DOCUMENT RESUME

ED 026 818 EF 002 302

New Trends in Fallout Protection.
Office of Civil Defense (DOD), Washington, D.C.
Report No-TR-31
Pub Date Sep 65
Note-4p. Reprinted from Civil Engineering--ASCE, July 1965
EDRS Price MF-$0.25 HC-$0.30
Descriptors-*Building Design, *Civil Defense, *Fallout Shelters

The objective of the national fallout shelter program is to provide shelter space for all Americans by--(1) locating, marking, and stocking suitable public shelter areas in existing buildings, and (2) having new structures designed and built to maximize protection. This nation's architects and engineers are now knowledgeable in radiation shielding analysis and design and in the use of new "slanting" techniques. New buildings can be designed with dual-purpose fallout protection at little or no increase in cost and without detracting from beauty or usefulness of the structure. (LD)

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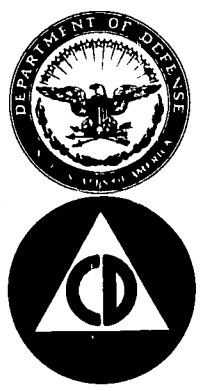
REPRINTED FROM

CIVIL ENGINEERING–ASCE • *July 1965*



DEPARTMENT OF DEFENSE **OFFICE OF CIVIL DEFENSE**

New trends in fallout protection

SEYMOUR WENGROVITZ, M. ASCE, Chief, Technical Support Branch, Architectural and Engineering Services Division
GORDON W. HIRTLE, Public Information Directorate
Office of Civil Defense, Washington, D. C.

It is clear that existing facilities will not yield enough shelter space to provide fallout protection for all Americans in the event of nuclear attack. This is why the Office of Civil Defense is giving special emphasis to the incorporation of preplanned, dual-purpose shelter areas in the original design of new structures. Engineers and architects throughout the country have a special stake in the fallout-shelter program, for it is the group that is largely responsible for the design and construction of such new facilities.

Authoritative studies by the Department of Defense credit a nationwide system of fallout shelters with a life-saving potential of tens of millions of Americans in the event of a nuclear attack on the United States. The actual number of survivors and casualties, of course, would depend on the type and weight of the attack, weather conditions, and other factors.

These studies employ the most advanced and reliable methods of analysis available to the Federal Government. They demonstrate that in virtually any kind of nuclear attack, a fallout shelter system would save more lives, and at far lower cost per capita, than any other single defense measure the nation could take.

Consequently, the National Fallout Shelter Program is the heart or core of the U. S. Civil Defense effort. Its objective is to provide shelter space for all Americans by: (1) locating, marking and stocking suitable public shelter areas in existing buildings, and (2) having new structures designed and built in such a way as to bring to a maximum the inherent protection they offer their occupants against fallout radiation.

In the past four years, substantial progress has been made on the first task, and a significant start has been made on the second.

Since 1961, when civil defense was made a responsibility of the Defense Department, existing shelter space has been found for more than 134 million persons. As of April 25, 1965, shelters with a total capacity of 73 million have been posted with shelter signs. Enough food and survival supplies have been placed in them to sustain about 32 million individuals for two weeks, or about 52 million persons for 8 days. Of course many more facilities are needed.

The role of engineers and architects

Engineers and architects have had a key role in the shelter program since its inception in the fall of 1961, when the Defense Department decided to survey existing structures in the country and identify those containing suitable shelter areas. It was immediately evident that the Army Corps of Engineers and the Navy Bureau of Yards and Docks —which were to conduct the survey for the Office of Civil Defense—would need the field asistance of a large number of professional personnel trained in this new subject of shelter analysis and design.

For this unprecedented task, the nation's engineers and architects constituted the natural pool or reservoir of "raw talent." To give them the needed special training in shelter analysis and design, the Office of Civil Defense, with the cooperation of educational institutions and professional societies, instituted a unique Professional Development Program. A special two-week course in radiation shielding analysis was developed and then conducted at various schools and universities for architects and engineers to prepare them for their field assignments in connection with the national survey.

Within a few months, about 2,000 engineers and architects had successfully completed the course, and it was they who carried out the massive initial phase of the National Shelter Survey.

The training courses have been continued, and expanded to include design techniques as well as shielding analysis methodologies and knowledge of the effects of nuclear weapons. To date, over 8,000 architects and engineers have successfully completed the course and have been listed in the Department of Defense directory of Fallout Shelter Analysts. As new research data and other technical information become available, it is disseminated to these analysts to keep them abreast of the latest developments.

