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BUILDING FOR A SECURE FUTURE
A Special Report by ENR and Architectural Record
OVERSEAS
Bitter Experiences Drive Israeli Design Practices

Scud attacks changed specifications for safe spaces

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By Neal Sandler in Jerusalem

There are few countries that can match the experience Israel has in designing protective structures. Military threats to population centers along the borders forced Israelis into the field decades ago. As early as 1969, the country began gradually adapting military expertise for civilian use.

TALL ORDER *Haifa high-rise and other post-1922 structures have extra protection.*

Large-scale investments in securing buildings began in the early 1970s. The primary threat was along Israel's border with Lebanon, where Palestinians and Lebanese fighters manned mobile Katyusha rocket launchers and artillery batteries. The attacks led to the design and construction of protected rooms in northern Israel's homes, schools and public buildings.

The 1991 Gulf War introduced Scud attacks, which increased the possibility of chemical and biological attacks. Saddam Hussein's missiles prompted a change in national policy on the protection of civilians and building codes.

"Over the years the threats have changed. We have modified our techniques to deal with the changing environment," says Reuben Eytan, a 61-year-old civil engineer who began his career in the late 1960s in the Israel Defense Forces' (IDF) Corps of Engineers, where he headed the fortification branch. During his tour of duty, he worked on the Bar-Lev line, a string of fortifications along the Suez Canal and over the years has played an important role in adapting military techniques for protecting civilians.

Upon leaving the service, Eytan in 1974 set up his own firm with his wife Michaela, a licensed architect. Eytan Building Design now is the largest of a handful of Israeli engineering firms specializing in security. It has been involved in nearly every major military and civilian project with protective structures.

The Sept. 11 attacks served as a wake-up call for engineers and architects in the U.S. But in Israel, protecting and hardening structures against terrorist attacks is standard procedure. Until the early 1990s, most buildings had bomb shelters and public shelters were scattered throughout the country.

The incoming Scuds–bringing with them the threat of weapons of mass destruction and a warning time of just a few minutes, at best–changed priorities. Bringing people to a shelter was no longer practical, but "bringing protection to the public wherever they happened to be" became more critical, says Eytan. Architects and engineers began to focus on protected spaces within buildings.

In 1992, IDF's Home Front Command introduced new technical specifications into civil defense law. Two years ago, Eytan's office drew up the design manual for architects and engineers detailing the security requirements. Residential plans typically specify a bedroom or another designated room on each floor of an apartment building for use by several families in an emergency.

The protected spaces are built to withstand blast and shrapnel from various conventional weapons as well as protection against chemical and biological agents. With reinforced concrete walls, ceilings and floors 20 to 30 cm thick, they feature heavy-duty airtight steel-framed windows and doors.

In high-rise buildings, the protected spaces are adjacent to staircases for easy access. Ideally, most protected spaces are fully integrated into the structural frame of the building, thereby increasing the resistance to horizontal forces.

The windows and doors are designed to offer increased protection in conjunction with gas masks, which are distributed to the entire population. Air filtration units offer an even higher level of protection. Recommended but not required in residences, the filter units are far more common in commercial buildings.

The law also designated the construction of larger and stronger protected spaces in all new commercial and public buildings. Unlike the past when shelters were the norm, the protected space became an integral part of the buildings' daily use.

The Home Front regulations call for an allocation of 1.25 sq meters of potential space per person in public buildings. The space itself is to be placed in close proximity to stairs, which must be protected by 20-cm-thick concrete walls. Commercial builders can reduce protected space requirements by 30% by incorporating advanced chemical-biological filtration units into a building's ventilation system.

Dozens of skyscrapers have been built in Israel since the new regulations went into effect. Buildings like the Aviv Tower, the highest in the Middle East with 66 stories, are required to have protected spaces on each floor. In addition, all tall structures have a core of reinforced concrete.

A government buildings program in Jerusalem and six other regional centers constitute the largest public works effort undertaken since the new regulations came into force. The $1-billion-plus effort got under way in 1993 and includes buildings at 20 sites. It involves construction of over 400,000 sq m of space and includes buildings for various ministries, courts and other government offices.

"When the project began, there were minimal security requirements. But after the wave of suicide bombings in the mid-1990s, we upgraded the security specifications," says Yair Artsi, chief engineer for the project. His Tel Aviv-based firm, Constructing Project Management (CPM) Ltd., won the construction management contract. Eytan Building Design signed on as security consultant.

The first move was to standardize security of all new government buildings. The specifications are general in nature, but Artsi says that construction is designed to withstand car bombs and other threats. Some buildings, such as the new foreign ministry office in Jerusalem, received an extra level of security. Bollards and a security wall ring most of the perimeter. There are designated protected spaces in all of the new buildings, but they are designed for daily use.

TEAM *Eytans bring architectural and engineering skills to the table.*

The extra security does not come cheap. "We estimate the additional cost at 8 to 14% of actual construction costs," says Artsi. Eytan puts the cost at up to 2% of project costs.

Thousands of protected rooms have been built over the past 30 years in northern Israel. Few changes have been implemented in the actual design specifications. "The protected rooms have worked and the proof is the low number of civilian casualties from rockets and other types of attacks," says Eytan.

In some cases, important public buildings have been strengthened further with retrofits. Seven years ago, the Magen David Adom (Israel's Red Cross) emergency clinic in Kiryat Shemona added 60-cm-thick protecting walls to the existing 46-cm walls. The clinic also received blast-resistant windows and an additional metal roof layer.

Israel's experience in protective building design has given its practitioners instant international credibility. A quarter of Eytan Building Design's work is outside of Israel and Eytan expects to find more work in the U.S. as security concerns increase.

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