new site. We left the lifting point exposed to facilitate rigging when the unit is moved.

Cost of Precast Bunker

Item	Cost (K)
Precast bunker parts	$19
Windows	6
Crane and rigging	4
Site preparation	1
Total	$30

Moving and consolidating ranges to meet financial and environmental constraints is a fact of life in our current downsizing phase. By using state-of-the-art construction materials creatively in our training areas, we help ensure that training is effective for soldiers, friendly to the environment, and cost effective for the tax payers.

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