In addition to the Fallout Shelter Analysis courses, other tuition-free courses in protective construction and environmental engineering are offered on a continuing basis in various cities throughout the United States. In the 1965 spring semester, approximately 135 courses were under way.

The initial emphasis was placed on analyzing and evaluating the fallout protection characteristics of existing structures—a type of post-design analysis. Since 1962, however, both the courses and the entire Professional Development Program have been enlarged in scope. They now include the increasingly important area of protective design and construction; and they provide the orientation and training that engineers and architects must have in order to include fallout protection in the original design and building of new structures. Increasing attention is now being given to this aspect of the national shelter program, both by OCD and by the architectural and engineering community.

Hypothetical designs—the first step

To demonstrate the feasibility of designing low-cost, dual-purpose shelter space in new buildings and to develop new ideas on how this could be done, the Office of Civil Defense sponsored a National School Fallout Shelter Design Competition in 1962, with the cooperation of the American Institute of Architects. Since more than one quarter of the U. S. population attends school, this was considered an appropriate subject for the competition. Over 100 elementary-school designs were obtained, incorporating dual-purpose

shelter space for students, faculty and residents of the surrounding neighborhood.

This was followed by a similar competition on the design of fallout shelter space in shopping centers, and also by a five-day design conference at Rice University on fallout-protected industrial plants.

The designs submitted in these projects illustrated how dual-purpose fallout shelter space could be incorporated in new buildings without adversely affecting their cost, appearance or day-to-day function. The buildings were attractive and functional and the areas designated for emergency use as fallout shelters were completely usable for normal purposes.

These design projects served a useful purpose by demonstrating the theoretical feasibility of the shelter concept. But the designs submitted were still hypothetical. They were not proved to be practical until individual buildings containing preplanned shelter space had actually been designed and constructed. This is now happening.

New trends in building construction

More and more architects and engineers are now becoming conscious of the need for fallout protection and many of them are designing new buildings in such a way as to enhance the inherent protection provided, without impairing either function or appearance.

In essence, all buildings are shelters of one kind or another. They are built to protect people and their possessions from the elements and from hostile forces, and to provide privacy. As building design and construction have evolved and improved, new protections and conveniences have been incorporated. For example, central heating systems and air-conditioning have been added to provide better shelter for building occupants against the extremes of cold and heat; walls, roofs and windows have been insulated for the same reason; acoustical walls and ceilings have been added to provide more protection against noise; electric lighting has been introduced as protection against hazards of darkness; portable fire-extinguishers, firewalls and fire doors are appurtenances commonly accepted in current building design.

Two things combined to bring about these improvements in buildings. First the need was recognized and defined; and second, new knowledge made it possible to solve the problem and meet the need.

This is exactly what has happened in the field of fallout protection. A great deal of new scientific and technical knowledge has been gained in the past decade concerning the nature and effects of radioactive fallout from nuclear explosions. This new knowledge has enabled men to define and measure its hazards. It has also enabled them to design and construct structures that will offer protection against fallout radiation—not necessarily special-purpose

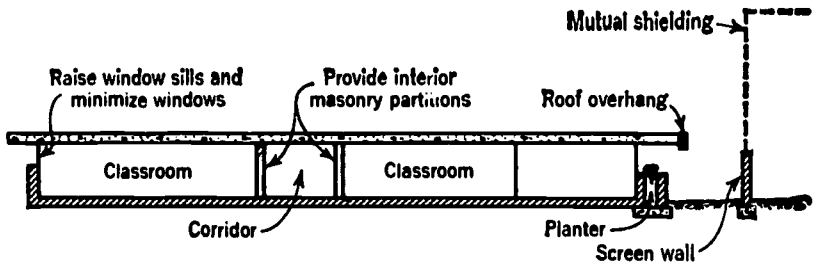


FIG. 1. Low-cost "slanting" techniques for barrier shielding include such features as screen walls, planter boxes, roof overhang, and raised windows.

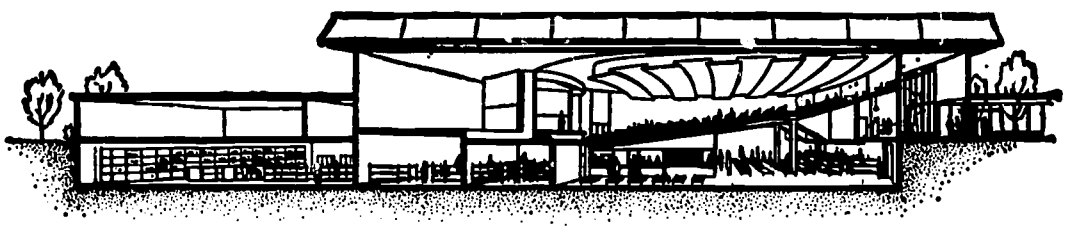


FIG. 2. Cafeteria area placed beneath sloping auditorium floor provides additional fallout protection for a school at an increase of less than 0.2 percent in bulding cost.

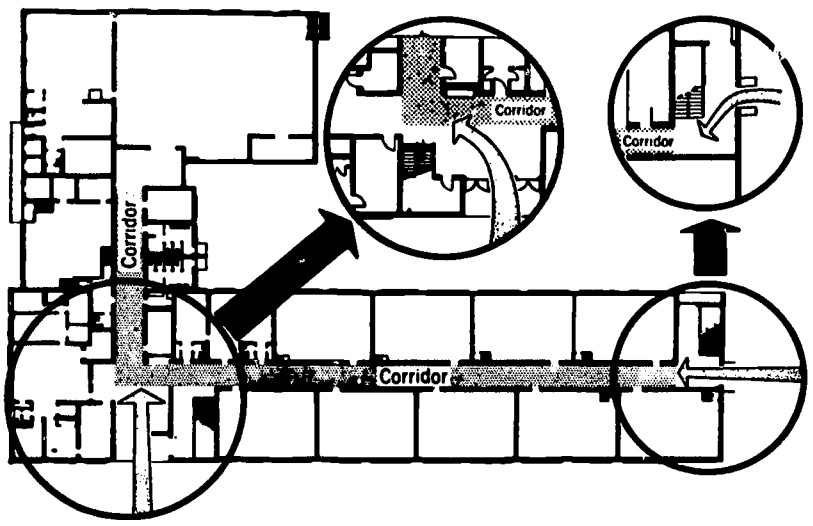


FIG. 3. First-floor plan of a typical elementary school shows that corridor areas offer best shelter potential. Their protective value is enhanced by relocation of stairwells and partial baffling of entranceways, shown by arrows.

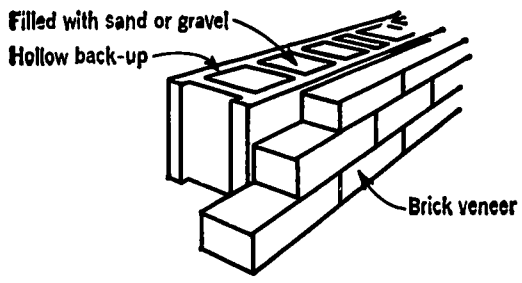


FIG. 4. Use of low-cost material to fill hollow tile provides additional mass in interior and exterior walls.

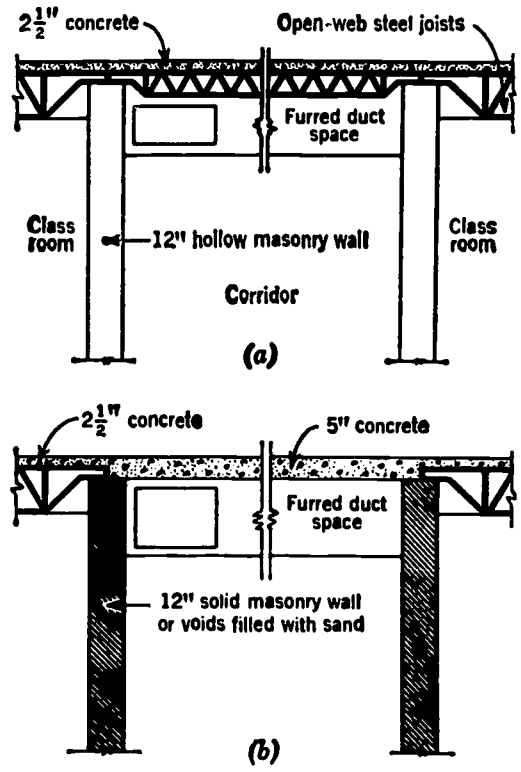


FIG. 5. Normal construction can be revised to give added fallout protection. Minor structural changes brought mass of roof, which was 31 lb per sq ft, in *(a)*, up to 62 lb per sq ft in *(b)*.

structures such as underground windowless bunkers, but conventional buildings that will serve their usual daily functions and still protect occupants against fallout radiation should the need ever arise.

Every building to some extent provides a natural shield against fallout radiation. Some buildings, however, are better than others. In the National Fallout Shelter Survey, millions of suitable shelter spaces were found in existing buildings, even though no consideration had been given to fallout protection when they were first designed and built. Many other buildings would have provided reasonable protection, but they had weak points which nullified otherwise good protection. If such weak points in structures now being built are detected by someone knowledgeable in radiation shielding during the initial design phase, then design changes can be made that will provide maximum fallout protection with little or no increase in cost. The incorporation of fallout protection in this manner is called "slanting."

Slanting techniques

Many architects and engineers are now using slanting techniques in designing new structures. These are the major factors involved in slanting:

1. Location and quantity of window areas. Can window areas be reduced or sills raised to reduce exposure to radiation?

2. Site conditions. Is the structure so located that maximum advantage is taken of mutual shielding from adjacent structures? Has consideration been given to the use of retaining walls, roof overhangs, or grading a slope away from the structure to minimize the effect of radiation from the ground? The inclusion of masonry screen walls or brick planter boxes will enhance the esthetic value of the structure and also increase the barrier shielding. It is also possible to improve the fallout protection by judicious site work and utilization of earth berms. See Fig. 1.

3. Basement. Is it possible to depress the ground floor partially or completely below grade to reduce the effect of radiation from the ground? See Fig. 2.

4. Entrances and exits. Have these been located to maximize the protection by baffles, or do they permit direct entry of ground radiation? Can stairwells be positioned so that they provide additional shielding at the ends of corridors and hallways? See Fig. 3.

5. Interior partitions. Have these been placed to block radiation?

6. Walls. Have dense, solid walls been used advantageously? Have hollow walls been filled with low-cost materials, where feasible? Has consideration been given to using reinforced concrete or concrete block construction in lieu of lightweight aggregate block or other lightweight wall construction? Have low-cost opportunities been exploited, such as the use of hollow tile or concrete block filled with sand or gravel to provide additional mass in interior and exterior walls? See Fig. 4.

7. Floors and roofs. Has a comparison been made of various systems, such as concrete slabs on precast T-beams or bar joists; composite floor systems, such as tile or terrazzo on concrete, or two-way slab design versus pan-joist construction? Cost differences may be negligible, but one system may provide significant additional shielding. The addition of a few inches of concrete topping to a precast concrete T-roof or floor-slab system will do much to enhance the protection afforded occupants. See Fig. 5.

8. Architectural arrangements. Has maximum advantage been taken in arranging the building modules to provide a protected core area that can be used for shelter?

If the protective requirements are clearly understood, the architect-engineer will find many ways in which the protective characteristics of the building can be enhanced with little or no increase in cost and without sacrificing esthetics or functional efficiency. While maximum protection may not always be achieved, a higher level of protection can usually be attained.

FIG. 6. An actual school building designed with fallout in mind features reduced window areas and baffled doorway, among other protective elements.

Examples of actual structures

Recently the Office of Civil Defense published a booklet entitled "New Buildings with Fallout Protection." This publication shows for the first time some of the actual accomplishments of architects and engineers in incorporating preplanned, dual-purpose shelter in the original design of actual buildings recently constructed or now under construction. It illustrates how architects and engineers, by using simple and inexpensive design techniques, have increased or maximized the inherent fallout protection offered by these structures.

The 34 buildings pictured and described in the booklet are not hypothetical designs—they are actual buildings. See Fig. 6. While over half of the projects are schools, others include police and fire stations, apartments, office buildings and churches, all of them designed with fallout protection in mind. Actual cost data furnished by the designers involved confirm that dual-use fallout-shelter space need not be expensive if it is planned for early enough in the design stage. In many cases, the shelter protection was inherent in the building design and was achieved at no increase in cost.

In this booklet, "New Buildings with Fallout Protection," the new theory—that fallout shelter can be incorporated in new buildings without adversely affecting their cost, appearance or function—is shown to be feasible, practical, and desirable.

Summary

A new requirement now exists in the field of building design and construction—the requirement that a new building should protect its occupants against fallout radiation, in addition to its other functions.

A large number of this nation's architects and engineers are now knowledgeable in radiation shielding analysis and design, and are becoming skilled in the use of the new "slanting" techniques to maximize fallout protection in their current design projects.

New buildings can be designed and built with dual-purpose fallout protection at little or no increase in construction cost and without detracting in any way from the beauty or usefulness of the structures.

Designing buildings with maximum fallout protection is no longer a mere theory or an academic exercise. All over America today, more and more such buildings are being constructed.

U.S. GOVERNMENT PRINTING OFFICE : 1965 O—788-412